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THE NATURE OF GAME STRATEGY OBSERVATION IN FIELD HOCKEY WITH RESPECT TO SELECTED VARIABLES

by

Margarite Ann Arrighi

A Dissertation Submitted to
the Faculty of the Graduate School at
The University of North Carolina at Greensboro
in Partial Fulfillment
of the Requirements for the Degree
Doctor of Education

Greensboro
1974

Approved by

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APPROVAL PAGE

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ARRIGHI, MARGARITE ANN. The Nature of Game Strategy Observation in Field Hockey with Respect to Selected Variables. (1974) Directed by: Dr. Kate R. Barrett. Pp. 132

The purpose of this study was to investigate the frequency of different types of field hockey strategy observed by individuals with various modes of field hockey experience and to examine the relationship of these observations to experience, knowledge, and visual perception.

Three classes of field hockey personnel; namely, coaches, club players, and college players were represented by 44 subjects selected from participants at the Mount Pocono Field Hockey Conference. Coaching, playing, and selecting experience, knowledge of game strategy, and visual perception were ascertained by administering a questionnaire, a knowledge test, and the Group Embedded Figures Test, respectively. Observations of game strategy were obtained via the viewing of a specially-prepared film of field hockey game play. Comments were recorded on audiotape and subsequently transcribed by the investigator onto a Master Code Chart utilizing broad categories representing elements of field hockey game play; namely, spatial relationships, total offense-defense, situation plays, strategic theory, and skill analysis. Observations were further identified as on or off the ball and as related or unrelated to the specified categories of game play.

A stepwise multiple discriminant function analysis utilizing the Biomedical Computer Program BMDO7M was employed to determine whether criterion groups could be distinguished from each other considering the entire set of variables; that is, experiences in coaching, playing, and selecting, knowledge of game strategy, visual

perception, spatial relationships, total offense-defense, situation plays, strategic theory, on and off the ball observations, and unrelated observations. Group classifications and differences between group means computed at each step of the discriminant analysis revealed that distinctive groups of field hockey personnel can be identified. Coaching experience and knowledge of game strategy contributed most to the discrimination of the groups. F values further revealed that the coach group was significantly different from both the club and college groups. Although significant, the obtained F's for the club/college groups were considerably smaller revealing less difference.

Separate univariate F tests computed by the TSAR Computer Program and a comparison of pairs of group means utilizing the Scheffe Test served to substantiate the differentiation between groups. Significant differences were revealed between the coach/college groups on coaching and playing experience, knowledge of game strategy, spatial relationships, and on and off the ball observations. The coach/club groups were significantly different with respect to coaching experience, knowledge of game strategy, and observation of spatial relationships. There were no significant differences between the club/college groups.

Correlations between the criterion variables (experience, knowledge, visual perception) and predictor variables (observations) for each group were determined by the Pearson Product Moment Correlation Coefficient computed by the TSAR Computer Program and tested for significance by the distribution of t for a two-tailed test. Correlations revealed that the variables which influence an individual's observations are different and are dependent upon group

classification. For the coach group, coaching experience was significantly correlated with spatial relationships observations; playing experience was significantly correlated with spatial relationships and on the ball observations, and selecting experience correlated significantly with total offense-defense observations. The one significant correlation for the club group was between playing experience and on the ball observations. For the college group, the knowledge variable correlated significantly with spatial relationships and off the ball observations. Visual perception was not a significant factor in the observation of game strategy for any of the groups.

The data were factor analyzed utilizing the Statistical Package for the Social Sciences (SPSS) Computer Program. Three factors, accounting for 90.8% of the variance, emerged as a result of this analytical procedure. Based upon the loadings on each variable the factors were identified as spatiality, player patterns, and situation plays. When considered as the essential components of game play, these factors suggest alternative approaches to coaching field hockey and to educating coaches in observation techniques.

ACKNOWLEDGEMENTS

The completion of this study was realized with the valuable assistance of numerous individuals. Their contributions are gratefully acknowledged at this time.

The writer is most indebted to her adviser, Dr. Kate Barrett, for her continued support and guidance throughout the development of this study. Her unique ability to bring one to the threshold of one's own thinking stimulated clear perceptions and precise reasoning and served as a continual source of inspiration. Sincere appreciation is extended to Dr. Pearl Berlin for her interest and encouragement and for her expertise in critically evaluating the research design and statistical procedures for this study. The constructive and critical review of this study by the remaining members of the committee, Dr. Hugh Hagaman, Dr. Gail Hennis, and Dr. Marie Riley, is sincerely appreciated.

Dr. William Powers of the Department of Mathematics of The University of North Carolina at Greensboro and Mr. Don Siegel, Research Assistant in the School of Health, Physical Education, and Recreation of The University of North Carolina at Greensboro willingly assisted with the statistical procedures and computer programming utilized in this study. An expression of thanks is extended to both of these individuals.

The encouragement and continued faith of many friends, colleagues, and students and the warm support of my entire family

is gratefully acknowledged. A special note of appreciation is expressed to Ms. Elsa Heimerer for her constant support and understanding and for serving as a questioner, "par excellence" throughout the pursuit of this study.

To Ms. Ethlyn Davis Myers, Director of the Mount Pocono Field Hockey Conference and to the coaches, club players, and college players whose cooperative participation made this study possible, a sincere note of appreciation is extended.

I am grateful to Mrs. Mary Jane Knight for her diligence and proficiency in preparing the final manuscript. Her genial nature and efficient manner were particularly helpful during the culminating stages of this work.

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CHAPTER I

INTRODUCTION

In an era of change, challenge, and redirection in women's competitive athletics, concern for the acquisition of a sound working philosophy of coaching and the development of quality leadership has been the focal point of attention of many educators. In seeking to maintain athletics within the proper educational perspective, the question of competency in coaching has received minimal emphasis.

The expansion of women's competitive athletics and the subsequent emergence of the need for coaching skills demand a more definitive consideration of the substantive aspects of coaching and the educational methodology associated with this phase of the program. Although some knowledges and skills relative to coaching can be acquired through direct experience in competition, the prospective coach must be exposed to experiences which are broader in scope and more specifically designed and structured. If the competitive program is an inherent part of the educational process, a critical inquiry into the competencies necessary for coaching and the evoking of changes to reflect the inclusion of these behaviors should be a major thrust of the re-examination of the teacher education process.

The complexity of human behavior demands that the teaching-learning process be examined to its fullest extent if effective

instructional strategies are to prevail. Among other factors, the successful coaching of sports involves the ability to observe effectively and efficiently the total strategies of a game situation, to translate the critical aspects into meaningful data, and eventually to utilize this information in evolving new and more effective strategy in individual and team performance. The development of this analytical ability involves an active process of gaining knowledges and skills through experience as well as building upon those innate characteristics which facilitate learning. Although recognized as a crucial characteristic of successful coaching, the ability to analyze has received very little attention in the training of coaches (Grieve, 1971).

A recognition of the need for greater competency in coaching has lead to a recent expansion of professional programs in directions to meet this objective. Evidence of movement towards this end is indicated in the recent proliferation of institutions offering the coaching minor, the coaching intern, and certification of coaches (Gallon, 1969; Sheets, 1971; Stier, 1970). However, the major thrust of concern in these instances has involved men's athletics; only recently has any consideration been given to the offering of similar training experiences for women interested in coaching athletics.

Numerous attempts have been made to analyze the professional preparation requirements of athletic coaches; however, there seems to be no consistent pattern in the types of courses required. Moreover, descriptions of practical experiences are limited, apparently due to a lack of information available relative to the skills and

techniques necessary for successful coaching (Bucher, 1959; Maetozo, 1965, 1971; Stein, 1963). This acquisition of knowledge and the subsequent neglect of the development of cognitive processes to deal with this information is a dominant pattern in education and one which must be overcome if effective teaching strategies are to accrue (Webb, 1970).

Although observation is an integral part of the preparation of teachers, the quality of the observation and consequently the extent to which observational learning occurs is directly related to the degree of preparation and the structure imposed. Systematic observation programmed with specific objectives provides a framework for observation which eliminates concentration on trivia and fosters a sharp, sensitive organization of data (Hyman, 1968; Kleine, 1970).

Educational technology has made available numerous samples of teaching-learning situations. Videotape recording has been employed to analyze and develop insights into classroom behavior, to effect changes in teaching strategies, and to gather data in retrievable form. This use of videotape recording as a technology of instruction provides a definite frame of reference for the student, thereby establishing one of the essential ingredients of successful observation. Utilization of media in combination with displaced feedback promotes an interaction of the learner with an expert in immediate discussion and clarification of observations. Active involvement of participants enhances learning and furthermore provides for an assessment of feedback which may assist in

reducing the significant differences in an individual's ability to perceive the critical aspects of an observation (Hixson, 1971; Zettl, 1967).

The utilization of films has been found to be an effective mode of teaching skills by promoting shorter learning periods and longer retention periods, and an elimination of the trial and error process (Glassow, 1947; Lockhart, 1944; Priebe and Burton, 1939). The use of film in coaching is not a new technique, but rather one that is becoming increasingly improved and greatly perfected. Properly filmed motion pictures yield a vast amount of knowledge that can be reviewed, analyzed, and interpreted; such information the human eye would be incapable of recording or in any case find very difficult to retain (Zeper, 1962).

Self analysis and self assessment represented the focal points for early research in videotape recording. Studies by Penman (1968), Robb and Teeple (1969), Smith (1968), and Thompson (1969) investigated the effect of visual feedback on the facilitation of learning; Clifton and Smith (1962) and DeBacy (1970) studied the effects of viewing on the ability of the individual to judge her own skill. Despite negative results of the effects of viewing performances via videotape recording, the possibilities inherent in such a medium remain viable in view of advanced technology and improved observational techniques.

Perceptual learning, the ability to extract information from the environment, represents another crucial factor in observational learning. Experiments in detection, discrimination,

recognition, and identity have shown that practice yields improvement (Elkind and Scott, 1962; Gibson, 1962; Piaget, 1962; Werner, 1948). An adaptive process is involved in the lowering of perceptual thresholds, reduction of constant and variable errors, and the increase of specificity of perception to stimulus variation. Visual perception presents even more definitive distinctions in terms of the extent to which an individual's perception is analytical. Field dependence or independence characterizes a person's perception in a wide variety of situations making for a marked individual self-consistency (Witkin, 1954).

No single medium, instructional strategy, or combination of these will accomplish the final task of training the teacher. The inherent complexity of the teacher education process and of instructional media necessitate research into the nature of interactions among the media used, teaching methods, student characteristics, conditions of the learning environment, and the specific goals of instruction (Bosley, 1967; Lesser, 1966). The ultimate question that must be asked of any instructional process is its effect on pupil learning.

The significance of this study lies in the quantification of gross behavior in terms of the categorization of strategical observations in field hockey. This quantification of observations may lead to an identification of the specific types of responses associated with different classes of individuals based upon their relative experience, knowledge, and visual perception.

The evidence obtained by studying the relative influence of each variable on the ability to analyze a game situation may

provide the initial impetus toward gaining insight into some of the behaviors necessary for coaching competency. More specifically and perhaps more importantly, this research may generate greater interest in the professional preparation of prospective coaches through the utilization of learning strategies which employ observational techniques. Finally, this study may lend support to those proponents of learning as a concept which involves functional endeavors with broad applicability in the total process of education.

STATEMENT OF THE PROBLEM

The purpose of this study was to investigate the frequency of different types of field hockey strategy observed by individuals with various modes of field hockey experience and to examine the relationship of these observations to experience, knowledge of game strategy, and visual perception.

This study sought to answer the following questions:

1. What types of strategies are observed in viewing a field hockey game?

   a. Are observations concerned with spatial relationships?

   b. Are observations specifically concerned with play "on the ball" or "off the ball?"

   c. Are observations related to static, fixed situations in contrast to dynamic, ongoing game play?

   d. Are observations related to strategic theory?

   e. Are observations concerned with total offensive or defensive play as contrasted with specific individual play?

2. What implications can be drawn from the observations of game strategy made by the various classes of individuals?

3. What are some of the variables that may influence an individual's observations?

a. Is experience, as defined by years of playing, coaching, and selecting in field hockey, a factor that may be associated with what is observed?

b. Is knowledge of game strategy, as measured by a written test, a factor that may be associated with what is observed?

c. Is visual perception, as measured by the Group Embedded Figures Test, a factor that may be associated with what is observed?

4. What implications can be drawn for coaching field hockey and for educating coaches in observational techniques?

DEFINITION OF TERMS

The terms specifically related to this study have been defined as follows:

1. Coaches: individuals who have been involved in the training of players for field hockey varsity competition for a minimum of two years.

2. College players: intercollegiate varsity level individuals with a minimum of two years of playing experience and from a college with active membership in the United States Field Hockey Association.

3. Club players: individuals with a minimum of two years of

playing experience with a field hockey club with active membership in the United States Field Hockey Association or comparable foreign association.

4. Dynamic play; continuous action within the game situation.

5. Experience: field hockey background acquired through coaching, playing, and involvement in the selection of teams.

6. Knowledge: understanding of strategic theory in field hockey as determined by a written test.

7. Off the ball: play concerned with the movement of the player(s) not immediately concerned with the ball.

8. On the ball: play concerned with the movement of the player with the ball or the ball itself.

9. Perceptual learning: "an increase in the ability to extract information from the environment as a result of experience and practice with stimulation coming from it" (Gibson, 1969:3).

10. Sectional level play: field hockey competition among association teams the members of which have been selected to participate as a result of club or tournament competition.

11. Selecting experience: involvement in the process of choosing individuals to represent teams on the basis of skillful play in field hockey competition.

12. Spatial relationships: the arrangements of space in terms of persons or objects filling the spatial framework.

13. Static situation: a momentary suspension of game play for the purpose of awarding a free hit, corner, roll-in, or bully.

14. Strategic theory: generally accepted principles regarding effective game play in field hockey.

15. Strategical observations: analyzation of tactics related to the coordination of team play both offensively and defensively; these observations may involve an isolated situation or a comprehensive situation.

16. Tactics: offensive and defensive maneuvers involved in a field hockey match.

17. Total defensive play: the maneuvering of the backfield players as a unit.

18. Total offensive play: the maneuvering of the line players as a unit.

19. Visual perception: "the process by which we visually obtain information about the world around us" (Gibson, 1969:3); "an awareness of complex environmental situations as well as single objects" (Allport, 1955:14).

ASSUMPTIONS UNDERLYING THE RESEARCH

The following assumptions governed this study:

1. The individuals attending the Mount Pocono Field Hockey Conference were representative of the various modes of field hockey experience as determined by the criteria set for this study.

2. Observation is an important aspect of coaching field hockey.

3. The viewing of 16 mm color film is representative of the observation of an actual game situation.

4. Strategical observations can be categorized according to the critical elements of game strategy as identified by the Master Code Chart designed specifically for this study.

5. The recording of observations via audiotape represents a valid method of identifying an individual's observations.

6. The investigator's transcriptions from audiotape to the Master Code Chart are free from bias, distortion, and misinterpretation.

SCOPE OF THE STUDY

The 44 subjects used in this study represented three classes of field hockey personnel; namely, coaches, club players, and college players. They were selected from participants at the Mount Pocono Hockey Conference, Tobyhanna, Pennsylvania, during the period of August 21 to August 28, 1973.

