

## Performance indicators in table tennis: a review of the literature

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**Abstract:** In the recent scientific literature in the field of sport sciences, research branches on performance analysis are widely developing. Hughes and Bartlett (2002) stated that sport biomechanists and notational analysts are concerned with the analysis and improvement of sport performance. They analyzed the structure of sports, distinguishing: technical, tactical and biomechanical indicators. The aim of this study is to summarize the most important table tennis performance indicators proposed in the literature. The authors commonly divide the performance indicators in different categories:

Player: gender, nationality, height, weight, use of right or left hand, grip (pen holder/classic), style of play (allround, defensive, etc), best ranking and current ranking, etc. Technique: strokes (service, push, top, top counter top, block, flick, drive, smash, lob, forehand or backhand) and steps (one step, chassé, slide, crossover and pivot). Tactic: impact position of the ball on the table (six areas), type of error, efficacy, time-out, play time (inter-serve times, rally time and inter-point time) and action outcome. Equipment, playing conditions and facilities: table, ball, net, floor, size of the gym, training hall, lightning, transports (jet lag), etc.

Performance indicators provide a good tool from a technical and tactical point of view for coaches and performance analysts, to improve training and agonistic results. It is possible to have a full and correct analysis of the data by using a statistical software. However, a lot of problems cannot easily be solved by using statistics, as sport is the complex result of interacting human behaviours.

**Keywords:** performance analysis, performance indicators, table tennis

### 1. INTRODUCTION

In recent scientific research in the field of sport, the area of performance analysis is carving out an increasing area of interest. A thorough bibliographic search allows us to find some books on the subject [1, 2] and some articles in journals dedicated to performance analysis [3, 4, 5, 6]. The majority of authors underlined the importance of analysing performance from a biomechanical point of view and of performance analysis. Hughes and Bartlett [7] analysed the structure of sport, classifying the different types of indicators: technical, tactical and biomechanical. O'Donoghue [8, 9] and Hughes [10] studied match analysis in racket sports and suggested methods for the selection of indicators. Other authors continued the work, elaborating on the methodologies of data collection and analysis [11, 12, 13, 14]. Continuing the study of the literature and entering into the world of table tennis we can find numerous authors who offer softwares and tools for the collection of data [15, 16]. Leser [17] has produced a software for the qualitative analysis of performance in table tennis. The software allows the collection of numerous types of data: type of stroke (service, topspin, forehand or backhand etc.), impact position of the ball on the table, instant of service, moment when the point is finished and type of error (out, net, etc.). It is immediately possible to note that performance analysis in table tennis is large topic, full of aspects that can be studied to improve both training and competitive performance. The objective of this study is to summarise the literature and to identify which of the performance indicators are the most

important in table tennis, to facilitate the work of analysing the performance.

### 2. CATEGORIES

The performance indicators can be classified into different categories: technical, tactical, etc. A thorough review of table tennis literature allows us to identify different categories which can be modified and expanded upon. Most of the authors analyse performance by collecting and analysing the following topics: player, technical indicators, tactical indicators, equipment, environment and playing conditions, psychology, etc.

In the following paragraphs the various topics will be expanded upon and more information will be given on the principal indicators studied in the literature.

#### 2.1. PLAYER

With regard to the characteristics of the player, some studies have been conducted comparing the performance of men and women, to find the differences between the genders [18, 19] and different age groups [20]. Otcheva [21] has compared both men and women but has also distinguished between different nationalities and backgrounds. Yuza [22] has started a study on performance, collecting anthropometric measurements (height and weight) and measuring heart rate during the game. It is important to remember that the authors report on the technique of holding the racket (grip), distinguish the various playing styles of the athletes they are studying [23, 24] and report the ranking of the players.

Summarising the literature, it is possible to collect various pieces of information about the players: name, gender, age, nationality, height, weight, use of right or left hand, grip (pen holder or classic), style of play (offensive, all-round, defensive, etc.), current ranking and best ranking, etc.

## 2.2 TECHNICAL INDICATORS

The fundamental technical aspects in table tennis are: strokes (strokes or shots) and movement (footwork or steps).

### 2.2.1 Strokes or shots

Tepper [25] and Molodtsov [26] have proposed a large and complete classification of the strokes used in table tennis. In their handbooks we can identify: service, push, topspin, topspin counter topspin, block, flick or flip, drive, smash and lob. Some authors have studied the use of strokes during the game to check the difference between forehand and backhand strokes [21, 27].

By summarising the literature it is possible to identify various pieces of information regarding the strokes: type of stroke, distinguishing between forehand and backhand.

