

THE 7TH ITTF SPORTS SCIENCE CONGRESS
(21st to 23rd April 2001)

The Seventh ITTF Sports Science Congress

Foreword by the ITTF President

Presented by the ITTF Sports Science Committee

cosponsored by

Taiho Pharmaceutical Co. Ltd.

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Theme:

**Role of sports science for developing table tennis with regards to
coaching, training, equipment, handicapped,
aging society (second childhood), etc.**

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PROCEEDINGS

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Foreword

Some may think that they know a lot, while others are sure that they do not know enough. In reality we know very little. Imagine an ant that will carry a grain of sand from the Sahara desert and will slowly transport it to the Grand Canyon. This ant must trek across the African continent, swim across the ocean and make its way through America to reach its destination and drop the grain of sand. The same ant must go back to the Sahara desert to pick-up the second grain of sand, and so on until it has transported the entire Sahara, grain by grain, into the Grand Canyon. The time it takes this ant to accomplish this feat is just a small fraction of the time we need to really acquire knowledge.

In sport, and more specifically in table tennis, it may seem that knowledge is finite. But human imagination and creativity have no limit. So how can we fit unlimited "grey cell" resources into a finite environment? "Impossible", I say. As long as we have time to think, we create limitless time to hold our thoughts. The more time we have, the more we think and the more we need time to contain our thoughts.

So how can we achieve our goals? How can we prove our theories? And please tell me how can we meet our deadlines? Do we limit our thoughts? Do we constrain our imagination? Or do we suffer knowing that we do not know?

Thank god for philosophers. They gave us the solution. While they stretch and define time, they give science the luxury of establishing parameters. While the philosophers ponder whether the ant realises that its futile journey is doomed to failure, the scientists could calculate exactly the amount of time it would take the ant to relocate the Sahara desert. They just need to take some scientific data- the size of the desert, the number of grains of sand in a cubic centimetre, the distance between the Sahara and the Grand Canyon, and the speed of a moving ant carrying a grain of sand over land and water. Amazingly, once the data collected it would take very little time, using today's technology, to provide us with an exact figure. But do we really need this figure? What would be its practical application other than confirm that we know very little?

What we really need is "applied" research. Applied Research that will provide practical and immediate applications. Applications that will have a direct impact on our activity. Activity that is enhanced and improved. Improved by finding solutions to our problems. Albert Camus may have recognized existentialism and may have understood the absurd punishment inflicted on Sisyphus. A scientist, however, may have helped Sisyphus conserve his energy rolling the rock up and down the hill.

The role of scientists in sport, and in our sport in particular, is to take an idea and transform it into a reality; to transform the absurd into the practical and to give our watches a function other than knowing that we are late. Without scientific research, without practical applications of theories, and without a hint of what the future holds, we, in table tennis, may still be wondering how long it would take for a 38mm ball to swell into a 40mm ball when exposed to the heat of the Sahara desert.

The 7th ITTF Sports Science Congress is a forum at which ideas are exposed, questioned and debated. It is the hub of scientific table tennis activity. I sincerely hope that it is also a step in finding solutions and enhancing all aspects of our sport be they technical, physical or psychological.

On behalf of the ITTF I congratulate Professor Yuza for organizing this Congress and I commend Dr. Kahn for promoting Sport Science within the ITTF, and to all participants I wish you a very successful Congress.

Adham Sharara

ITTF President

Foreword

It is indeed a great honour and pleasure for the Sports Science Committee to be given the opportunity to hold the ITTF scientific congress in Japan for the second time in ten years.

We are specially proud to present our works on table tennis in Yasuda "Academia" Osaka, and I am confident that all participants will have fruitful discussions and animated debates during these three days. My wish is that the 7th ITTF Sports Science Congress be followed by new and long-lasting collaborations between researchers coming from different laboratories and different countries for the benefit of Table Tennis. Nowadays science in racket sports is rapidly developing, and we must confirm that table tennis science holds a leading position since many years.

I would like to express my gratitude towards the JTTA for their hospitality before and during the 46th World Table Tennis Championships, and also towards the Congress Board chaired by Professor Yutaka TSUJI, Osaka University, for a great organisation.

I am particularly grateful to Professor Nobuo YUZA, Chukyo Women's University and full member of the ITTF Sports Science Committee, for his invaluable and permanent involvement in the organisation of the 7th ITTF scientific congress.

I wish every success to all participants,

Jean- François Kahn, M.D. Ph.D.

ITTF Sports Science Committee

Chairperson

Foreword

It is a great honor and pleasure for me to chair the 7th ITTF Sports Science Congress held here in Osaka under the auspices of the ITTF Sports Science Committee.