Observations of game strategy in field hockey were ascertained through the viewing of two eight-minute sequences of 16 mm color film of game play and the simultaneous recording of observations on audiotape while viewing the film. A Master Code Chart was devised incorporating the elements of field hockey strategy; the observations of each subject were transcribed onto the chart utilizing a quantification and categorization process which served as the basis for the final analysis of the data.

The variables in this study included the relative experience of each subject including playing, coaching, and selecting experience, knowledge of game strategy, visual perception, spatial relationships, total offense and defense, situation plays, strategic

theory, skill analysis, on and off the ball observations, and unrelated observations.

CHAPTER II

REVIEW OF LITERATURE

Although there is no empirical evidence which has indicated the accuracy of emphases in coaching curricula, teacher training institutions are forced to decide on the development of appropriate abilities for coaching. The review of literature for this study attempts to examine the operational skills of teaching, the observational and practical experiences which assist in the attainment of these skills, and the role of visual perception in this specific learning process. When considered in its entirety, the review has implications for a theory of teaching which is prescriptive in character. An indication of definitive modes of procedure, the selection and utilization of optimal teaching strategies, and a consideration of one aspect of visual perception as it pertains to the learning process, are contributing factors in the larger sphere of educating coaches.

The first section of the review focuses on the professional preparation of coaches with specific reference to related instructional strategies. Observational learning with particular emphasis on media utilization in the education of coaches and teachers follows in the second section. The final section of this chapter is devoted to a discussion of the role of visual perception in the learning process and the assessment of the dimension of field dependence-independence utilizing the Group Embedded Figures Test as a framework.

PROFESSIONAL PREPARATION OF COACHES

As educational systems seek to become more effective, the basic processes which underly teaching and learning have come under increasing scrutiny. Numerous attempts have been made to analyze scientifically the complexities of the teaching-learning process. Early efforts focused primarily on the influence of personality traits of teachers, spaced versus massed learning periods, lecture versus discussion, and the contribution of audiovisual aids to instruction (Withall, 1960). Very little consideration was given to the major variables in the teaching-learning process; namely, the teacher, the learner, and the interactive processes between these two variables. Subsequent research efforts were directed toward the development of a conceptual framework for systematic analysis of classroom behavior and the specification of operational definitions of observable behaviors (Flanders, 1963; Peck and Tucker, 1973).

The work of Biddle, Gump, Meux, and Smith (Biddle and Ellena, 1964) has been both descriptive and correlational in nature. Based upon the premise that the teacher is a specialist in human behavior, these studies have attempted to measure precisely teacher effectiveness in terms of learning outcomes. These attempts at examination and understanding of the basic processes involved in teaching and learning have led to significant and continued advances in the development of a science of effective teaching (Soar, 1970).

The continued emphasis on observational studies has produced a proliferation of systems and frequencies of teacher-student

behaviors. Likewise, models of teaching have generated specific kinds of research on teaching. Despite these efforts, there is little evidence of a universally accepted body of knowledge or teaching model (Nuthall and Snook, 1973). It is possible that the patterns of effective teaching are so idiosyncratic that they will never be totally isolated. However, it is impossible to make a firm statement or to offer conclusive evidence to this effect considering our present lack of sufficient empirical research (Rosenshine and Furst, 1973).

The expansion of athletics in education and the subsequent demand for qualified coaches has led to an increased interest in the education of coaches. Within the last decade, the coaching profession has been increasingly influenced by the availability of scientific data, the application of research findings, and most recently, the impact of the disciplines of psychology and sociology (Singer, 1972). Although the common characteristics of coaches have yet to be established by research (Singer, 1972), the complexities of the coaching profession demand continued inquiry into coaching competencies as well as the formal education processes necessary to attain these behaviors.

The development of competency in coaching has been of concern to male physical educators for numerous years. This is evident in the recent development of professional programs which include the coaching minor, the coaching intern, and certification of coaches (Gallon, 1969; Sheets, 1971; Stier, 1970). Likewise, a proliferation of writings have appeared which have been designed

to analyze the professional preparation of coaches in the interest of expanding the competency of individuals involved in this area (Bucher, 1958; Grieve, 1971; Maetozo, 1971; Stein, 1963).

Although no common agreement exists relative to the behaviors necessary to achieve coaching competency, an analysis of coaching functions has revealed specific insights. Maetozo (1965) analyzed the professional preparation of athletic coaches in six sports. The evidence indicated that there was no seeming coordination between what is needed most in the field and the structure of courses. Although coaching theory, psychology of sport, and administration of athletics are essential ingredients of the education of coaches, these subjects fail to provide the practical experiences in analyzation and observation which are crucial elements of such a program. Mere course taking and credit accumulation does not assure competence, yet this pattern continues to persist in many colleges and universities.

Maetozo's research further revealed that most coaches attributed skills and knowledges in coaching to experiences in observation and actual participation which evolved from a personal involvement removed from the context of courses. Moreover, much of the knowledge was gained through the trial and error method of actual coaching experience following graduation. However, as pointed out by Grieve (1971) although experience is probably the greatest teacher, this fact does not assure that an individual has acquired the analytical abilities necessary to be a good coach.

Although the practical aspect is deemed of particular significance to coaching competency, it has received very limited

attention in respect to the employment of specific developmental experiences in the education of coaches. Only one published reference could be identified in which formal training for coaching included an actual practicum of experience under the leadership of an experienced coach and instructor (Gallon, 1969). However, an identification of several recent coaching course outlines have given an indication of a movement in the direction of including a minimal number of observational experiences in the education of coaches (The University of North Carolina at Greensboro, 1973; University of Maryland, 1973; University of Nebraska, 1972). Without such practical and functional experiences, the prospective coach gains superficial insights into the actual role, responsibilities, and the necessary skills of a coach (Spasoff, 1971). It seems valid to assume that the ability to function effectively in the area of coaching is as much dependent upon practical experience as is the classroom teacher's involvement in same.

A vast amount of research has identified many variables which govern learning (Gagne and Bolles, 1959; Peck and Hunter, 1973). However, there has been very little investigation of teacher behavior as it relates to the learning of physical education skills. For example, the entire field of the teacher's role as a systematic observer has been unexplored (Nixon and Locke, 1973). A single study by Giardin and Hanson (1967) has attempted to gain insight into the capacity of teachers to observe and analyze motor performance. Perhaps a similarity can be drawn to the field of coaching in partial explanation of the omission of practical experiences in the education of coaches. A continued pursuance of definitions

of teaching procedures and identification and classification of elements therein may provide concrete evidence to effect changes in the substantive content of professional preparation programs and consequent improvement in teaching and coaching (Fishman and Anderson, 1971).

The recent increase in athletic competition for women has promoted an interest in providing qualified personnel in leadership and coaching positions. A survey of the limited literature relative to coaching in women's field hockey indicated an emphasis on the qualities of the coach as opposed to an exposure to those skills and experiences which are crucial to the attainment of knowledge and more specifically, strategical knowledge of the game. The areas of concern are most often categorized under knowledge of the game, the art of coaching, the personality of the coach, and the psychology of coaching (Barnes, 1959, 1972; Delano, 1966; Hausserman, 1970; Macheath, 1969). Only two sources made mention of the ability to concentrate on watching positions and patterns of play and looking for the strengths and weaknesses of both teams (Barnes, 1959; Poisson, 1972).

British texts tended to deal at greater length with the practical aspects of coaching. Taylor (Coaching Hockey in Schools) advocated that sound knowledge of performance of each skill and an understanding of the factors which contribute to them will enable one to observe effective and ineffective movement with a discerning eye. Cadel (1972) referred to the ability to read the game situation. It is significant, she said, to ". . . see the

whole game and to watch players who are not near the scene of the action" (Cadel, 1972:114). Macheath (1969) mentioned the anticipation of patterns of the game and the ability to observe and demonstrate as important to coaching. Methods of acquiring these abilities are briefly discussed herein; however, within the total review, there is no specific reference to the employment of methods of observation in the education of prospective coaches. Although research may eventually conclude that teaching is a practical activity which can never be the object of meaningful empirical research (Nuthall and Snook, 1973), currently and until such evidence is available, instructional strategies must be developed to assist and direct the student to function effectively in numerous learning situations. The inspection of an environment such as a game situation provides too broad a stimulus complex to be distinguished with accuracy by most individuals. A structure must be imposed which allows for the greatest gains by all individuals (Travers, 1970).

OBSERVATIONAL LEARNING

The direct involvement of prospective teachers in the teaching-learning process through laboratory experiences relevant to the content and theory of professional courses has promoted effective changes in teaching behaviors (Sandefur, 1970). The provision of observational learning experiences in the classroom situation as well as through media utilization, is an extensive and integral part of the preparation of teachers; however, the

ability of students to observe effectively remains questionable and warrants attention.

Essential to any observation is the imposition of structure in order to provide direction and guidance. As pointed out by Kleine (1970), a multitude of factors may seriously limit the spectrum of events observed by an individual in any one situation; these include previous experiences, individual values, and emotional responses. Constructs must be developed to allow for the selection of a broad set of perceptions which consequently can operate within a contextual framework, thus eliminating concentration on trivia and fostering a sharper, more sensitive organization of data. Specific and direct guidance and instruction provide a focal point for meaningful observation; without this guidance observation becomes haphazard and vague and superficial insights are gathered. Further gains can be realized by providing time to study the observed data, to pool ideas, and to participate in guided interpretation and discussion (Kleine, 1970).

The earliest research in observational learning was conducted by Bandura and Walters (1963) in the area of child psychology. Studies involving the learning of aggressive behavior through models indicated that children learned more quickly by observing another person's behavior than by being reinforced for enacting behavior in a sequence of successive approximations. How do these linkages between mediational responses and performance behavior occur? Apparently, as the observer watched he covertly rehearsed the response and vicariously reinforced himself, thereby producing a linkage of responses.

Williams and Willoughby (1971) indicated that two representational processes occur in observational learning; that is, the formation of images through association of events, and the acquisition of verbal correlates of observed behavior. Whether active observer involvement leads to more rapid and accurate reproduction compared to passive absorption seemed to be in the affirmative although there was some indication that active involvement interfered with processing.

Although scattered research has indicated that learning effectiveness is a function of instructional treatment and individual learner characteristics, the extent to which learner characteristics influence observational learning has not been systematically studied (Snow, et al., 1965). Individual differences in acquiring a teaching skill from written and video-mediated modeling processes were investigated by Koran, et al., 1971. Results indicated that complex behavior may be acquired through observation without external reinforcement, although the observer's characteristics influenced the extent to which observational learning occurred. Koran (1971) further observed that the presence of audiovisual stimuli placed demands on perceptual coding abilities; however, the absence of audiovisuals in instruction required the subject to generate his own image, thus constituting an equal demand on perceptual abilities. One may compensate for deficiencies in some perceptual coding or analytic ability skills through the explicit, concrete presence of stimulating elements. On the other hand, Koran (1971) indicated that for high perceptual analytic subjects the presence of detailed, concrete information at a fixed, perhaps

slow pace may interfere with the encoding process or diminish performance through boredom or fatigue. Although this study did not demonstrate the greater effectiveness of one treatment over the other, it did suggest specific modifications and developments regarding the individualization of teacher training programs appropriate to learner characteristics.

Efforts to improve instructional strategies have directed researchers toward the development of diverse observational systems for quantifying and analyzing teaching-learning behaviors (McAvoy, 1970; Webb, 1970; Rosenshine and Furst, 1973). These systems have attempted to identify the types of variables which affect learning as well as to develop a taxonomy of behaviors exhibited in classroom situations. In addition to describing the intellectual range of classroom activities, the data accumulated through systematic observation have made significant contribution toward the development of instructional theory (Webb, 1970). Precise measurement of teacher effectiveness in terms of learning outcomes has led to a systematic variation of teaching behaviors as specifically related to learner capabilities, the cognitive processes to be developed, and specific instructional objectives. An acquisition of cognitive skills needed to deal with knowledge has become an important aspect of educational theory. If specific kinds of behaviors are to be consistently developed, then questions such as the following must be answered: (1) what kinds of teaching strategies are related to achievement at higher cognitive levels, and (2) do strategies differ at different grade levels and content

areas? (Webb, 1970). As Flanders (1963) has pointed out, the ultimate goal of the study of teacher influence in the classroom is to achieve understanding of teacher-pupil interaction and in particular to specify conditions in which learning is maximized.

Media Utilization in Teacher Preparation

Any viable program of teacher education must, to some extent, depend upon the actual classroom situation for observational experiences; however, the sheer physical requirements of expanding teacher education programs has limited the possibility of the classroom continuing to serve effectively for demonstration, observation, and practice (Morrison and Childs, 1969). Increasing attention has been given to ways in which live and closed circuit television can maintain and enhance the use of the classroom as a vital and practical source of information.

Videotape recording has opened an observational doorway to numerous samples of teaching-learning situations as well as possibilities for immediate feedback for prospective teachers. These observations have served the purpose of analyzing and developing insights into classroom behaviors, effecting changes in teaching strategies, and gathering data in retrievable form (Borg, 1969; Crews, 1969; Johnson and Tettmer, 1970).

The utilization of videotape recordings has not only provided the opportunity for a common observation experience but has likewise evidenced the following distinct advantages:

(1) pre-screening possibilities to determine the suitability of an observational situation, (2) facilitation of scheduling and structuring of observation, (3) assurance of the presence of desired illustration, (4) repetition of sequences for clarification, and (5) a wide variety of observational situations (Morrison and Childs, 1969). The use of tapes either totally or as a supplement to class lecture has contributed significantly to the promotion of needed transfer from the purely theoretical to the actual teaching-learning situation. Playback techniques have replaced subjective bias and inferential ratings of performance of student teachers by providing reproducible evidence for assistance in changing toward more desirable and effective teacher behavior (Morrison and Childs, 1969).

Rigorous empirical research on the application of media in teacher education is scarce. The absence of replication and cross validation of research is perhaps the most conspicuous characteristic of research on media usage in teacher education. Two central questions which continually arise are: (1) how can complex phenomena be subjected to observation and analysis without losing the meaning of the phenomena in the analytic process, and (2) can the analysis of intricate media effects within complex learning contexts retain enough of their inherent complexity so that the essential significance of the phenomena are not destroyed? (Lesser, 1966)

Some of the more extensive research in the use of videotape recording in student teaching experiences has been done at

Hunter College. In 1964 during three experimental semesters, 60 student teachers were involved in three supervisory techniques; that is, personal visitation, use of kinescope films, and a combination of both of these techniques. The results indicated no significant differences in the three conditions although an analysis of the kinescope group indicated that definite changes were established in both student teacher effectiveness and attitudes (Scheuler and Gold, 1964).

A similar study was conducted by Leonard (1971) in which three supervisory feedback techniques were studied in relation to effects on the interactive behavior of teachers. Videotape, audiotape, and control groups were used; evidence indicated that the videotape group exhibited less "direct teaching influence" and more "indirect teaching influence" as categorized by Flanders Interaction Analysis Scale.

Popham (1966) studied the efficacy of four videotaped instructional sequences in bringing about specific behavior changes in 124 prospective teachers. Significant F values in all four post tests indicated that instructional programs can be devised which will significantly increase the probability that students will acquire the ability to identify the presence of certain instructional principles in the videotaped teaching situations. This acquired ability aided the student in subsequently incorporating such behaviors in their own teaching patterns.

