

CENTRE FOR SPORT AND EXERCISE SCIENCES

NOTATIONAL ANALYSIS LABORATORY

In 1986 Liverpool Polytechnic hosted the First World Congress of Science in Football. During the course of the conference a very successful series of workshops in notational analysis were held in the basement of the Mountford Building. The room in which these workshops were held was the new laboratory for notational analysis and this was the first time that it had been used. Although considerable amounts of notational analysis were and had already taking place in the department, this was the first time that we had a base specifically for this work alone. As the academic years have passed more and more students have become involved in notation work. The contribution to the undergraduate body of the sport science degree by this subject area has also grown each year, and this has been reflected by similar growths at other institutions teaching sports degrees. In December 1989 the laboratory moved into a larger and better suited room nearby in the same building.

The time seemed appropriate to reflect on the work done over the past seven years. I decided to make a permanent record of these reflections and at the same time provide a mechanism whereby this information could be shared not only within the School of Health Sciences, or indeed the Polytechnic, but also with anyone within the fields of sports science or coaching who might find it useful.

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6.2.90.

What is notational analysis?

Paralleling the growth of interest in coaching there has been a noticeable increase in the presentation of "match facts" in the media over the past few years, ranging from basic tables of soccer goalscorers in the newspapers to complex match analysis in American football presentations on television. Popular statistics can be useful to coaches, but more often than not they give an over-simplified picture which can be misleading. A notational analysis system enables the comprehensive recording of all the pertinent details of a match - all the actions, outcomes, where they happened and which players were involved. These systems are most effective when designed in conjunction with the coach who is going to benefit from the analysis. The system must be accurate and objective, and its use must be refined in match settings.

Why do coaches need notational analysis?

Coaching is a deliberate act of intervention in sport with the intention of improving performance. Most coaches observe their athletes in performance and then provide feedback to modify that performance. In most competitive sports, in particular team sports and racket sports, the amount of information to absorb, analyse and process is vast. The human eye-brain system is an unrivalled device for reasoning and problem-solving but it is unfortunately limited in its capacity for observation and recall. For example, research on memory capacity among top coaches (in Canada) showed that 70% of what the coaches recalled was wrong.

Because of the limitations of eyes, ears, attention span, concentration and memory, it is difficult for the coach to observe a match accurately and objectively. The quality of both watching and analysing is crucial to the success of the coaching process. Not only must match information be comprehensively stored, but it should also be compiled as objectively as possible. For a host of reasons, it is very easy for unintended bias to effect a coach's appraisal of a performance. In addition, competitors themselves invariably respond best to match records which have been objectively compiled and analysed. Because of these factors, notational analysis evolved.

THE DEVELOPMENT OF NOTATIONAL ANALYSIS IN LIVERPOOL

Although it has existed for centuries, in one form or another, it was in the mid-seventies that real initiatives were made in its development in sport. Even at this stage, Liverpool Polytechnic was leading the field with several

pieces of research that have formed the cornerstones of later work. Reilly and Thomas (1976) examined the work rates of first division soccer players by notating the movements of specific players in the Everton side. Sanderson and Way (1979) evolved a notational analysis system for patterns of shots used in squash. Both these systems have become "templates" for later workers to copy and modify.

On joining the Polytechnic, and specifically the sports science degree, in 1981 I very soon became involved in the then current research and development of the notational analysis. The first step forward was the use of the computer to process the mass of data that the Sanderson and Way system collected (Hughes, 1983). Very soon microcomputers were being taken to the back of squash courts and matches were being recorded "live" into the computer. This enabled considerable research into the patterns of tactics adopted by different standards of squash players (Hughes, 1984, 1985, 1986). At this time the technological developments in computing were very rapid indeed and soon the progressions in notational analysis were reflecting this pace.

Over the next four years notation systems were developed in the labs in Liverpool for a large number of different sports. Most of these were developed in conjunction with leading coaches in the respective disciplines, e.g. soccer - Dick Bate (then North-west development officer for F.A.), hockey - Jenny Cardwell (England Ladies team coach), rugby union - Ian McGeechan (then Scotland coach).