First, I would like to describe briefly how this congress comes to be. The ITTF Sport Science Congress is held before the World Table Tennis Championships (WTTC), the 46th of which takes place in Osaka. Every congress is promoted and planned by the table tennis association in the host country of the WTTC. Therefore, the Japan Table Tennis Association (JTTA) is responsible for the 7th Congress and has organized committees based on members of the JTTA Sports Medicine & Science Committee. Due to the superb efforts and cooperation of the members of the advisory board, organizing committee and scientific committee, as well as the efforts of many others, we are able to hold this congress. In addition, we are able to receive a lot of support and cooperation from various organizations which I would like to acknowledge.

Next, I would like to describe what I think are the special features of this congress. Table tennis is one of the most popular sports in the world. In Japan, the number of people who play table tennis is more than those of any other sport. Players range from the aged to children. Because of this, scientific studies on table tennis are increasing. Research on table tennis has been done in many unrelated fields such as physical training, psychology, physiology, medicine, dietetics, physics, engineering, etc., and many conclusions have been reached. However, the separation of the different disciplines imposes limits on the research. Also, information exchange within only one country further limits the results that can be produced. To overcome these limitations, the conventional academic disciplines must be crossed over and the leading researchers need to be brought together at international meetings. Furthermore, we must promote interdisciplinary research and provide the benefits for the betterment of mankind by carrying out academic and information exchanges. I would characterize this congress as a place that meets these goals of bridging between different disciplines and countries, as well as contributing to the international community.

Finally, I would like to ask for your continued effort to make this conference as good as possible for everyone and to help make it a success. I hope that all of the participants, especially those from overseas, will enjoy the congress and will safely return home where they can continue to make even more progress in their research.

Yutaka Tsuji, Dr-Eng.

Chairperson - the 7th ITTF Sports Science Congress

Vice-Chairperson - JTTA Sports Medicine & Science Committee

Professor - Osaka University, Department of Mechanophysics Engineering

The Review of the 38mm Ball Era and the Bright Future of the 40mm Ball Era in Table Tennis

Yinsheng Xu

Former President of the International Table Tennis Federation

President of the Chinese Table Tennis Association, P. R. China

LRTT Group:

In Feb 2000, during the 45th World Table Tennis Team Championships in Malaysia, a revolutionary decision in table tennis history was made by the ITTF Congress, which decreed that from 1st Oct.2000, the 40mm diameter ball instead of the 38mm ball would be used in the matches approved by ITTF.

In this talk I review the significant contribution of the 38mm ball era to the history of table tennis, and attempt to forecast the bright future of the 40mm ball era:

1. Strengthening the unity and friendship among the people over the world
2. Accomplishing justice and democracy in table tennis
3. Emphasizing the development of table tennis through science
4. Realizing the principle of common participation
5. Predicting the future of the 40mm ball

ITTF Longer Reach Table Tennis Experiment: Does a Longer Table Promote More Rallies and Physical Fitness in South African Players?

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In recent years, competitive table tennis has been criticized as not producing longer rallies because of over-reliance on advancement in rubber technology, which not only yields the required spin and speed but also reduces players' athletic effort. Based on the need for competitive table tennis to produce longer rallies and consequently be more attractive to TV and spectators, the idea of longer reach table tennis was conceived. This experiment was carried out to provide a scientific basis for evaluating the effectiveness of longer reach table tennis in promoting athletic effort among players as compared to conventional table tennis.

The experiment involved 11 South African national players in junior (U-14) and senior categories. The players were matched for playing ability and assigned to two treatment groups: Group 1: Conventional table tennis (CTT, N=6) players and Group 2: Longer reach table tennis (LRTT, N=5). The players' fitness and skill performances were tested before and after a four-week skill-training program. The fitness measurements included anthropometric profile, aerobic and anaerobic power, muscular strength and endurance, flexibility, balance and speed, while the skill and tactical tests comprised service and return of service, counter hit and top-spin drives, topspin (with footwork, smash, block shot) and tactical abilities (third-ball attack, skill combinations and variation in positional and directional play). Both categories of players also competed in three sets of trial matches before and after the skill training program, which were video taped and analyzed. During the trial matches, the players' exercise heart rates were measured using Polar heart-rate monitors, to assess the intensity of competing on the longer reach and conventional tables. Findings were analyzed using descriptive statistics and t-test.

After the training program, the LRTT group lost a mean weight of 1.1kg, while the CTT category gained a mean weight of 0.2kg. Relative body fat was reduced by 0.6% (LRTT Group) and 0.2% (CTT Group) in the players. In flexibility measurements, the largest improvements found in the LRTT group were in respect of internal (Left: 9.6°; Right: 1.6°) and external (Left: 3.8°; Right: 3.4°) shoulder rotation. Corresponding shoulder rotation values for the CTT group were as follows: internal (Left: 6.7°; Right: 4.3°) and external (Left: 2.8°; Right: 0.2°). These comparisons were however not statistically significant.