Using 84 subjects, Johnston (1969) examined the relation between student teacher attitudes and incidents of direct and

indirect control in classroom interactive behavior. Using self supervision via videotape recordings with aspects of Flanders system for categorical analysis of teacher behavior and micro-teaching, it was found that self supervision via videotape recordings tended to promote indirect teaching, higher scores on the Minnesota Teachers Attitude Inventory and greater pupil and teacher accepting attitudes.

Although a number of studies related to teacher effectiveness show no significant differences between groups employing feedback via videotape recordings and groups utilizing conventional learning systems (Borg, 1969; Chu and Schramm, 1967), the prevalence of this finding can perhaps be attributed to inadequate research designs and objectives which are too vague and lacking in specificity. Despite this evidence, the medium of videotape recording continues to show promise as a tool for the development of specific teaching skills and behavior patterns through observational learning.

Media Utilization in Coaching and Physical Education

The preceding discussion has indicated the extensive use of media in the preparation of teachers; however, there is limited evidence of the employment of media in the preparation of coaches. Since the field of coaching is significantly involved in the utilization of various aspects of media, provision of observational experiences through media would seem to be warranted and appropriate.

The value of the motion picture film as a coaching device was realized as early as 1939. In a study by Priebe and Burton (1939) slow motion pictures of champion athletes were used in coaching the high jump. Using 40 high school males, the results of the experiment indicated that this type of viewing promoted faster progress, eliminated the trial and error period, and provided a means of handling a larger number of students. It was concluded that motion picture viewing was superior to verbal and demonstration methods especially in the initial stages of learning.

The game film and the more recent videotape playback have provided the coach with a valuable tool for analyzing and evaluating individual and team performance and for recording a vast amount of knowledge which is incapable of being recorded by the naked eye (McVay, 1964; Ward, 1967; Zeper, 1962). Although the mere availability of films and videotape recordings does not guarantee constructive viewing, the proper focus of attention can be attained through guided direction and repeated emphasis on important facts (Del Ray, 1972).

In the development of instructional strategies of physical education programs, both films and videotape recording have been utilized as a means of recording behavior samples for feedback purposes. As early as 1936 the Motion Picture Committee of the National Section of Women's Athletics of the American Physical Education Association advocated the use of motion picture film in the analysis of skills as an aid in the promotion of shorter learning periods, longer retention periods, and a generally superior learning experience (Palmer, 1936).

Lockhart (1944) found the motion picture to be an effective device in the learning of bowling skills during a seven week instructional period. Although Nelson (1958) found no significant differences between experimental and control groups in testing 47 college men and women in golf, there was some indication that motion picture viewing did aid in pointing out the intricacies of the skill, especially in the more highly skilled subjects. Both groups tended to become more homogenous with practice but there was greater learning in the early stages of the lower level and greater learning at the later stages at the upper level.

A further use of the motion picture has been in the area of self-analysis. In a study by Watkins (1963) the effect of motion picture viewing in the correction of batting faults in baseball was indicated by a significant decrease in batting faults by those who viewed films in comparison to those who had not had this experience. Similar results were obtained by Burkhard (1967) in teaching elementary karate movements to 13 male students and by Londeree (1967) in training for recognition of specific football plays via motion picture versus flash cards.

Early research in the use of videotape recording likewise focused on self-analysis procedures. Penman (1968) used this technique to teach trampoline to 24 subjects; results indicated no significant difference in the post test scores of the control and experimental groups. Similar results were obtained by Smith (1968) using 37 college women in beginning golf classes employing one traditional and three videotape methods of instruction in teaching the pitch and run shot.

Studies by Robb and Teeple (1967) using beginning bowlers and Thompson (1969) using beginning golfers indicated no significant alteration in performance abilities of subjects through the use of videotape recording. However, analytic abilities of the observers increased indicating that a definite facilitation of learning had occurred through observation.

Videotape recording has also been used effectively in estimating the accuracy of self-assessment of a sport skill. DeBacy (1970) found a reduction in over-assessment of skill common to women students in beginning golf classes. Using videotape recordings as feedback in the learning of open skills has been a recent development. Del Ray (1972) indicated that replays functioned as knowledge of results (KR) by indicating the total environmental results of a fast break situation in basketball. The critical importance of employing directed attention by pointing out relevant parts of the display was strongly emphasized in this study.

VISUAL PERCEPTION

Visual skills are of vital importance to the learning and performance of coaching behaviors. Specific visual processes within a stimulus situation including detection of critical features, recognition of patterns, and rate of search are deemed particularly significant contributors to the ability to analyze a game situation. Although certain features of visual perception are manifest at birth, other features of perception emerge and

improve with practice. It is within the context of the latter aspect and in conjunction with the interactive processes of learning that visual perception is presented in this chapter. Further, one aspect of visual perception, field dependence-independence, is discussed utilizing the Group Embedded Figures Test as the framework for assessment.

Visual Perception as a Learning Process

Perceptual learning has been variously defined as " . . . an increase in the ability to extract information from the environment" (Gibson, 1969:4) and ". . . an identification of those constancies in the environment which provide information of crucial value and suppression of environmental information that have relatively little value" (Travers, 1970:15). It is marked by a discriminatory response to the variables of stimulation. Thus, the criterion of perceptual learning becomes an increase in specificity; that is, a detection of properties, patterns, and distinctive features which have particular significance to the organization in a stimulus situation (Gibson, 1969).

Visual perception is merely one mode of perception within the broad scope of modalities which affect the learning process. When defined as ". . . the capacity to interpret or give meaning to what is seen" (Butenika, 1968:16), it becomes a critical factor in learning. In this sense, visual perception can perhaps be identified with every action of an organism (Day, 1969).

Werner (1948) proposed a developmental concept of human behavior which indicated that visual perception progresses through

the same developmental process as general development. On this premise Werner hypothesized that visual perception developed from early, undifferentiated perception through a sequence of developmental stages to a differentiated, articulated, and organized perception.

A further related concept was proposed by Werner (1948) indicating that a perceptual property is an experience that corresponds to a particular relation between the state of the organism and the stimulation from an object. This view is consistent with Piaget's (1962) notion that perception is a very active process and that it involves some motor activity.

The relative importance of innate and learned characteristics in the development of behavior has been a subject of considerable interest to numerous researchers. The early work of Helmholtz, Titchener, James, and the Gestaltists of the 1900's attributed perception to unconscious influence and an accrual of past experience (Gibson, 1966). Contemporary theories resulting from the work of Brunswik, Drever, Piaget, and Bruner have ascribed to the viewpoint of perceptual development as an enrichment process involving an active, cognitive aspect (Gibson, 1966). In general, these contemporary theories have accepted an intermediary position which states that, as in the case of behavior, innate tendencies complement and balance the ability of the organism to profit from experience.

The research efforts of Butenika (1968), Dember (1960), Liebowitz (1965), and Solley and Murphey (1960) have affirmed the

position that although hereditary factors govern the capacities and limitations of perception, the cumulative effects of learning through exposure are important interactive factors in perceiving. Day (1969) has identified the unlearned aspects of perception as perception of depth and distance. Those aspects which are dependent upon experience with the environment include discrimination learning, learning new relationships between information from different systems, and learning resolving information from ambiguous stimuli. Thus, within the limits of inherent factors exposure to numerous experiences can increase visual perception to an unlimited extent.

Although the role of learning and past experience has been inevitably involved in the study of many aspects of perception, not until recently has there been an attempt to interpret the phenomena of perception in terms of learning theory. As distinguished by Hilgard (1948) the predominant theories of learning are the association theories and the field theories. The former involving a linkage of connections and a strengthening of these through repetition; the latter, in contrast, are marked by sensory components in a pattern or field relationship (Allport, 1955).

Just as these two theories have represented conflicts in the understanding of learning, similarly, their relation to visual perception has presented similar distinctive differences. The field theories of the Gestaltists represent some similarity to theories of perception in terms of the sudden acquisition of a cognition and the very brief, all or none principle of attaining

a percept. On the other hand, the association theories have eliminated meanings, perceptual relations, and cognitions and have become concerned with the acquisition of a consistency of reaction to a certain stimulus object (Allport, 1955). Although a synthesis of these two broad concepts and their relation to perceptual theories is impossible, it is clear that perception can no longer be viewed as an entity which is separate from learning. The resulting behavior of the organism must be considered as a physiological process or pattern which is developed and strengthened over time and performances as well as a process that underlies immediate experience (Allport, 1955).

The Concept of Differentiation Applied to Visual Perception: Field Dependence-Independence

Since 1942 Witkin and his associates have conducted a systematic and in-depth research program in the broad area of perceptual functioning (Witkin, et al., 1962). On the basis of the evidence obtained from extensive studies, differentiation, a broad dimension of psychological functioning was hypothesized. The concept of differentiation refers to the complexity of a system's structure and incorporates both the complexity and effectiveness of integration of a system. It is a dimension of human functioning which cuts across performance in areas traditionally classified as perception, intellectual functioning, social relations, and personality. Studies by Karp (1963) have demonstrated that from a knowledge of one's relative level of

differentiation, prediction can be made regarding aspects of his functioning within a broad spectrum of tasks, situations, and psychological states.

Although initially observed in the perceptual realm, this differentiation concept has been further refined and identified as a "cognitive style" which extends across diverse psychological functioning with a marked consistency (Witkin, et al., 1971). In the broad context of cognitive style, Witkin, et al., (1954) has used the term "field approach" to identify the two extremes of cognitive functioning; namely, an analytical field approach and a global field approach. An analytical mode of perceiving entails a tendency to experience items as discrete from their background and reflects the ability to overcome the influence of an embedding context. A global mode of perceiving, on the other hand, involves a tendency to experience surroundings with a relatively passive conformity to the influence of the prevailing field or context.

This global-articulated cognitive style is part of a still broader psychological dimension. Using the tendency to respond analytically as an indicator, behavior has been analyzed in numerous situations; the results lend support to the differentiation hypothesis (Witkin, et al., 1962). Individual differences, in this context, have been related to individual differences in body concept, the nature of the self, and the control and defense mechanisms commonly used. More specifically, an articulated cognitive style promotes an articulated body concept; that is, the body is experienced as whole and defined within limits of structure. A sense of

separate identity is associated with the concept which implies the experiencing of self from the non-self. Finally, the differentiation concept is related to use of specific defense mechanisms such as isolation in comparison to the global repression (Corah, 1965; Karp, et al., 1969; Witkin, et al., 1962).

An individual's level of differentiation is reflected in his mode of perceiving. The designation field dependence-independence has a specific perceptual connotation. In a field dependent mode of perceiving, parts of the field are experienced as fused. In a field independent mode of perceiving, parts of the field are experienced as discrete from organized ground (Witkin, et al., 1962).

According to Gibson (1966), when patterns of intensity, frequency, or separation are presented, learning is the rule. A great number of psychophysical experiments have shown decreasing errors in discrimination, estimation, detection, and recognition even when the observer is uninformed of his errors. The observer learns to look for critical features and to listen for distinctive variation; that is, it is an education of attention to the information available in the stimulus situation. This increase in discernment is not confined to the detection of finer detail. The span of attention is increased with practice and within limits it can be enlarged in scope and extended in time. It is a matter of detecting larger forms and longer episodes.

Dember (1960) hypothesized that visual perception is characterized by organization. The most basic organizational

pattern was identified as the segregation of figures from their backgrounds. The nature of the organization is determined by such invariables as proximity, similarity, good continuation, common fate, and closure; these properties are based upon principles of Gestalt psychologists. Although organization was originally thought to be immediately perceived upon presentation, recent evidence has shown that, like figure formation, it takes time to develop and that this development proceeds from the simple to the complex (Dember, 1960).

The Assessment of Field Dependence-Independence Utilizing the Group Embedded Figures Test

The perceptual task of disembedding figures is a universal concept in human experience. It would seem to be a particularly significant aspect of perceiving an array of complex stimuli such as a game situation. The Embedded Figures Test provides a useful tool for this study as it deals with the dimension of field dependence-independence and reflects an individual tendency to function at a more or less differentiated level via perception.

The Embedded Figures Test presents figures in which the subject's task is to locate a previously seen simple figure within a larger complex figure which has been so organized as to obscure or imbed the sought after simple figure. Scores on the Embedded Figures Test reflect the extent of competence at perceptual disembedding; that is, the ability to analyze a complex configuration and to respond to some parts of it while disregarding

others. The speed of location of the simple figures measures the ability to remain uninfluenced by the context in which the item is presented (Witkin, et al., 1954).

The Group Embedded Figures Test (GEFT) is designed to provide an adaptation of the original individually administered Embedded Figures Test (EFT) making group testing more practical. The combined evidence relative to validity and reliability of the GEFT suggested that the test provided a useful substitute of the EFT where individual testing is impractical (Witkin, et al., 1971).

Evidence of a consistent tendency to perceive in a field dependent or field independent fashion was found in numerous studies yielding significant correlations between individual scores on the Embedded Figures Test, the Rod and Frame Test, and the Body Adjustment Test (Witkin, et al., 1963; Linton, 1955; Witkin, 1950). An individual's mode of perceiving across these structurally similar perceptual tests reflected the strong influence of the immediate surrounding field upon the way in which one of its parts is perceived. Further, in a factor analytic study by Karp (1963) a perceptual non-discriminatory test was compared to the Embedded Figures Test. This study demonstrated that competence in the EFT not only required the ability to discriminate between conflicting stimuli, but more specifically, it required the breaking up of a field in order to separate parts of it.

A group of studies by Elkind and Scott (1962), Witkin (1950), Witkin, et al. (1962), and Witkin, et al. (1967), have provided further insights into the characteristics associated with

the Embedded Figures Test and implications which can be drawn therefrom. Consistent sex differences on the field dependent dimension have indicated that men are more field independent than women. Also, the ability to differentiate and discriminate visually shows a continuous increase between the ages of 8 and 15, reaching absolute stability in young adulthood. However, field dependence as a perceptual style can and does persist into adulthood in some instances.

Further evidence has supported the hypothesis that field independence is an asset in intellectual tests requiring perceptual concept formation; that is, the abstraction of elements and relations from among things rather than words (Elkind, 1963). However, studies by Goodenough and Karp (1961) and Karp (1963) have indicated that performance on the Embedded Figures Test is not related to intelligence tasks which do not require this disembedding factor.

SUMMARY

Although the behaviors associated with coaching competency have not been clearly defined, numerous recent attempts have been made to devise programs which will lead to the development of greater competency in coaching. The inclusion of the coaching minor, the coaching intern, and certification of coaches has provided evidence of a movement in this direction.

Currently there is little evidence to support the significance of including the practical aspect in programs designed for

attainment of coaching competency. The limited literature relative to coaching women's field hockey has focused on the skills and strategies of the game; very little attention has been directed to those experiences deemed particularly significant to the acquisition of coaching skills. However, knowledges relative to the role of the learner in the instructional process have strongly indicated that instructional strategies which employ the involvement of the learner in practical experiences are warranted if a viable program of education of coaches is to ensue.

Although observational learning experiences have become an integral part of teacher preparation programs, the factors which affect the learning process are not clearly understood. However, experiences which provide for structured observation and a consideration of individual learner characteristics are indicated if effective instructional strategies are to be developed.

The utilization of media, especially videotape recording, has contributed significantly to the enhancement of learning through observation. Numerous teaching-learning situations as well as improved feedback possibilities have been made available to the prospective teacher, thus assisting in meeting a vast array of educational objectives.

Research involving the application of media in teacher education has produced scattered significant results. However, specific behavior changes in terms of more "indirect" teaching, more positive attitudes, and an increased ability to identify instructional principles have been observed. The continued

pursuance of rigorous empirical research is indicated if media are to continue to serve as resource tools for the studying and improving of teacher education programs.