### 2.2.2 Footwork or steps

Movement in table tennis is considered to be a very important technical aspect and is often undervalued in the literature. A correct footwork allows an athlete to move quickly in the direction of the ball and therefore allows him to execute the best possible stroke. Some authors have proposed a standard international classification, which could be useful for coaches [25, 26]. Malagoli Lanzoni [28] has classified 5 types of movement, based on the technique executed: one step, chassé, slide step, crossover and pivot. Each movement was given a description and the main phases of play in which they were used were defined. Ak [29] introduced another step, called split step, used mainly in preparation for the return of serve. It is a little hop on the spot, which allows a quicker response and allows the athlete to move faster. Yuza [22] delved more deeply into the performance analysis, studying the position of the player with respect to the table, to evaluate their ability to move.

To sum up the information on movement, we can define: type of movement (split step, one step, chassé, slide step, crossover and pivot), direction of movement and position with respect to the table.

## 2.3 TACTICAL INDICATORS

By analysing the literature on performance analysis we can define various tactical indicators, useful for improving both training and preparation for competition. The authors mainly focused on: efficacy of stroke, type of error, impact position of the ball on the table, play

time, results, etc.

### 2.3.1 Efficacy, type of error and result

Djokic [30], Malagoli Lanzoni [31, 32], Wang [33], Wu Xiao [34] and Zhang [35] have delved into the study of strokes during the game, introducing an important indicator, the efficacy of the stroke and its result. They defined the strokes as: winning, transitional and losing. Some studies [27, 36] focused their attention on the sequence of strokes and on the relationship between the serve and the next stroke. Wu Xiao [36] has also introduced the chance variable (luck) and Leser [17] has suggested the study of type of error: net, out, etc.

To sum up the tactical indicators linked to the stroke we can define: efficacy (strokes: winning, neutral and losing), sequence of strokes, type of error and lucky shots.

### 2.3.2 Impact position of the ball on the table

Some authors consider the study of the area of impact of the ball on the table as an important tactical aspect. If the study of the trajectory and direction of the ball is combined with the study of efficacy and result, we have a powerful tool for tactical analysis. Leser [17, 37], Baca [38] and Kornfeind [39] have studied the equipment and methods needed to detect with precision the impact zone of the ball on the table. Wu Xiao [34] suggests the division of each half of the table in 6 equal parts, 3 close to the net and 3 at the end of the table.

### 2.3.3 Game time

The duration of the phases of play and pauses represents a very interesting field of study and is addressed by various authors, with different objectives. Drianovsky [40] and Yuza [22] considered the number of strokes made during the exchange and measured: inter-serve time, rally time and inter-point time.

Most recently, Katsikadelis, has studied the real time play of games during the Olympic Games in Athens (2004), comparing men and women in the various rounds of the competition. The same author has compared the duration on the action between the Olympic Games in 2004 (Athens) and 2008 (Beijing) to observe the differences [41].

To sum up the performance indicators linked to game time, we can identify: length of exchange (rally time), time between the points, time between the sets, time-out and relationship with the results.

## 2.4 EQUIPMENT

To evaluate a performance, it is important to know which instruments are used during the game, in order to see if a connection exists between the materials used and the result. The International Table Tennis Federation provides, in their handbook 2010-2011 [42], a list of rules which must be followed in the materials

used for the game: table, net, ball, floor, lightning, clothes, dimensions of the hall, etc. It is important that analysts of the performance collect all the pertinent information about the materials of the game and adapt the training conditions to what they will find during the game, in order to gain the best possible results.

## 2.5 ENVIRONMENT AND PLAYING CONDITIONS

Platonov [43] underlined the importance of the environment conditions in the analysis of performance. The author took into consideration the following conditions: climate (hot or cold countries, humidity etc.), geography (transport, jet-lag, etc.), social-cultural (food, religion, etc.). This field of research is very large and should not be undervalued, especially for those athletes who travel a lot and find themselves playing in diverse conditions different from those in which they normally train.

## 2.6 PSYCHOLOGY AND OTHERS

Some authors have focused their attention on the psychological aspects that govern the game and have tried to study the performance from this perspective.

Matytsin [44] has studied the role that the personal characteristics of the players provide in stability and efficacy during the competition.

Sève [45, 46] has tried to observe the link between psychological aspects and the score of the game. Sève [46] has also linked the regulatory aspects to the psychological ones, by submitting a written questionnaire to the athletes at the end of the game (post-match interview).

In conclusion, many researchers selected the important performance indicators both before and after principal rule changes made by the International Federation: score from 21 to 11 [46], diameter of the ball from 38 to 40mm [20, 35, 47].

## 3. CONCLUSIONS

Performance analysis in sport is an excellent way to improve skills in table tennis. Trainers and performance analysts can use match and notational analysis to improve their own knowledge. This represents a useful tool, both from a technical and tactical point of view, for improving the training regime and competitive results. At the start of any research, a correct classification of the most important performance indicators should be established. This review of the literature could be of some use to all technicians involved in table tennis. Experts can have a complete and correct analysis of the data by using statistical softwares. However, a lot of problems cannot easily be solved by using statistics, as sport is the complex result of interacting human behaviours.

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