The most important philosophy of the notation laboratory in Liverpool is that these systems cannot replace the coach, their sole function is to make the role of the coach more efficient - in fact they cannot exist without the coach to design and refine the respective systems, and also to interpret the data.

A full list of the sports for which systems have been developed are listed below:-

Squash

Hockey

Basketball

Soccer

Rugby Union

Rugby League

Volleyball

Tennis

Badminton

Dinghy Sailing

Handball

Athletics - middle distance racing

Netball

Lacrosse

The majority of these systems are for analysing actions within the respective sports, with respect to the players executing the actions, their outcomes and where they occur on the pitch. Some, however, are for notating the motions and gaits of players with a view to analysing movements, work rates, fitness and assessing the fitness specificity of these sports.

In addition to creating all these systems, considerable research and developmental work has been completed in the use and refinement of certain aspects of the applications of computers within the field of notational analysis. These can be summarised under the following headings:

Data Input

Although using computers makes data processing easier and immeasurably faster, the use of the normal keyboard, the "QWERTY" keyboard, to enter the data can be both laborious and can also often introduce errors. To reduce the need for fine keyboard skills, Liverpool pioneered the use of the concept keyboard in notation (Hughes and Billingham, 1986; Hughes and Feery, 1986). This is a digitisation pad consisting of 128 programmable cells and acts as an alternative keyboard to enter data into the computer. The concept keyboard enabled quick, accurate data entry without the need for codes or highly developed typing skills.

Another explorative research project examined the possibility of using a voice-interactive system with which to enter the data into the computer (Taylor and Hughes, 1988). Using a combination of commercially produced hardware and software written in the labs, a system was developed that could be used to record the events in a squash match with the

operator talking to the computer. This is an even easier way to enter data into the computer. Because of very limited research funds for this work, the hardware was the simplest on the market. Consequently the system was not fast enough to notate in real time, but it did demonstrate that this method of communication with the computer is a facet of the near future. Hardware systems do exist at this time that would enable real time analysis but currently these are relatively expensive, but prices in electronic technology are dropping all the time.

Data Output

The output from analysis systems have tended to lag behind the recent advances in computer graphics. Recent work (Hughes and McGarry, 1989) has gone some way to addressing this problem. The main thrust of this work was to update the software for analysis of squash and produce three-dimensional graphs of the frequency distributions of the shots. These were in colour and profiles of two players, or sets of data, could be compared on the screen at the same time. In addition the figures could be rotated to obtain the optimum perspective. these routines have now been incorporated into the more recent programmes.

Video Interactive Systems

Current research is being undertaken to integrate video systems with computers so that video-tapes of matches or performances, once analysed, can be controlled by the computer. This means that not only will the computer produce statistics about the most important events and actions in a game, but also it can search through the tape, or disc, to enable instant replays of those events. This is a very useful aid for the coach in relaying the feedback to athletes.

WHERE TO NOW?

Currently systems are being developed in cricket, volleyball and badminton (doubles). Further analysis work is being completed on a comparative analysis of the patterns of play in association football of England and Ireland in their qualifying games in the World Cup. Two research projects in squash are also under way. One is trying to assess the actual impact of this type of detailed feedback to players and the subjective impressions of their coaches. The other is examining the differences in playing patterns as a young

player prepared for the British Open Championships (under 16). In addition a collaborative project in hockey and lacrosse is being undertaken with the National Coaching Centre at Crewe and Alsager. The main bulk of the work from Liverpool's point is to write the programmes for the research and analysis. This is a job that has become very simple to do with all the experience that has been gathered at this laboratory.

All the systems listed above have been used for different research projects, as is demonstrated by the publications list of the laboratory, together with the many invitations for addresses and presentations. Considerable work has been completed in this large number of sports, in particular squash and soccer, but very few systems have been used practically by coaches as aids to their analysis and feedback processes. It is time that this lack of direct practical application of these systems was addressed.

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