Research relative to the utilization of media in the preparation of coaches is limited. Except for early uses of the motion picture film as a coaching device and the more recent use of film and videotape recording for filming and analyzing game play, there has been very little recognition of the significance of media in this aspect of the program. On the other hand, films and videotape recording have been used extensively in physical education programs since 1936. Motion pictures have been used as an effective instructional strategy in the learning of specific skills in physical education. Likewise, both films and videotape recording have been used effectively as self-analysis tools.

Despite the inconclusive evidence of the effects of media on observational learning, one cannot ignore the possibilities inherent in media such as the motion picture film and videotape recording. With improved observational techniques and advanced educational technology, the negative factors influencing observational learning can be substantially overcome.

Visual processes were deemed a particularly significant aspect of coaching behaviors because of the inherent nature of game play. Of specific interest to this study was that aspect of visual perception which occurs as a result of learning. Research evidence has clearly shown that although some features of visual perception are innate, many perceptual abilities are dependent upon experience with the environment.

Research in perceptual functioning has led to an identification of the concept of differentiation, a broad dimension of psychological functioning which extends across numerous areas of human performance. Within this context, Witkin (1962) and his associates have identified a basic cognitive style of functioning. The two extremes are represented by an analytic field approach in which items are perceived as discrete from their background, and a global field approach in which items conform to the background in which they occur.

Field dependence-independence denotes the level of differentiation of an individual's visual perception and relates to the field approach idea. The Group Embedded Figures Test deals with this dimension in the perceptual task of disembedding figures. Research has indicated a consistent tendency among individuals to perform in a field dependent or field independent fashion in similar perceptual tests. Other characteristics associated with the GEFT include an increase in visual discrimination with age, reaching stability in young adulthood, the prevalence of field independence among men to a greater extent than among women, and a relationship to those intellectual tests requiring perceptual concept formation.

From the references cited in this review, justification was drawn for the designing of a study which would assess observational behaviors in a game situation and which would ultimately serve the purpose of lending direction and support for the inclusion of practical learning experiences in the education of coaches.

CHAPTER III

PROCEDURES

The purpose of this study was to investigate the frequency of different types of field hockey strategy observed by individuals with various modes of field hockey experience and to examine the relationship of these observations to experience, knowledge of game strategy, and visual perception. The procedures for this study involved three processes; namely, the preliminary preparation, the collection of data, and the treatment of the data.

PRELIMINARY PREPARATION

The preliminary preparation included the following six steps: (1) development of a film for measuring observation of game strategy in field hockey, (2) development of a scheme for recording observations, (3) development of a questionnaire, (4) development of a knowledge test, (5) selection of a visual perception test, and (6) selection of a locale for testing.

Development of a Film Suitable for Measuring Observations of Field Hockey Strategy

A review of the existing films and literature indicated that there were no films available appropriate to the design of this study. Therefore, it was decided to make a film which would meet the specific needs of this study.

Final decisions relative to the development of a film were based upon experimental filming by the investigator and knowledges acquired through consultation with the Head of the Media Center for Research at the University of Maryland. During experimentation, various types of Super 8 mm film, lenses, and speeds of filming were utilized. Also, the films were shot from various angles, heights, and distances in order to ascertain the most advantageous point of observation within a realistic context. On the basis of the information obtained through these pursuits, the following steps were taken in order to produce a film which would be appropriate and feasible within the design of this study:

1. A professional cameraman was employed to film 30 minutes of a field hockey match using 16 mm color film. This type of film projects an image which is of sufficient size and contrast to readily distinguish players and their relative positioning in relation to the ball.

2. The film was shot from a point 20 feet above and behind the goal cage. As a result of experimental filming and in consultation with field hockey coaches and selectors, it was determined that the strategic positioning of players and patterns of movement as well as a total game perspective could be most accurately observed from this location.

3. Sectional level of field hockey play was utilized in the filming. This level produces a high enough caliber of game for distinctions to be made by individuals with various modes of field hockey experience.

4. The match was filmed at 24 frames per second, with the accuracy checked by filming a stopwatch for 10 seconds. This film speed produces a visual image which is as close as possible to an accurate record as viewed by the naked eye. The camera was mounted on a fluid head tripod in order to insure that there would be no camera movement which would distort the action.

5. Insofar as was feasible, full field coverage was filmed in order to provide as much information as possible. The development of many strategic patterns of movement is dependent upon the observation of individual players as well as total team involvement. A standard focal lens (25 mm) was used in order to project an image which would be similar to the scope of vision of the naked eye. The use of a wide angle or zoom lens would introduce an uncontrollable variable and perhaps produce a psychological impact which would be impossible to evaluate. Inside the nearer 25 yard line the lens was opened to 35 mm in order to maintain a similar perspective.

6. All pertinent information relative to the film, the filming process, the camera, and the processing of the film was recorded for the purpose of replication of research (see Appendix A).

7. The 30 minutes of film that was developed was subsequently edited by the investigator to produce two eight-minute sequences and two minutes of practice film, both incorporating the normal flow of the game. The services of a professional photographic laboratory were engaged to reproduce the edited film.

The final prints included the two-minute practice film and the two eight-minute sequences separated by 64 frames of leader film to allow for the separate viewing of these sequences in that order.

Development of a Scheme for Recording Observations of Field Hockey Strategy

The following steps were taken in developing the Master Code Chart (MCC) for recording observations of field hockey strategy as specifically related to this study:

1. A review of the literature on field hockey strategy was surveyed to determine the critical elements of game strategy.

2. Persons knowledgeable about field hockey coaching were consulted to determine the appropriateness of selected elements.

3. A pilot testing of a designed scheme was undertaken utilizing game film and audiotape recording. The observations of several individuals with various modes of field hockey experience were transcribed to the chart categories.

4. The chart categories were designed to represent four broad elements of field hockey strategy; namely: (a) spatial relationships, (b) total offensive and defensive play, (c) situation play, and (d) strategic theory. Each category was further defined to include: related items of a more specific nature, a consideration of individual offensive and defensive positions, and observations on and off the ball (see Appendix B).

Development of the Questionnaire

A questionnaire was developed to determine the relative experience of each subject in field hockey (see Appendix C). This

form served to identify the various classes of individuals including coaches, club players, and college players. The categories of experience included were the number of years of playing experience, coaching experience, and selecting experience.

Development of the Knowledge Test

A test consisting of 25 multiple choice items which incorporated various aspects of field hockey strategy was developed to assess the subjects' knowledge. Content validity of the test was ascertained from the literature and informal discussion with "authorities" in the field. Construct validity was determined by administering the test to 12 varsity field hockey players and 12 beginning field hockey players; the difference between the means of the two groups was significant at the .01 level. A reliability of .96 was established by applying the Kuder-Richardson formula to the above-mentioned test results.

Selection of a Visual Perception Test

The Group Embedded Figures Test (GEFT) was selected to test visual perception because of its applicability to this study, its availability, and its practicality of administration to large groups. The GEFT is designed to provide an adaptation of the original individually administered Embedded Figures Test (EFT). It contains 18 complex figures, 17 of which are taken from the EFT. Likewise, it utilizes the same mode of presentation and format of the EFT. The similarities in addition to its high validity and its reliability of .82 indicate that it is a satisfactory substitute for the Embedded Figures Test (Witkin, 1971).

The GEFT consists of three sections. The first is a two-minute practice session involving simple items; the second and third each includes nine more difficult items. The subject's task on each trial is to locate a previously seen simple figure within a larger complex figure which has been so organized as to obscure or embed the sought after simple figure. Therefore, the scores on the GEFT reflect the extent of individual competence at perceptual disembedding. The total time involved in completing the test is 12 minutes.

The Group Embedded Figures Test deals with a perceptual style; specifically field dependence-independence. In a field independent mode of perception, the individual tends to experience his surroundings analytically with objects experienced as discrete from their background. A field dependent mode represents a relatively global way of perceiving with a passive conformity to the influence of the prevailing field or context (Witkin, 1954). It is this dimension of the test which deemed it particularly significant and applicable to this study.

Selection of a Locale for Testing

It was decided that a summer field hockey camp setting would be most appropriate to the design of this study. Primary consideration in this decision was given to the availability of representative classes of individuals to be studied, the availability of resources for collecting the data, and the conduciveness of such an atmosphere for research in the observation of game strategy in field hockey.

A letter (see Appendix E) to the Director of the Mount Pocono Hockey Conference, Tobyhanna, Pennsylvania, was acknowledged indicating the willingness of the camp personnel to cooperate in this research endeavor during the first week of the Conference, August 21 to August 28, 1973. Subsequent communication with the Director affirmed the agreement and the plans for the collection of the data.

COLLECTION OF DATA

The collection of data included the following steps: selection of subjects, administration of the questionnaire, knowledge test, and visual perception test, examination of the film, and transcription of the observations.

Selection of Subjects

The names of coaches, club players, and specific college teams that would be in attendance during the first week of the hockey conference were secured from the Director. A letter was sent to each of the coaches employed by the conference (see Appendix E) and to each of the club players (see Appendix E) with an enclosed response card to indicate the individual's willingness to participate in this study. Also, a letter (see Appendix E) was sent to each of the college teams that had registered with the conference requesting that the field hockey coach submit the names of individual college players who would be willing to participate in this research study.

The number of letters forwarded and responses received were as follows: (1) coaches, 11 of 12, (2) club players, 12 of 14, and (3) college players, 32 from seven institutions. The remainder of the coaches and club players were solicited from among the individuals at the conference who had not previously been contacted because of their late registration. College players were randomly selected from the names submitted by the college coaches. A total of 44 subjects was used in this study. The following criteria were used in the selection of the subjects:

1. A minimum of two years of experience must have been attained at each representational level. This experience must have been attained since the year 1970.

2. The subjects must not have participated in the game from which the film was developed, nor have observed the actual game or the original film.

When the number of subjects meeting the criteria for this study exceeded the established number of subjects, a random selection was made. Where there was a duplication of classes among subjects, they were placed in the highest category for which they qualified; the rank order of categories being identified as: coach, club player, and college player. For example, if a subject was both a coach and a club player, she was categorized as a coach.

Administration of the Questionnaire, the Knowledge Test, and the Visual Perception Test

During the course of activities of the first day at the conference, each subject was individually contacted in regards to

the initial testing period. The criteria for the selection of subjects were verbally ascertained at this time.

The questionnaire, knowledge test, and visual perception test were administered to the total group of subjects during the first evening session of the hockey conference. Following the completion of the questionnaire, the visual perception test was briefly explained and administered within the time limit of 12 minutes. The testing was concluded with the administration of the knowledge test for which 25 minutes was allowed. This testing period followed a half day of field hockey playing or coaching for all individuals involved.

Examination of the Film

The subjects were scheduled for film viewing in pairs beginning on the afternoon of the second day of the hockey conference; thus, each subject had been exposed to at least one full day of field hockey experience previous to viewing the film. Film viewing sessions were scheduled on the hour each day from 8:30 a.m. to 9:30 p.m. from August 22 through August 25, 1973.

The film viewing area consisted of a darkened room with two chairs placed 12 feet apart and 30 feet from the screen, separated by the 16 mm film projector. Each subject was provided with a portable cassette tape recorder and instructed in the mechanics of its operation.

A specific set of directions was given to each subject indicating the technique for identifying the teams, the type of

play, and the type of responses anticipated (see Appendix F). The subjects then viewed the two-minute practice sequence of specific game play. This film was designed to acclimate the subjects to the color of the teams, the goal each team was attacking, the viewing perspective, and the recording technique. Questions were answered following this sequence.

Each eight-minute sequence was then viewed with a two-minute interval between sequences. The subjects were instructed to comment, simultaneously while viewing the film, on the elements of field hockey strategy observed. The tape recorders remained in operation throughout each eight-minute sequence. Total examination time was 25 minutes for each pair of subjects.

Transcription of the Observations

Subsequent to the collection of all the data, each individual tape was transcribed to the Master Code Chart by the investigator. Each tape was played and the observations were recorded onto a separate code chart. In some instances, depending on the number of recorded comments, the tapes were replayed to ascertain the accuracy of the investigator's recording. Using the chart categories, each recorded comment was tabulated according to the specific type of observation, whether it related to play on or off the ball, and whether it represented a value judgment or was merely a statement of fact. More explicitly, in the latter case, those comments which merely indicated the location of the player or the ball without specific reference to a positive or negative factor were considered insignificant observations as specifically related

to this study. For example, a comment such as "the center forward received a pass from the left wing" was considered insignificant as related to this study. On the other hand, a comment such as "the center forward was upfield in good position to receive the well-placed through pass from the left wing" was considered a value judgment relative to strategy and therefore of importance to this study.

A check for reliability was made a week following the final tape transcription by repeating the transcription of a randomly chosen tape. A .95 reliability coefficient was established using the Spearman Rank-Difference Correlation method. The data were then compiled into a form for computer analyzation.

TREATMENT OF DATA

A stepwise multiple discriminant analysis utilizing the UCLA Biomedical Computer Program BMDO7M was employed to determine whether criterion groups could be distinguished from each other using the entire set of variables; that is, experience in coaching, playing, and selecting, knowledge of game strategy, visual perception, spatial relationships, total offense and defense, situation plays, strategic theory, skill analysis, on and off the ball observations, and unrelated observations. This procedure also considered individual variances about group means, group variability on each variable, and the interaction between all criterion measures, i.e., classes of individuals with various modes of field hockey experience and the stated variables.

Utilizing the discriminant analysis in a multivariate comparison of several groups provides three kinds of information. First, it determines whether, in fact, certain groups are actually distinct with respect to selected variables. Secondly, it reveals which variables provide the best discrimination among the groups; and thirdly, it indicates the degree to which individuals assigned to a group are similar to other individuals within that group (Kroll, 1972).

The significance of the difference of group means was determined by computing separate univariate F tests on each variable utilizing the Telestorage and Retrieval System (TSAR) computer program. When a significant F ratio was found, the Scheffé test was used to determine which of the means differed significantly.

The TSAR system procedure TFCORR was utilized to compute a Pearson Product Moment Correlation Coefficient to determine if any one of the criterion variables (experience, knowledge, and visual perception) was correlated with the predictor variables (observations). The significance of the correlation coefficients was tested by using the distribution of t.

Finally, data were factor analyzed utilizing the Statistical Package for the Social Sciences (SPSS) Computer Program. A varimax rotated factor matrix was calculated to determine underlying patterns and interrelationships among the variables.

CHAPTER IV

ANALYSIS AND DISCUSSION OF DATA

ANALYSIS

This study focused on the types of field hockey game strategy observed by individuals with various modes of field hockey experience. In addition an attempt was made to relate the types of observed strategies to selected variables; namely, experience, knowledge of game strategy, and visual perception.

Data were collected from 44 subjects selected from participants at the Mount Pocono Field Hockey Conference. Audiotape responses to a specially-prepared film were subsequently coded by the investigator into meaningful units. The obtained data were then treated statistically by three multivariate analytic methods; namely, multiple discriminant function analysis, one-way analysis of variance, and factor analysis. Further, the Pearson Product Moment Correlation Coefficient was used to calculate correlations between criterion and predictor variables for each group.