Results on leg power and grip strength yielded substantial differences in favor of the LRTT training group. Specific mean values were 24.9 Watt (SE=11.54) for leg power and 1.6 kg (SE=1.32) for grip strength (right hand). Predicted VO₂max. assessed with the Progressive Multistage Shuttle Run Test also showed relatively superior improvements in the LRTT players in contrast to the CTT players: 7.2 ml.kg.min⁻¹(SE=3.02) (LRTT Group) and 3.1

ml.kg.min⁻¹ (SE=1.35) (CTT Group). This indicates that the longer reach table tennis was more effective in improving the players' aerobic fitness than conventional table tennis.

The skill tests did not substantially specialize the players, except that significant improvement was found regarding FH topspin with footwork in the LRTT group ($P<0.05$). In order to assess players' ability to apply skills in a competitive situation, their performances were analyzed in pre- and post-test trial matches. The match analyses yielded the following results:

LRTT Group:

- Service had little effects on opponents because of the longer distance the ball traveled before it was retrieved. This made the ball loose thereby promoting safer returns and limiting trickery in service delivery. Opponents also had ample time to successfully retrieve services.
- Short returns were generally avoided because it was regarded as a fault if the ball landed in the *still waters area*. Consequently, short players were not disadvantaged. Rather players played longer rallies, i.e. aiming at the center of the table and beyond in order to increase the chances of the ball landing correctly with each rally.
- Players tended to direct shots to the sides (diagonally) rather than playing strokes straight court. This was an attempt to keep the ball in as safely as possible. The fact that the rallies were longer made the strokes more visible.
- Top-spins and smashes were the most frequently used strokes in the trial matches.
- When the LRTT group competed on the conventional table several unforced errors were noted in which some of the players top-spinned beyond the baseline. Many of these strokes would have landed correctly if they were playing on the longer reach table.
- In the post-test trial matches, the mean exercise heart rate for the LRTT group was 191.6 beats per minute (bpm). This was higher than the 181.0bpm found for the same group of players when they competed on conventional tables. The LRTT players also recovered faster 60 sec. After competing on the conventional table (28 bpm) than they did after playing on the longer reach table (25.6 bpm). These findings confirmed that the LRTT group did more physical work competing on the longer reach table than on the conventional table.
- The eye-hand coordination/reaction-time test, did not indicate any marked differences between the LRTT (65.8%) and CTT (65%) groups, but the LRTT group had a slightly better score.
- For the matches analyzed, the average number of hits per point was 4.5 compared to 2.5 when the LRTT group competed on the CTT. In the post-test period, the total number of points (not games) won by each player in every game (in the LRTT group) over six trial matches was summed. This gave a total of 500 points, whereas when the same players competed on the CTT two days later the total points won was

464. This gave a decline of 36 points and suggests that rallies of the LRTT players were more consistent on the longer reach table than on the conventional table and that matches were more keenly contested on the longer reach tables than on conventional tables. The duration of the games on the LRTT was 4-9 minutes, but when the players competed on the CTT the games lasted 3-7 minutes.

CTT Group:

- When the CTT players competed on the longer reach table, some played more consistently, but no consistent trend was noted.
- A number of errors were committed by players hitting the ball to the net or the still waters area.
- Most points were lost when players thought that particular shots would normally go out but would turn out to be good returns because of the enhanced table length.
- For the matches analyzed, the average number of hits per point was 2.4 compared to 2.6 when the CTT group competed on the LRTT.

Based on the results of the experiment and in spite of its limitations it was concluded that the longer reach table tennis was more effective in promoting longer rallies and athletic effort in South African national players. It is recommended that the ITTF should introduce the LRTT as an invitational tournament to test its suitability for TV coverage and public appeal.

Recent Problems with Equipment

J. Rufford Harrison

ITTF Equipment Committee Chairperson, United States of America

This paper will discuss several problems that currently face the Equipment Committee;

The problem of changing from the 38mm ball to the 40mm balls is largely behind us, but for some months, until the manufacturers perfect their changed techniques, we cannot expect the quality that we have come to expect in the 38mm ball.

Tables - We have recently received complaints about deteriorating and variable quality of tables, largely associated with friction. Of all the properties of the table, this happens to be the most difficult to measure. We shall probably have to develop dynamic tests, which will be more costly.

Racket coverings - Both the Executive Board and the Council have expressed displeasure at the large number of authorised racket coverings, and we have been asked to find a way to shorten the list. Several possible ways will be discussed.