Multiple Discriminant Analysis

Initially, an effort was made to determine whether groups of individuals with various modes of field hockey experience; that is, coaches, club players, and college players could be clearly

differentiated from each other according to all of the stated variables considered collectively and separately. Multiple discriminant analysis allows for determining whether a set of groups can be distinguished from each other on the basis of a set of measures. This procedure utilizes the set of measures as a whole rather than as separate, independent factors. In brief, discriminant analysis takes into account variability of group means, variation of individuals about group means, and the interrelationships of all variables (Rushall, 1969).

Raw data for each of the 44 subjects including scores on the knowledge test, the GEFT test, the number of years of experience as determined by the questionnaire, and the frequency of observations in each of the categories on the Master Code Chart were subjected to a stepwise multiple discriminant function analysis using the UCLA Biomedical Computer Program BMDO7M. This program executes the multiple discriminant analysis in a stepwise manner. At each step one variable is entered into the set of discriminating variables. The variable entered is selected by the first of the following set of equivalent criteria: (1) the variable with the largest F value, (2) the variable which when partialed on the previously entered variables has the highest multiple correlation with the groups, and (3) the variable which gives the greatest decrease in the ratio of within to total generalized variances (Dixon, 1965). The stepwise discriminant analysis considers only those variables that contribute significantly to the discrimination of the groups.

The program also (1) calculates a matrix of F statistics at each step to test the equality of group means between each pair of groups, (2) classifies each subject into a specific group at each step on the basis of the specific variable(s) being considered, and (3) plots a graphical illustration showing the dispersion of the group members on the basis of the discriminant function analysis.

Table 1 summarizes the findings of the stepwise discriminant analysis. The discriminatory power of each variable is reported in terms of an F value. It is clear from the F values that coaching experience was the single most discriminating variable among the groups. Knowledge of game strategy was also an important discriminating variable; the remainder of the variables contributed decreasingly and proportionately less to the discrimination of the groups.

Table 2 provides information relative to the classification of each identified class of individuals into three discriminant groups at each step of the discriminant function analysis. The results of this treatment indicate that the club and college group members fell almost exclusively into their assigned groups. The coach group, on the other hand, exhibited a greater degree of variation, e.g., at each step several of them were classified with club and college players.

Table 3 summarizes the classification of all subjects on all 13 variables and indicates the percentage of correctly classified individuals for each group. Examination of the summary

TABLE 1

Stepwise Multiple Discriminant Function Analysis of Coaches, Club Players, and College Players on 13 Variables (N = 44)

Step Number	Variable	Value of F Statistic
1	Coaching experience: number of years of involvement in coaching field hockey teams at any level	33.1996
2	Knowledge: understanding of strategic theory in field hockey as determined by a written test	8.5457
3	Selecting experience: involvement in the process of choosing individuals to represent teams on the basis of skillful play in field hockey competition	2.3920
4	Skill analysis: determination of the components of proper execution of a skill	1.6233
5	On the ball: play concerned with the movement of the player with the ball or the ball itself	1.2343
6	Playing experience: number of years of involvement in field hockey competition as a player	1.1541
7	Visual perception: the process of visually obtaining information from the world around us	1.0023
8	Strategic theory: generally accepted principles regarding effective game play in field hockey	.8493
9	Unrelated observations: insignificant comments relative to the categories of observations used in this study	.7618
10	Total offense-defense: the maneuvering of the line and backfield players as a unit	.3978
11	Spatial relationships: the arrangements of space in terms of persons or objects filling the spatial framework	.1913
12	Off the ball: play concerned with the movement of the player(s) not immediately concerned with the ball	.2494
13	Situation plays: Special situations in the game when play is momentarily suspended for free hits, corners, etc.	.0340

TABLE 2

Classifications on Each Variable at Each Step of the Discriminant Function Analysis (N = 44)

Variable	X Coach N = 14			Y Club N = 14			Z College N = 16		
	X	Y	Z	X	Y	Z	X	Y	Z
Coaching experience	9	5	0	0	5	9	0	0	16
Knowledge	8	4	2	0	11	3	0	3	13
Selecting experience	10	2	2	0	12	2	0	3	13
Skill analysis	8	4	2	0	13	1	0	3	13
On the ball	9	3	2	0	13	1	0	3	13
Playing experience	9	3	2	0	13	1	0	3	13
Visual perception	9	3	2	0	13	1	0	1	15
Strategic theory	9	3	2	0	13	1	0	1	15
Unrelated observations	9	3	2	0	13	1	0	1	15
Total offense-defense	10	2	2	0	14	0	0	1	15
Spatial relationships	10	2	2	0	14	0	0	1	15
Off the ball	10	2	2	0	14	0	0	1	15
Situation plays	10	2	2	0	14	0	0	1	15

reveals that the "a priori" classification of subjects into groups by criteria selected by the investigator was accurate. On each variable there was very little variation of subjects; the summary in Table 3 indicates an overall classification accuracy of 84%. This evidence lends support to the assumption that there are definite and distinctive characteristics associated with individuals who are classified as coaches, club players, and college players.

TABLE 3

Percentage of Classifications of All Subjects on All Variables. (N = 44)

	Subject Classification				
Group	N	Coach	Club	College	Per Cent Correct
Coach	14	10	2	2	71
Club	14	0	13	1	93
College	16	0	2	14	88
				Average =	84%

A summary of the F matrices indicating the equality of pairs of means calculated at each step of the discriminant analysis is shown in Table 4. A statistically significant difference is indicated between each pair of groups on all variables with the exception of coaching experience. On this variable the club and college group means were not significantly different.

TABLE 4

Summary of F Matrices of Equality of Pairs of Group Means at Each Step of the Discriminant Function Analysis (N = 44)

Variable	Coach/Club	Coach/College	Club/College
Coaching experience	46.17314**	54.17355**	0.11720
Knowledge	22.98685**	31.20952**	8.41010**
Selecting experience	18.12891**	21.29214**	6.17371**
Skill analysis	13.35257**	17.08871**	5.32632**
On the ball	10.90922**	13.31770**	4.81615**
Playing experience	9.01763**	10.93206**	4.53652**
Visual perception	7.79677**	9.12675**	4.23976**
Strategic theory	6.98097**	8.33210**	3.62442**
Unrelated observations	6.02374**	7.48101**	3.38617**
Total offense-defense	5.33949**	6.76991**	2.99302*
Spatial relationships	4.75012**	6.07020**	2.64652*
Off the ball	4.21599**	5.47348**	2.40999*
Situation plays	3.77584**	4.88939**	2.15280*

* $p < .05$
** $p < .01$

It is interesting to note that a highly significant difference was found between the coach/club and coach/college groups (.01). Although significantly different, the F values for the club/college means were considerably smaller.

The plot of identified group members in Figure 1 provides a spatial summary of the above findings. The group means* for the club and college groups fall relatively within the same plane. The small F values between the means of these groups is clearly indicated. College and club players are visually depicted to be similar in regard to the coaching variable. This is consistent with the juxtaposed placement of these subjects to the coaches. Likewise, the plot also represents the classification of individual members of each group clearly. As noted earlier in Table 3, the percentage of accurate classifications is similarly indicated herein by the clustering of subjects about the group means of the club and college groups. The coach group, on the other hand, is more scattered, representing a degree of variation among the members of that group on the variables as well as reflecting the lower percentage of accurate classifications for that group.

Univariate Analysis of Variance

The significance of the differences of group means was determined by computing separate univariate F tests on each

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*Group means refer to values obtained in canonical variables generated by the program but not otherwise elaborated in the discussion of the data analysis. See table of canonical variables in Appendix G.

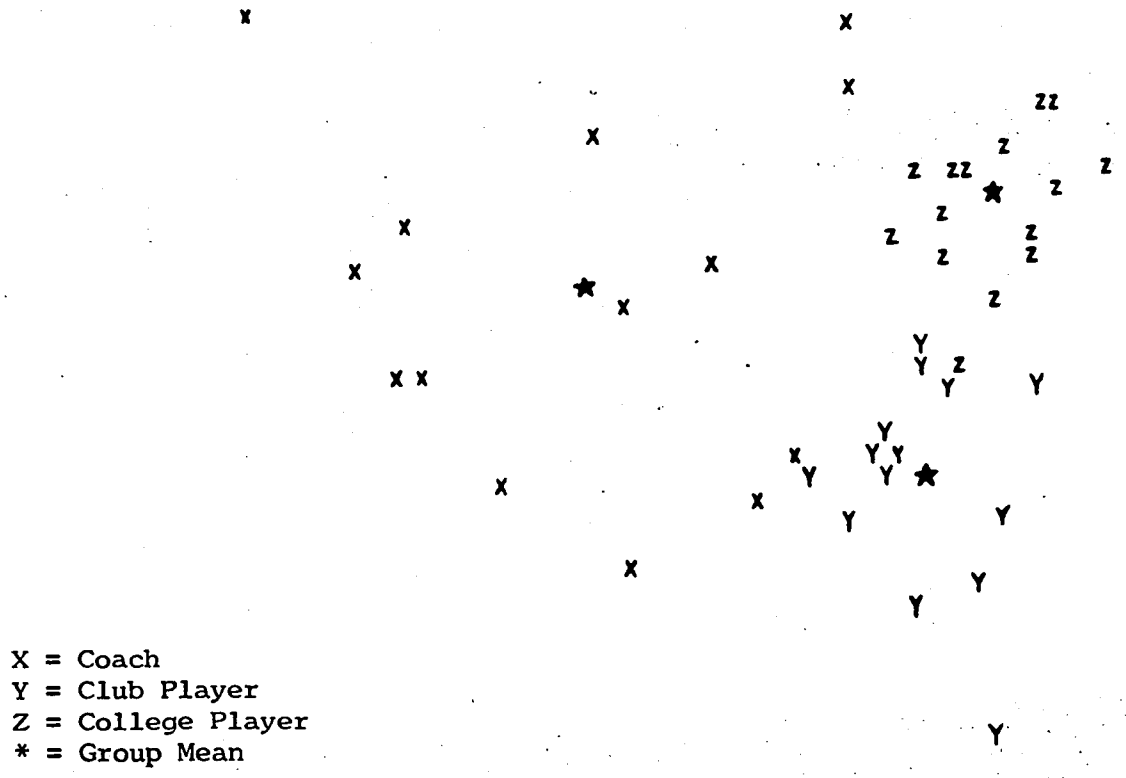

FIGURE 1

Plot of Dispersion of Group Members
on Discriminant Analysis
(N = 44)

variable utilizing the Telestorage and Retrieval System (TSAR) Computer Program. When a significant F ratio was found the Scheffé test was used to determine which of the means differed significantly.

Summarized in Table 5 are the separate univariate F's for each variable. This analysis reveals that a significant difference existed between the groups on each of the following variables: coaching experience, playing experience, knowledge of game strategy, spatial relationships, on the ball, and off the ball observations. This finding demonstrates the added meaning one is able to discern from the multiple discriminant function analysis. Whereas univariate F tests indicate significant differences in only six of the measured variables, when groups and variables were considered collectively and separately, all variables were statistically significant. Only the coach and club groups were analyzed on the coaching and selecting experience variables since these two variables were not applicable to the college group.

Further interpretation of the data was suggested by comparing pairs of group means to determine which differences were significant. The Scheffé test was used to compare group means two at a time. The results presented in Table 6 indicate that a significant difference existed between the coach/club groups on coaching experience, knowledge of game strategy, and spatial relationships and between the coach/college groups on playing experience, knowledge of game strategy, spatial relationships, on the ball and off the ball

TABLE 5

Univariate Analysis of Variance: Summary
(N = 44)

Source	df	MS_b	F
Criterion Variables			
Coaching experience	1/26	18.45	29.28**
Playing experience	2/41	28.59	5.61**
Selecting experience	1/26	6.31	0.46
Knowledge	2/41	4.68	11.03**
Visual perception	2/41	16.12	1.96
Predictor Variables			
Spatial relationships	2/41	102.66	7.65**
Total offense-defense	2/41	25.85	2.19
Situation plays	2/41	31.01	.004
Strategic theory	2/41	1.81	1.22
Skill analysis	2/41	1.82	0.97
On the ball	2/41	85.97	3.55*
Off the ball	2/41	61.03	5.53**
Unrelated	2/41	140.60	1.80

* $p < .05$ 1/26df = 4.22
2/41df = 3.22

** $p < .01$ 1/26df = 7.72
2/41df = 5.15

TABLE 6

Scheffé Test: F Values for Comparison of Pairs of Group Means

Variable	df	Coach/Club	Coach/College	Club/College
Coaching experience	1/26	29.37**		
Playing experience	2/41	.56	10.69**	6.15
Knowledge	2/41	15.13**	17.34**	3.88
Spatial relationships	2/41	6.44*	15.06**	1.70
On the ball	2/41	4.34	6.46*	1.25
Off the ball	2/41	3.50	11.09**	2.04

* $p < .05$ 1/26df = 8.44
2/41df = 6.44

** $p < .01$ 1/26df = 15.44
2/41df = 10.3

observations. There were no significant differences between the club/college groups.

The frequency of types of observations made by each group is discernible by examining the means for the predictor variables presented in Table 7. A comparative inspection reveals that the four variables with the highest number of frequencies for each group are: (1) coaches: on the ball, spatial relationships, off the ball, and situation plays, (2) club players: on the ball spatial relationships, unrelated observations, and off the ball, and (3) college players: unrelated observations, on the ball, situation plays, and spatial relationships.

The marked differences between the coach/college groups is clearly evident from an examination of the mean scores on spatial relationships, off the ball, and unrelated observations. However, the large standard deviations on each of these variables must be considered in the interpretation of these differences; there was considerable variation among the members of both the coach and college groups.

Pearson Product Moment Correlation Coefficient

The TSAR System procedure TFCORR was utilized to compute a Pearson Product Moment Correlation Coefficient to determine if any of the criterion variables (experience, knowledge, visual perception), correlated with the predictor variables (frequency of observations). The significance of the correlation coefficients between criterion and predictor variables for each group was then tested by using the distribution of t for a two tailed test.

TABLE 7

Means and Standard Deviations of Predictor Variables for Each Group

Variable	Coach Group		Club Group		College Group	
	$\bar{X}$	S	$\bar{X}$	S	$\bar{X}$	S
Spatial relationships	22.857	14.888	13.357	7.438	8.500	6.366
Total offense-defense	8.285	6.832	5.285	4.339	4.562	3.723
Situation plays	9.000	6.151	8.928	4.066	8.812	6.134
Strategic theory	0.357	0.633	1.071	1.817	1.000	1.316
Skill analysis	1.214	1.672	1.214	1.368	0.625	0.957
On the ball	23.857	10.875	16.571	6.272	15.375	9.918
Off the ball	15.500	10.420	10.071	7.610	6.000	4.746
Unrelated	8.857	9.412	11.000	7.306	16.750	16.163

Table 8 indicates the correlation coefficients for the coach group. The correlation coefficients for the club and college groups are indicated in Tables 9 and 10, respectively.

Table 8 reveals several significant relationships between the criterion and predictor variables for the coach group. These relationships vary from a moderately high relationship, r = .561; t = 2.34, between coaching experience and spatial relationships scores to the extremely high relationship, r = .761; t = 4.06, between playing experience and spatial relationships scores. Correlations between playing experience and on the ball observations as well as selecting experience and total offense-defense observations fell between these two extreme significant levels. For significance at .05, 2.18 is required; 3.05 is required for significance at the .01 level.

As indicated in Table 9, there was only one significant correlation among the variables in the club group. Playing experience and on the ball observations were significantly correlated, r = .536; t = 2.19, at the .05 level.

The college group correlation matrix shown in Table 10 indicates a significant correlation between the knowledge variable and two predictor variables; namely, spatial relationships (r = .608; t = 2.86), and off the ball observations (r = .510; t = 2.21). Visual perception was significantly correlated with unrelated observations (r = .510; t = 2.21).

TABLE 8

Correlation Matrix for Coach Group
(N = 14)

Variable		2	3	4	5	6	7	8	9	10	11	12	13
Coaching experience	1	.519	.659	.155	-.364	.561*	.395	-.348	.200	-.096	.292	.480	-.163
Playing experience	2		.608	.518	-.177	.761**	.099	-.015	.057	-.078	.631*	.411	.054
Selecting experience	3			.202	-.424	.472	.604*	-.350	-.102	.058	.395	.324	-.046
Knowledge	4				.226	.318	.153	.187	.259	-.262	.453	.316	-.417
Visual perception	5					-.079	.026	.000	.330	.053	-.185	.190	-.433
Spatial relationships	6						.297	.087	-.084	.038	.689	.843	-.085
Total offense-defense	7							-.181	-.168	-.006	.354	.543	-.301
Situation plays	8								-.197	.254	.584	.085	.266
Strategic theory	9									.140	-.160	-.041	.048
Skill analysis	10										.044	.099	.168
On the ball	11											.517	.221
Off the ball	12												-.411
Unrelated	13												

* $p < .05$ r = .533; t = 2.18

** $p < .01$ r = .663; t = 3.05

TABLE 9

Correlation Matrix for Club Group
(N = 14)

Variable		2	3	4	5	6	7	8	9	10	11	12	13
Coaching experience	1	.302	.400	.178	.268	.526	.282	-.046	-.094	.149	.220	.509	.049
Playing experience	2		.863	.090	-.351	.524	.267	.202	-.217	-.143	.536*	.408	.082
Selecting experience	3			.036	-.164	.460	.357	.117	-.152	.131	.376	.347	.014
Knowledge	4				.069	.224	-.210	-.349	.421	-.271	-.123	-.071	.475
Visual perception	5					.105	.293	.320	.334	.134	.049	.373	-.158
Spatial relationships	6						.202	.309	.157	-.053	.698	.770	.347
Total offense-defense	7							.398	-.130	.675	.420	.530	.187
Situation plays	8								.063	.044	.750	.574	.104
Strategic theory	9									-.254	.124	.222	.359
Skill analysis	10										.029	.006	.331
On the ball	11											.737	.376
Off the ball	12												.094
Unrelated	13												

* $p < .05$ r = .533; t = 2.18

TABLE 10

Correlation Matrix for College Group
(N = 16)

Variable		2	3	4	5	6	7	8	9	10	11	12	13
Coaching experience	1	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
Playing experience	2		.000	-.232	-.454	-.251	.112	.050	-.077	-.092	.012	-.205	-.463
Selecting experience	3			.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
Knowledge	4				-.252	.608*	.161	.266	-.063	-.087	.331	.510*	.226
Visual perception	5					-.050	-.012	.085	.155	-.072	.068	-.016	.510*
Spatial relationships	6						.336	.679	.016	.230	.708	.836	.365
Total offense-defense	7							.618	-.231	.549	.794	.294	-.178
Situation plays	8								.140	.521	.896	.753	.139
Strategic theory	9									-.053	-.026	.171	-.135
Skill analysis	10										.613	.147	-.011
On the ball	11											.615	.094
Off the ball	12												.324
Unrelated	13												

* $p < .05$ r = .496; t = 2.15

Factor Analysis

The final procedural step involved factor analysis of the variables utilizing the Statistical Package for the Social Sciences (SPSS) Computer Program. Varimax rotation maximized the variances of squared factor loadings. Varimax is an orthogonal rotation technique; a strong feature of this method is its ability to discern the same cluster of variables regardless of the number or contribution of other variables in the analysis (Rummel, 1970). In this orthogonal rotation the factors are rotated in such a way that each factor defines a different grouping of highly correlated variables. An orthogonal factor matrix represents both a pattern and a structure matrix; that is, coefficients in the table represent both regression and correlation coefficients (Nie, 1970). Thus, the selected variables in this study can be viewed in another way on the basis of the factor analysis.

The varimax factor matrix is presented in Table 11. The analysis yielded three factors accounting for 90.8% of the total variance. Eigenvalue 1.00 was used as the cut-off for factor identification. Loadings of .35 or higher were criteria utilized in extracting variables which make up the factors. The summary of the factor analysis is shown in Table 12. Examination of the data suggests that the first factor is a spatiality factor which is intimately associated with coaching, playing, and selecting experience as well as knowledge and has specific reference to both on and off the ball observations. The 57.7% of the total variance accounted for by this factor is indicative of its importance in considering the components of game play.

TABLE 11

Varimax Rotated Factor Matrix

Variable	Factor 1	Factor 2	Factor 3
Coaching experience	.64099	.19701	-.21763
Playing experience	.76832	-.01356	-.05305
Selecting experience	.60299	.24061	-.23268
Knowledge	.53491	-.00431	.03216
Visual perception	-.06592	.08258	.05730
Spatial relationships	.92240	.13835	.13570
Total offense-defense	.30723	1.01569*	-.11692
Situation plays	.12378	.24413	.91680
Strategic theory	-.00978	-.16492	.03656
Skill analysis	.02916	.33622	.18284
On the ball	.63150	.36985	.58440
Off the ball	.79128	.34946	.10391
Unrelated	-.12389	-.09578	.24361

*Although factor loadings are generally considered to be a form of correlation index, the limits may, on occasion, exceed ± 1.00.

TABLE 12

Factor Analysis: Summary

Factor	Variable	Loading	Communality	Eigenvalue	Proportion of Variance
I				4.41953	57.7%
	Coaching experience	.64099	.56487		
	Playing experience	.76832	.69025		
	Selecting experience	.60299	.59206		
	Knowledge	.53491	.29392		
	Spatial relationships	.92240	.88926		
	On the ball	.63150	.90338		
	Off the ball	.79128	.80677		
II				1.56309	20.4%
	Total offense-defense	1.01569	1.14428		
	On the ball	.36985	.90338		
	Off the ball	.34946	.80677		
III				.97603	12.7%
	Situation plays	.91680	.92284		
	On the ball	.58440	.90338		
	Cumulative Proportion of Variance				90.8%

The second derived factor could be appropriately identified as a player patterns factor. The extremely high loading on the total offense-defense variable is indicative of observations relative to the maneuvering of offensive and defensive units of players with direct reference to both on and off the ball observations. This factor accounted for 20.4% of the total variance.

The third factor that emerged can be specifically identified with the variable which loaded most appreciably on this factor; that is, situation plays. These may be defined as those special situations when the game is momentarily suspended for free hits, corners, bullies, and roll-ins. The static type of play implies a primary focus on the ball. The total variance accounted for in this factor was 12.7%.

DISCUSSION

Through the years, the literature relative to field hockey and individuals with expertise in teaching and coaching field hockey have placed considerable value on experience as a determining factor both in the acquisition of a broad base of knowledge of game strategy and in the development of playing skills and abilities to coach and select. At best, this value position, which presumes the existence of differences among individuals involved in field hockey, has been based upon intuition and conjecture. This study has statistically verified numerous assumptions that are basic to such a point of view and has also generated new theoretical positions via the direct observation of game play by various classes of field hockey personnel.

The results of the multiple discriminant function analysis statistically identified three distinct groups of field hockey personnel. Further, it revealed the variables contributing to group differentiation and specified these differences as they pertained to each group. In addition, the study provided statistical evidence that identifies the variables which influence observation of game strategy. Finally, it defined factors which can be appropriately utilized to describe components of game play. These statistically verified concepts serve as the focal point for the pursuant discussion.

Group Classification

Examination of the F values in Table 1 clearly indicates that coaching experience was the single most discriminating variable among the groups with knowledge of game strategy also being a major contributor in this differentiation of groups. The remainder of the variables contributed considerably less to the discriminatory process. That definitive groups of field hockey personnel exist is observed in the classification on each variable at each step of the discriminant function analysis (Table 2) and the summary of classifications (Table 3). These statistics indicate that classifications in the club and college groups were highly accurate, whereas, the coach group exhibited more variation. These results statistically verify that there are distinct differences among classes of field hockey personnel as well as within specified groups. This fact is particularly evident within the coach group classifications which exhibit a kind of non-conformity

of several group members. The final classification and the plot shown in Figure 1 similarly confirm this tendency. These results, in the writer's opinion, reflect an apparent need to identify behaviors and competencies necessary for coaching field hockey. A system for certification of women coaches does not currently exist in the United States; therefore, one's admission to this category is not necessarily based upon qualifications, but rather upon personal desire, self-appraisal, and related experiences. Individual abilities thereby become primarily dependent upon the value of prior experiences and possibly a self-determination to become competent in an extremely complex environment. An identification of definitive behavioral characteristics and modes of training and assessment would contribute immeasurably to individual competency in a coaching environment.

The equality of pairs of means summarized in F matrices at each step of the discriminant function analysis (Table 4) gives further indication of group differences. Significant differences were found between the means of all variables except coaching experience; on this variable the club and college group means were not significantly different. Examination of the differences between group means as shown by F's reveals that the coach group was significantly different from the college and club group (.01). F's obtained for the club/college groups, on the other hand, reveal considerably less, though significant, difference. That there is minimal improvement in terms of increased ability to observe strategically a game situation when comparing college

and club players is clearly indicated. This fact points to the necessity for continued coaching of players at the club level. An increased awareness of spatial relationships and off the ball observations are intimately associated with coaching behaviors as well as being critical elements of game play. In a practical sense, these behaviors may accrue through effective coaching of club players.

The Univariate F's presented in Table 5 serve to further substantiate the differentiation between groups. Consideration of the variables individually produced fewer, but more precise differences between groups. The direction of these differences is clearly indicated in Table 6. Again, two very distinct patterns emerged; that is, the highly significant differences between the coach/college groups and the relative insignificance of the differences between the club/college groups. More importantly, these statistics reveal that the coach group observed spatial relationships and off the ball, the critical elements of game play, to a significantly greater degree than the college players. Playing experience, knowledge of game strategy, and presumedly coaching experience were obvious influential factors in this process. Differences in coaching experience and knowledge of game strategy influenced the greater number of observations of spatial relationships of the coach group compared to the club group.

Shown in Table 7 are the group means and standard deviations for the predictor variables. An interpretation of these scores indicates the types of strategies observed by individuals

with various modes of field hockey experience. A comparative evaluation of the mean scores indicates extreme differences between the coach and college groups on spatial relationships, off the ball observations, and unrelated observations. The coaches, as a group, critically evaluated certain aspects of game play identified as spatial relationships and on and off the ball observations. The college players, as a group, exhibited a tendency to comment consistently on the position of the ball and players regardless of its importance to game strategy. These unrelated observations reflect an inability to analyze some of the critical components of game play; namely, spatial relationships, on the ball and off the ball observations.

Criterion Variable Correlation

The Pearson Product Moment Correlation Coefficients reported for each group in Tables 8, 9, and 10 provide evidence relative to which criterion variables influence an individual's strategical observations of field hockey game play. It is clear that the influential variables are different and are dependent upon group classification. The comparison of the coach and club groups is interesting. Although playing experience seems to be reflected in on the ball observations for both groups, this same variable contributed to observation of spatial relationships for the coach group only. These statistics fail to support the commonly accepted notion that spatial awareness instinctively ensues as a result of playing field hockey. Apparently, it is those experiences and

related knowledges associated with coaching which account for an increased awareness of spatial relationships within the context of game play for the coach group.

It is encouraging to note that knowledge of game strategy was a significant contributor to observation of spatial relationships and off the ball observations for the college group. Apparently, the significance of the spatial concept in game play as well as an awareness of players away from the ball has been stressed in the instructional process with this specific group of individuals. The value of simultaneously available practical experiences can only be surmised; the dual emphasis of theoretical principles and functional learning experiences would seem to be of inestimable assistance in learning to observe strategical elements of game play.

The inconsequence of visual perception, as measured in this study, in observing game strategy warrants comment. The mean scores for all groups on the GEFT indicated that field-independence prevailed. According to the literature, this visual attribute should have contributed to one's ability to analyze the game situation. The negative results may be attributed to the fact that the GEFT is a static-type test, whereas, game play is essentially movement-oriented. Dynamic play situations may necessitate a completely different set of visual operations compared to static situations. On the other hand, it may be contended that although one may have visually processed a situation, other factors may have precluded a critical analysis of the

environment. Further, the validity of the GEFT as a research instrument can be questioned on the basis of lack of extensive validation data.

Factor Identification

Factor analysis of the data for this study produced three factors, each defining a set of highly correlated variables. The spatiality factor supports the notion that the focal point of strategic game play in field hockey is wise use of space; that is, the utilization of already existing space, the creation of new space, and the closing of space. The degree to which an individual or team controls or takes advantage of spatial arrangements determines the effectiveness of game play. Structuring the elements of field hockey strategy within the concept of space has implications for coaching as well as for observational learning. Ultimately, such an approach may serve to increase coaching competency.

Player patterns, that is the maneuvering of the line and backfield players as a unit, make an important contribution to game play. The inherent complementary nature of game play in field hockey necessitates a recognition of player patterns or movements both immediately concerned with the ball as well as action away from the ball. Although individual players have clearly defined functions, it is the collective operation of units of players, their anticipatory actions, and positioning relative to the available spaces which contributes to the final effectiveness of team

play. Focusing on units which comprise the whole is deemed a significant process of involvement in coaching field hockey.

Situation plays are distinctly separate parts of the game in which play is momentarily static and concentration can be directed to both on and off the ball observations at the same time. A directed focus of attention provides a structured framework and enhances observational learning.

Consideration of the three identified factors as the essential components of field hockey game play suggests alternative approaches to coaching field hockey. Viewing the game innovatively may necessitate the utilization of spatial arrangements both individually and cooperatively in a more flexible manner. A less structured but precisely planned learning environment may generate creative movements and patterns of movements ultimately resulting in more effective game play.

Further, these factors have potentially practical implications in terms of developing diverse observational techniques. Viewing strategical elements of game play from the perspective of spatiality, player patterns, and situation plays identifies a specific framework of observational focus. By structuring within these concepts the complexity of total game play is substantially diminished. It is the gradual assimilation of significant concepts and the specifying of a focal point of attention which contributes to maximal observational learning. Improved observational abilities may result in the ultimate realization of increased coaching competency.

Summary

Coaching any team sport is inherently a complex task. Comprehension of the innumerable aspects involved necessitates an education which emphasizes more than the organization of practice sessions, the psychology of coaching, and the selection of players at each position. Although these are vitally important, of equal significance is the acquisition of abilities to observe effectively and efficiently a game situation and to analyze the critical elements of game play. These abilities will not automatically accrue as a result of playing field hockey; knowledge, as well as opportunities for application must be specifically planned and structured within the educational process.

If coaching and selecting experiences enhance observational abilities, as indicated in this study, then the inclusion of such experiences in the professional preparation of coaches is warranted. As Macheath (1969:78) has so aptly said: "A good coach does not suddenly appear. She has developed over a considerable period of time and she has increased her experiences in all aspects of the game. . . ." It is contended by the investigator that this "considerable period of time" can be significantly reduced through the incorporation of practical and functional learning experiences in college coaching courses.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

SUMMARY

This study investigated the frequency of different types of field hockey strategy observed by coaches, club players, and college players and examined the relationship of these strategic observations to experience, knowledge of game strategy, and visual perception.

A total of 44 subjects selected from participants at the Mount Pocono Field Hockey Conference viewed two eight minute sequences of a filmed field hockey match. Their comments were recorded on audiotape and subsequently transcribed onto a Master Code Chart by the investigator utilizing broad categories of strategical elements of the game of field hockey.

The BMDO7M Computer Program was utilized to compute a multiple discriminant function analysis on the data. This statistical technique identified those variables which contributed to the discrimination of the three groups of field hockey personnel. It also compared pairs of group means and classified subjects into specific groups considering all variables collectively and separately.

The TSAR Computer Program was used to compute univariate F's on all variables. Significant F ratios were submitted to the

Scheffé test to determine the direction of differences between the group means.

The TSAR Computer Program was further utilized to compute a Pearson Product Moment Correlation Coefficient to determine the relationship between the criterion and predictor variables for each group. The t distribution for a two-tailed test was used to test the significance of the correlations.

Finally, to determine underlying patterns and interrelationships among the variables, the data were factor analyzed utilizing the SPSS Computer Program. The varimax rotation method provided maximal factor loadings for each variable; specific factors relative to this study were derived from these statistics.

Coaching experience and knowledge of game strategy were found to be the most discriminating variables among the groups. Classification of subjects at each step of the discriminant function analysis and in the final summary indicated that distinctive groups; namely, coaches, club players, and college players could be identified on the basis of the variables utilized in this study.

Univariate F tests indicated that there were significant differences among the groups with respect to three criterion variables; namely, coaching experience, playing experience, and knowledge of game strategy. The groups were also significantly different relative to three predictor variables; that is, spatial relationships, on the ball, and off the ball observations. Further statistical analysis of the data revealed more explicitly the

direction of these differences: (1) the coach group was significantly different from the college group on all variables (coaching experience was not applicable to the college group), (2) the coach group was significantly different from the club group on coaching experience, knowledge of game strategy, and spatial relationships observations, and (3) the club and college groups were not significantly different from each other on any of the measured variables.

Correlation coefficients for each group indicated the criterion variables which influenced the types of observations made by the various classes of field hockey personnel. Coaching experience and playing experience were significantly correlated with spatial relationships observations for the coach group. Further, playing experience was significantly correlated with on the ball observations; selecting experience was correlated with total offense-defense observations. The single significant correlation of variables in the club group was between playing experience and on the ball observations. Knowledge of game strategy was a significant factor in both spatial relationships and off the ball observations for the college group.

Three factors emerged as a result of factor analysis of the data for this study. The first factor was identified as a spatiality factor, intimately related to experience and knowledge with specific reference to both on and off the ball observations. The extremely high loading on total offense-defense on Factor 2 led to the identification of this factor as

player patterns, the maneuvering of units of individuals within the game situation both on and off the ball. A distinctly separate part of the game can be associated with the third factor; that is, situation plays, representing momentary static involvement within the context of the game. Herein, focus on the ball is a primary consideration.

This factor analysis procedure represented an initial attempt to determine highly correlated variables in field hockey game play and to project possible alternative modes of viewing the game within the context of both the coaching and observing processes. The task of evolving innovative approaches necessitates further reflection and study.

CONCLUSIONS

Within the limitations of this investigation and from the analysis of the data the following conclusions seem appropriate:

1. Distinctive groups of field hockey personnel, namely, coaches, club players, and college players can be identified on the basis of the variables utilized in this study. College and club players, as groups, exhibit similarity with respect to field hockey experiences, knowledge, and observation of game strategy. Coaches, on the other hand, can be clearly differentiated from either of these two groups although a greater variation exists among individual members of this group.

2. Coaching experience and knowledge of game strategy are significant contributing factors both in the discrimination of the groups and in the types of field hockey strategies observed.

3. The components of field hockey game play can be definitively described in terms of three factors; namely, spatiality, player patterns, and situation plays.

The following questions can be conclusively answered on the basis of the findings in this study:

1. What types of strategies are observed in viewing a field hockey game?

a. Coaches, as a group, observe spatial relationships and on and off the ball to a significantly greater degree than the college group. This fact can be attributed to distinct differences in coaching and playing experience and knowledge of game strategy.

b. Coaches, as a group, observe spatial relationships significantly more than club players. Significant differences in coaching experiences and knowledge of game strategy are influential factors in this finding.

c. Club and college players are not significantly different with respect to observation of game strategy in field hockey.

2. What are some of the variables that may influence an individual's observation of game strategy?

a. Experience in coaching, playing, and selecting are significant factors in the coaches' observation of spatial relationships, total offense-defense observations, and on the ball situations.

b. Playing experience is a significant factor with respect to on the ball observations by the club players.

c. Knowledge of game strategy is a significant factor in spatial relationships and off the ball observations by the college players.

d. Visual perception, as measured in this study, is not a significant factor in observing game strategy in field hockey.

In addition, the following proposed questions relative to implications of the above findings can be answered:

1. What implications can be drawn from the observations of game strategy made by the various classes of individuals?

a. An expansion of practical experiences provided at the college level is warranted to facilitate observation of spatial relationships and action away from the ball in a game situation.

b. Continued emphasis on spatial relationships and off the ball observations through effective coaching at the club level may improve the observational abilities of players.

c. A system of identifying and assessing effective coaching behaviors would serve to increase the competency of all coaches.

2. What implications can be drawn for coaching field hockey and for educating coaches in observational techniques?

a. A consideration of alternative approaches to coaching field hockey is warranted on the basis of the factors identified in this study.

b. Early exposure to experiences which involve the observation of strategical elements of field hockey game play structured within the identified concepts of spatiality, player patterns, and situation plays would appear to be particularly valuable in educating prospective coaches.

c. Learning experiences which employ diverse observational strategies with a specific observational focus would serve to increase observational abilities and ultimately coaching competency.

RECOMMENDATIONS

On the basis of the results of this study, the following recommendations should be considered:

1. A similar study should be conducted utilizing a live game situation. Viewing the game within the total environmental setting represents a different perspective both visually and from the standpoint of external stimuli. Expanded knowledge relative to game strategy observation may be gained from such a study.

2. Subsequent research is needed to confirm the present study. Extending the investigation to include a larger number of subjects and specifically identifying top level coaches, club and college players would provide valuable related information.

3. Further study should investigate the validity of instructional methodologies which employ the factors identified in this study.

4. Research should be designed to investigate the relationship of game strategy observation to field hockey playing abilities.

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APPENDIX A

Film Processing Information

PHOTOGRAPHIC RESEARCH EXPOSURE DATA . . . . 1 of 2 .

PROJECT ID #	Field Hockey				
EXPOSURE #					
DATE	18 Nov. 1972				
TIME: 0-2400	01145				
FILM FORMAT					
EMULSION	7242				
ASA RATING	80				
CAMERA MODEL	Arri BL				
LENS MAKE-F & f	Zeiss				
EXP. APERTURE	f. 22				
SHUTTER-TP & SP	1/48				
FILTER & FACTOR	85A				
LENS-SUBJ. DIST.	inf.				
ILLUMINATION...	sun				
...APPLICATION					
LIGHT METER MDL.	Spectra Combi. 500				
INCID. or REFLEC.	incid.				
METER READING	16/22				

JRN-SFVSC-PE545-FS69

PHOTOGRAPHIC RESEARCH PROCESSING DATA . . . 2 of 2 .

PROJECT ID #	Field Hockey				
EXPOSURE #	N/A				
FILM DEV. & PRO.	N/A				
DEV. TIME/TEMP.	2:30 min 110°				
STOPBATH T/T	:45				
ACID-HARD T/T	N/A				
HYPO-CLEAR ?	N/A				
WASHING TIME	1:00 min each tank				
DRY PROCEDURE	110° 70% humidity 3:00 dry time				
PAPER/CONTRAST	N/A				
PROJ. LENS F-f	50 mm F 1.6				
PRINTING APERT.	N/A				
PROJ. FORMAT	N/A				
PRINT DEV. T/T	N/A				
STOPBATH T/T	N/A				
ACID-HARD T/T	N/A				
WASHING TIME	N/A				
FINISH MAT/GLOS	N/A				

JRN-SFVSC-PE545-FS69

APPENDIX B

Master Code Chart and Samples of Items in Chart Categories

MASTER CODE CHART (MCC)

DEFENSE

SPATIAL RELATIONSHIPS																		
PLAYER RECOGNITION										SPACE RECOGNITION								
	Marking Position Left-Rt	Marking Depth	Covering Angle	Backing Depth	Holding Ball					Clearing to Space	Clearing to Player	Covering Depth						
LH																		
CH																		
RH																		
LB																		
RB																		
G																		

TOTAL DEFENSE PLAY						SITUATION PLAYS				STRATEGIC THEORY			SKILL ANALYSIS		OTHER
	Fullbacks Square	Halves Depth	General Position	General Play		Free Hit Placement Position	Corner Rush Mark	Roll-In Marking	Bully	Position Play					

MASTER CODE CHART (MCC)

OFFENSE

SPATIAL RELATIONSHIPS												
PLAYER RECOGNITION							SPACE RECOGNITION					
	Team-mate with Ball	Team-mate without Ball	Ball	Own Defense	Rushing	Shoot-ing	Cutting for Ball	Late Early Cut	Flat Pass	Through Pass		
LW												
LI												
CF												
RI												
RW												

TOTAL OFFENSE PLAY					SITUATION PLAYS				STRATETIC THEORY			SKILL ANALYSIS		OTHER
	General Position	General Play	Inter-chg.	Cross Field Pass	Free Hit Cutting Marking	Corner Quick Shot-Rush	Roll-in Position Cutting	Bully	Position Play					

SAMPLES OF ITEMS IN THE SPECIFIC
MASTER CODE CHART CATEGORIES

I. Spatial Relationships

A. Player Recognition

1. Teammate with the Ball: the left inner has drawn away from her center forward in order to make a space for the ball to be passed into.

2. Own Defense: the center forward is too close to her own center halfback; she should be ahead for the pass.

3. Ball: the left inner should have held the ball in order to draw the defense.

B. Space Recognition

1. Flat Pass: since the right wing was not marked, the pass should have been placed closer to her stick.

2. Cutting: a nice backward cut was made by the right inner to receive the ball that was passed in front of her opposing left inner.

II. Total Offensive and Defensive Play

1. General Positioning: the forward line should be spaced out on the field more in order to spread the defense.

2. General Positioning: the fullbacks are playing square; the left fullback should be well up with the play.

3. General Play: the defense is marking tightly in the circle.

III. Situation Play

1. Free Hit: the center forward should have cut away from the center of the field to receive the free hit or to make a space for the ball to be passed into.

IV. Strategic Theory:

1. Position Play: The right fullback tackled the left wing; she should have been taken by the right halfback.

V. Skill Analysis

1. Body Positioning: the center halfback does not get her feet and body around on her tackles but rather lunges for the ball.

APPENDIX C

Questionnaire

QUESTIONNAIRE TO SUBJECTS

Name _____

Home Address _____

_____

Please answer all the questions in reference to Field Hockey.

1. Which of the following categories currently applies to you? (Check each appropriate item)

   _____ Coach _____Club Player _____College Player

2. How many years have you coached Field Hockey? _____ years.

3. How many years have you played Field Hockey? _____ high school

   _____ college

   _____ club

4. How many years have you attended a Field Hockey camp as a player? _____ years.

5. How many years have you served on a selection committee? _____ years.

6. Are you primarily an offensive or a defensive player?

   (check) ___ offensive ___ defensive _____
   (Please indicate position)

Do you desire a copy of the results of this study? ___ yes

___ no

Research Study - Margarite Arrighi
Mt. Pocono Hockey Conference
August, 1973

APPENDIX D

Knowledge Test

FIELD HOCKEY KNOWLEDGE TEST

MULTIPLE CHOICE: Select the best answer and place it on the appropriate line on your answer sheet. If you do not know the answer use foil (e) rather than guessing.

1. What should the right wing do after she has passed to the inner?
   a. continue down the field on a line with the ball
   b. follow the ball to be sure it reaches the inner
   c. stop to see what the inner is going to do next
   d. move in and block out the fullback for the inner
   e. do not know

2. The center halfback is taking a free hit just outside the striking circle at her offensive end of the field. The forwards are all closely marked. What should the halfback do?
   a. dribble in to shoot
   b. drive hard toward goal
   c. drive to the inner
   d. flick into a space
   e. do not know

3. The left halfback rushes the opposing right inner who is receiving the hit on a short corner. What should the fullback do?
   a. cover the space behind the halfback
   b. go to cover on the other side
   c. move over to mark the wing
   d. move to the cage to help the goalkeeper
   e. do not know

4. What is the position of the fullbacks when RI has the ball at her offensive 25 yard line?
   a. the right fullback is on the inner and the left fullback is back
   b. the left fullback is on the inner and the right fullback is back
   c. both fullbacks are marking
   d. both fullbacks are back covering
   e. do not know

5. Who should take the free hits near the attacking goal line? Why?
   a. the wings so that the halfbacks are not pulled out of position.
   b. the wings so that the hit can be taken quicker
   c. the halfbacks so that the forwards can be ahead and ready to shoot for goal

(continued)

d. the halfbacks so that they can follow their normal pattern and avoid confusion
e. do not know

6. Marking is a technique which is best described by which one of the following statements?
   a. marking takes place in the circle by the defensive players who are in a position to prevent a shot or the receiving of the ball by the offensive player
   b. marking means the inners guard the fullbacks between those fullbacks and the goal they are attacking
   c. marking position should be closest at the 50 yard line with the "depth" of position toward their defensive goal
   d. marking is an offensive technique designed to pull the defense away from the goal area
   e. do not know

7. Which of the following best describes close marking?
   a. being on the ball side of the opponent and near enough to prevent her from getting the ball
   b. being between the opponent and the goal she is attacking
   c. tackling your opponent in the striking circle
   d. positioning oneself in a space in order to intercept the ball
   e. do not know

8. Which of the following is absolutely not true concerning a play beginning with a corner hit to the inner?
   a. the inner stops the ball and shoots for goal
   b. the fullback or side halfback rushes out to mark the inner
   c. the center half drops behind the fullback
   d. the center forward rushes the goal after the shot
   e. do not know

9. In which of the following situations does the right halfback "cover" the area near the left inner?
   a. when the right fullback has been passed at the 50 yard line
   b. when the ball is on the opposite side of the field and the LI is at her attacking 25 yard line
   c. when in the defensive circle only
   d. when in the attacking half of the field only
   e. do not know

10. A free hit is taken by the red right fullback at the 50 yard line. Which of the following statements is true?
    a. the red right halfback should be out toward the wing and up ahead of the play
    b. the red left fullback should be beside the red right fullback
    c. the red halfbacks should be beside or behind the red right fullback and in their position area
    d. the blue forward line should be behind the red right fullback
    e. do not know

11. Which of the following is good strategy on a roll-in when near your defensive goal?
    a. wing rolls to the near inner or halfback
    b. halfback rolls to fullback who is opposite her
    c. halfback rolls directly up the wide line to the wing or inner
    d. halfback rolls to center forward across the field
    e. do not know

12. Which of the following statements is <u>not</u> true?
    a. a pass is better than a dodge as a means of moving the ball
    b. on a shot by the LI, the right side of the line should wait for the goalie to clear the ball
    c. tackling back is an important tactic for forwards especially when the backs are hard pressed
    d. clearing is an important defensive tactic for fullbacks when near the defensive goal
    e. do not know

13. When does the covering fullback take a free forward coming in alone to shoot?
    a. as soon as the forward breaks free from her defensive player
    b. never, but rather allows the goalkeeper to come out to meet her
    c. at the 25 yard line at all times
    d. just before the forward gets to the edge of the circle
    e. do not know

14. Which of the following is <u>not</u> good strategy for forward line players?
    a. aim for the corners of the goal cage, especially to the goalie's left
    b. use flat passes in the circle when free to shoot
    c. pass from the wing to the center of the field when near the attacking goal
    d. shoot at the edge of the circle and rush all shots
    e. do not know

15. Which of the following is not good strategy for the goalkeeper?
    a. come to meet the free forward to reduce the possible angle for scoring
    b. stay slightly to the left of center when the center forward is approaching with the ball
    c. use the stick to clear all shots on the right side
    d. control the ball with the feet and use a kick clear to the space
    e. do not know

16. The RED RW has the ball at mid-field. What would be the correct positioning of the Blue halfbacks?
    a. LH tackling the RW, CH marking the CF, RH marking the LW
    b. LH tackling the RW, CH marking the CF, RH covering deep opposite the LI
    c. LH tackling the RW, CH covering the CF, RH covering the LW
    d. LH tackling the RW, CH covering near the CF, RH covering deep opposite the LI
    e. do not know

17. The LW dribbles down the alley and passes her opposing RH at mid-field. What should the remaining defense players do?
    a. the closest defense player should tackle the LW immediately
    b. the covering back moves up to tackle the LW at the 25 yd. line
    c. the RH is allowed to recover; otherwise, the covering back tackles the LW at the edge of the circle
    d. the RB moves over to tackle and the CH moves over to mark the LI
    e. do not know.

18. Which of the following would not be considered an important offensive tactic?
    a. making a space by pulling away from your teammate who has the ball
    b. using a straight through pass into a space
    c. using square passes when your teammate is closely marked
    d. dribbling in order to draw the opponent and then passing or dodging
    e. do not know

19. What is the advantage of forwards using the "W" formation in the defensive striking circle?
    a. the ball can be passed out to a fast wing or through the CF up field for a quick breakaway

(continued)

b. it brings the wings back to help defend with a possible breakaway by the inner
c. it prevents the CH from shooting by keeping the defensive CF on the edge of the circle
d. the ball can be passed to the right inner or wing who can clear across the field
e. do not know

20. Which of the following is not a true statement?
a. covering is a means of preventing through passes
b. marking is a means of preventing square passes
c. when the ball is in the Red defensive striking circle, all Red defense players should mark
d. fullbacks should always avoid playing "square"
e. do not know

21. The right wing has the ball three feet from her offensive end line. Which of the following would be the best move?
a. drive the ball back to the edge of the striking circle
b. give a short push pass to the right inner
c. hit the ball back to the right halfback
d. either a or c could be correct depending on the position of the opponents
e. do not know

22. The left fullback has been left behind and the opposing right inner is approaching the striking circle with the ball. Who should go to tackle the right inner?
a. the center halfback
b. the left halfback
c. the right fullback
d. the left inner
e. do not know

23. The center forward makes a through pass directly in front of her intended for the left inner. Which of the following actions should take place?
a. the center forward should hang back to make room for the left inner who is cutting to get the ball
b. the center forward should go after the ball and then tap it over to the left inner's position
c. the left inner should cut to get the ball and the center forward should move into the left inner's position
d. the center forward should run on a diagonal to the left to make room for the left inner who is cutting for the ball
e. do not know

24. What should a forward do as soon as she loses the ball to her opponent?
    a. cut toward the center of the field to make a space
    b. rush ahead to be ready for a pass from her defense
    c. tackle back immediately and try to regain the ball
    d. hang back and try to intercept a pass from her opponent
    e. do not know

25. A lone right inner is dribbling down the field just outside the alley line having passed all of the defense. What would be the best action for the goalie to take?
    a. rush the forward as she comes into the circle
    b. rush the forward just outside the circle
    c. wait about three or four feet in front of the center of the goal
    d. wait about one or two feet in front of the right corner of the goal
    e. do not know

APPENDIX E

Letters to Camp Director, Coaches,
Club Players, and College Teams

January 22, 1973

Miss Ethlyn Davis
Mt. Pocono Hockey Conference
426 Wildwood Avenue
Pitman, New Jersey 08071

Dear Ethlyn:

I am currently involved in a research endeavor related to field hockey as part of my doctoral work at The University of North Carolina, Greensboro. In this regard, I should like to request your permission to collect data at the Mt. Pocono Hockey Conference in August, 1973.

Very briefly, I am interested in investigating the observation of game strategy in field hockey utilizing different individuals with various levels of experience including coaches, club, and college players. It is my hope that the results of this research effort will eventually assist in the training of coaches and/or selectors in observational techniques, thus producing more effective coaches and/or selectors.

Presently, plans for my research project include the utilization of a twenty-five (25) minute game film and will involve approximately fifty (50) individuals selected at random from persons at your camp. The tests to be administered should take about 1-1½ hours and would be conducted at a time which would be amenable to your camp schedule.

Your consideration of this request at your earliest possible convenience would be very much appreciated in order that I may continue to pursue my plans for the collection of data. If I can provide any further necessary information, please let me know.

Sincerely,

Margarite A. Arrighi

MAA:hm

UNIVERSITY OF MARYLAND
College of Physical Education, Recreation and Health
College Park 20742

Department of Physical Education

April 30, 1973

Dear

With the kind permission of Miss Ethlyn Davis, I will be conducting a research project at the Mount Pocono Hockey Conference as part of my doctoral program at The University of North Carolina at Greensboro. It is my understanding that you will be coaching at the Hockey Conference the week of August 21-28. At this time I am soliciting your cooperation as a participant in this project.

Very briefly, through my research I am seeking to determine the nature of observations of field hockey strategy; that is, what are the kinds and amounts of strategy that are observed by various individuals and what is the relationship to knowledge, visual perception, and experience. Hopefully, the answers to these questions will provide some impetus to the future training of field hockey coaches.

Participation in the project would involve the taking of a knowledge test, a perception test, and the viewing of 16 minutes of film while simultaneously recording observations on a tape recorder. The approximate total amount of time involved is one hour and fifteen minutes to be arranged at a time which would be amenable to the camp schedule.

I would appreciate it very much if you would return the enclosed postcard airletter to me indicating your willingness to participate in this project. You will receive further information from me upon your arrival at hockey camp. Thank you very much for your assistance.

Sincerely,

Margarite A. Arrighi

Dr. Kate R. Barrett
Dissertation Advisor

UNIVERSITY OF MARYLAND
College of Physical Education, Recreation and Health
College Park 20742

Department of Physical Education

June 12, 1973

Dear

With the kind permission of Miss Ethlyn Davis, I will be conducting a research project at the Mount Pocono Hockey Conference as part of my doctoral program at The University of North Carolina at Greensboro. It is my understanding that you will be attending the Hockey Conference as a club player the week of August 21-28. At this time, I am soliciting your cooperation as a participant in this project.

Very briefly, through my research I am seeking to determine the nature of observations of field hockey strategy; that is, what are the kinds and amounts of strategy that are observed by various individuals and what is the relationship to knowledge, visual perception, and experience. Hopefully, the answers to these questions will provide some impetus to the future training of field hockey coaches.

Participation in the project would involve the taking of a knowledge test, a perception test, and the viewing of 16 minutes of film while simultaneously recording observations on a tape recorder. The approximate total amount of time involved is one hour and fifteen minutes to be arranged at a time which would be amenable to the camp schedule.

I would appreciate it very much if you would return the enclosed postcard to me indicating your willingness to participate in this project. You will receive further information from me upon your arrival at hockey camp. Thank you very much for your assistance.

Sincerely,

Margarite A. Arrighi

Dr. Kate R. Barrett
Dissertation Advisor

UNIVERSITY OF MARYLAND
College of Physical Education, Recreation and Health
College Park 20742

Department of Physical Education

April 16, 1973

Dear

With the kind permission of Miss Ethlyn Davis, I will be conducting a research project at the Mount Pocono Hockey Conference as part of my doctor program at The University of North Carolina at Greensboro. It is my understanding that the team will be attending the Hockey Conference the week of August 21-28. At this time I am soliciting your assistance in securing the names of players who might be willing to participate in this project and in informing them of my intentions.

Very briefly, through my research I am seeking to determine the nature of observations of field hockey strategy; that is, what are the kinds and amounts of strategy that are observed by various individuals and what is the relationship to knowledge, visual perception, and experience. Hopefully the answers to these questions will provide some impetus to the future training of field hockey coaches.

Participation in the project would involve the taking of a knowledge test, a perception test, and the viewing of 16 minutes of film while simultaneously recording observations on a tape recorder. The approximate total amount of time involved is one hour and fifteen minutes to be arranged at a time which would be amenable to the camp schedule. Subjects must have at least two years of playing experience at the college level.

If possible, I would appreciate your securing a temporary commitment from your players by sending their names to me in the enclosed envelope. They will receive further information from me upon their arrival at hockey camp. Thank you very much for your assistance.

Sincerely,

Margarite A. Arrighi

Dr. Kate Barrett
Dissertation Advisor

APPENDIX F

Directions for Film Viewing

Research Study - Margarite Arrighi
Mt. Pocono Hockey Conference
August, 1973

PLEASE READ BEFORE VIEWING FILM

The purpose of this experiment is to investigate the different types of field hockey strategy that are observed by individuals with various modes of field hockey experience and also to examine the relationship of these observations to knowledge of the game, experience, and visual perception.

You will view two eight minute sequences of color film of sectional level play. Your task is to comment on points of strategy on the tape recorder while simultaneously viewing the film.

Because of the nature of the study, the game has been filmed to produce a visual image which is as close as possible to an accurate record as viewed by the naked eye. For this reason the use of a zoom lens has been avoided and an attempt has been made to present full field coverage. Due to these factors, there will be occasions when the ball will be difficult to observe or the play will be at such a distance to make it impossible to make accurate observations. Do not be disturbed by these incidental occasions. Continue your comments as best you can.

Directions to Subjects

To begin, you will view a two-minute practice film. Please read the directions below and attempt to follow these in preparation for the two eight-minute sequences.

1. Place the greatest amount of emphasis on strategical observations rather than skill analysis.
2. Be aware of the following points in your observations:
   (a) individual performance
   (b) team performance
   (c) fixed situation plays, i.e., corners, free hits, etc.
3. Identify the player by color and position, where possible. Example: "The Red center forward cut to receive the ball."
4. Preface fixed situation plays with the type of play. Example: "Red free hit . . . ."

In the first sequence the teams will be moving in the same direction as in the practice film. The team colors and location of the camera will be the same throughout the entire film. The tape recorder will be turned on for you. Please allow it to continue recording throughout your total film observation period.

APPENDIX G

Raw Data and Canonical Variables
Evaluated at Group Means
(Table 13)

RAW DATA

Coach Group
Years of Experience, Knowledge and Visual Perception Test
Scores, and Frequencies of Observations Recorded

Subject	Coaching Experience	Playing Experience	Selecting Experience	Knowledge	Visual Perception	Spatial Relation-ships	Total Offense-Defense	Situation Plays	Strategic Theory	Skill Analysis	On the Ball	Off the Ball	Unrelated
1	4	9	0	23	15	20	15	18	0	0	39	17	11
2	11	19	2	24	14	37	4	7	2	2	28	22	16
3	16	24	6	22	10	33	6	0	0	0	21	14	1
4	10	20	3	22	2	22	1	14	0	0	36	0	31
5	12	11	3	22	9	18	9	16	1	4	29	15	11
6	4	10	0	23	17	5	8	2	1	0	11	5	2
7	5	2	2	18	9	10	10	8	0	0	18	9	16
8	20	19	9	23	8	45	29	3	0	2	37	35	2
9	3	10	0	22	14	19	3	18	0	4	25	15	4
10	14	19	0	22	12	55	7	14	0	0	35	38	4
11	6	7	1	23	8	25	6	11	0	1	26	16	1
12	2	4	0	23	11	8	6	7	0	0	9	12	0
13	4	3	0	15	10	16	5	5	0	4	11	9	22
14	18	1	0	20	9	7	7	3	1	0	9	10	3

RAW DATA

Club Group
Years of Experience, Knowledge and Visual Perception Test
Scores, and Frequencies of Observations Recorded

Subject	Coaching Experience	Playing Experience	Selecting Experience	Knowledge	Visual Perception	Spatial Relation-ships	Total Offense-Defense	Situation Plays	Strategic Theory	Skill Analysis	On the Ball	Off the Ball	Unrelated
1	0	3	0	23	16	7	8	5	1	4	6	1	19
2	1	18	6	21	12	22	11	14	0	3	26	14	18
3	0	13	0	23	13	13	5	16	0	0	23	11	17
4	0	9	1	19	17	7	14	13	0	3	22	14	5
5	1	5	0	21	17	3	0	6	0	1	8	0	2
6	0	8	0	21	7	5	0	6	0	0	11	0	7
7	0	7	1	20	9	9	4	10	1	2	16	9	10
8	0	6	0	22	16	17	0	8	0	0	14	7	1
9	2	9	1	24	16	25	8	7	2	2	22	20	21
10	0	7	0	24	14	4	5	5	4	0	10	4	11
11	1	9	0	20	16	18	9	11	0	1	16	22	3
12	0	14	1	22	5	16	2	3	0	1	17	4	18
13	0	7	0	22	18	21	2	14	6	0	24	18	18
14	1	22	7	23	13	20	6	7	1	0	17	17	4

RAW DATA

College Group
Years of Experience, Knowledge and Visual Perception Test Scores, and Frequencies of Observations Recorded

Subject	Coaching Experience	Playing Experience	Selecting Experience	Knowledge	Visual Perception	Spatial Relationships	Total Offense-Defense	Situation Plays	Strategic Theory	Skill Analysis	On the Ball	Off the Ball	Unrelated
1	0	9	0	17	3	3	2	6	1	0	4	5	3
2	0	3	0	20	17	13	1	16	2	0	14	15	48
3	0	6	0	17	12	9	10	21	1	3	33	8	8
4	0	5	0	20	5	3	1	0	1	0	1	3	4
5	0	6	0	18	11	10	5	11	2	0	21	11	11
6	0	6	0	18	16	6	12	13	0	1	26	5	16
7	0	5	0	18	7	8	9	8	0	2	18	5	6
8	0	5	0	13	15	0	0	0	0	0	0	0	2
9	0	4	0	17	16	8	1	4	0	0	10	2	42
10	0	7	0	16	12	4	3	7	1	1	13	0	29
11	0	4	0	20	16	10	6	5	1	0	13	7	35
12	0	7	0	21	11	4	1	5	2	0	11	1	4
13	0	2	0	22	9	21	4	12	0	2	25	12	40
14	0	7	0	22	7	23	9	18	0	0	31	13	6
15	0	3	0	17	14	11	4	11	5	1	17	7	4
16	0	2	0	20	12	3	5	4	0	0	9	2	10

TABLE 13

Canonical Variables Evaluated
at Group Means

Group	Variable 1	Variable 2
Coach	-2.11148	0.25136
Club	0.63229	-1.29316
College	1.29430	0.91157