Speed glue - When "speed glue" was first introduced, it contained solvents that were toxic, even possibly carcinogenic. We therefore had to devise tests to detect the offending solvents, and to place upper limits on the permissible concentrations. The resulting Dräger-tube method is fairly simple to operate, and not too costly, but it does have problems. Detecting any solvent is far easier than detecting certain specified ones. Our preferred solution is to ban the presence of any solvent.

Colour and Lighting - Another task that we have been given is to prescribe the optimum colour scheme for our sport, for both TV viewers and those in the hall. Orange or white ball? Blue or green table? Red floor or some other colour? Net? Surrounds? A difficulty here is the effect of the lighting, which is always different from one event to another, and which affects the perceived shade of a colour and the amount of haze.

Doping Control by the ITTF from 1990

Dr. Jean-François Kahn

ITTF Sports Science Committee Chairperson, France

With the exception of the 34th WTTC held in Birmingham (UK) in 1977, 1990 is considered to be the actual starting point of the ITTF anti-doping program, when Mr. Ichiro Ogimura, the then ITTF President, decided to officially appoint a person in charge of this matter. The first meeting was organised in September 1990 in Tokyo (Japan) a few months before the 41st WTTC in Chiba (Japan). At that time, players (event at high level), coaches and officials held a low opinion and were rather doubtful about the usefulness of dope testing in table tennis, and in some cases had no knowledge about it at all.

Since then, the anti-doping program, consisting of three parts has been progressively implemented. The first part was the elaboration of rules. They are based on the IOC Anti-Doping Code and are regularly updated. They constitute chapter 5 of the ITTF Handbook, and the testing procedures are described in detail in Technical Leaflet 13. The second part of the program, and certainly the most valuable, is the spread of information among the different categories of participants in order to convince them not to use unauthorised substances and/or methods. The information has been circulated and will continue to be circulated among people involved in table tennis training and competition, whatever their level of play, especially the young players. Regarding the dope testing itself (the third part of the program) everyone is aware nowadays that players may be subject to testing during any competition under the ITTF authority, and in some cases even during a training session, as out-of-competition testing has become a full part of the ITTF anti-doping program since the year 2000. For example, from Chiba (1991) to Kuala-Lumpur (2000), 271 tests have been carried out during all the world championships (team and individual events), and in the weeks preceding the Olympic Games in Sydney, 28 out-of-competition tests have been conducted on qualified players thanks to the collaboration of the recently created World Anti-Doping Agency (WADA). As in any other field regulated by specific rules, people (not only players) who do not respect the limits fixed by the rules are subject to penalties the application of which may be extended at different levels (national and/or continental and/or international and/or IOC levels).

Today, 10 years later, the fight against doping in conjunction with educational programs for training, physical and mental preparation and diet, has become a full component of the development program of our sport, which means that the image of table tennis is not only linked to the sports results, but also to the dope testing results.

Information Processing and Decision Making in Table Tennis: The Factors of Expertise

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Key words: 40 mm ball, rebound power, impact force, contact time

In table tennis the player is confronted with situations of which the extreme high level of informational constraints generally overflows the resources and the processing capacities used by human beings in usual life situations. For instance, the player has to gaze at a ball flying at near 300 °/sec. while its maximal capacity of oculomotor pursuit is about 50 °/sec. Also, the duration between two strokes is sometimes less than 300 msec. while reaction time for triggering the same complex technical gesture, like the one carried out in the field, needs, in the condition of the laboratory, more than 400 msec. These paradoxes can be explained by considering that expert players adapt their bio-informational system of processing to the non-usual constraints of table tennis situations.

The aim of this paper is to describe these adaptations. We will describe two sectors of the game concerning on the one hand, the behavior involved in the act of hitting the ball and on the other hand, the strategies involved in decision-making. We will address the following major question: does the adaptation of the players result from a transformation of the software or of the hardware of his bio-informational system of processing?

Compared to the 38 mm ball, the impact force with the 40 mm ball is slightly larger, the contact time is shorter below 15 m/s and longer above 15 m/s of impact velocity, the deformation of the ball is much larger but that of the rubber is almost the same, and the rebound power coefficient is slightly larger below 20 m/s but smaller above 20 m/s of impact velocity. Accordingly, the post-impact velocity of the 40 mm ball is slightly faster below 20 m/s of impact velocity and slower above 20 m/s compared with those of the 38 mm ball. Since the drag force of the 40 mm ball should be larger than that of a 38 mm ball, the velocity of the 40 mm ball should be slower.

Motor Unit Recruitment and Metabolic Responses Using the New Larger Ball in Table Tennis

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We examined the influence of ball size on motor unit recruitment pattern and metabolic responses during regular training in table tennis. Eight university table tennis players performed a 30 min sequence of regular daily training consisting of three 10 min periods of different strokes. Samples were obtained from both thigh and shoulder muscle groups before and after exercise.

The girths of the thigh and crus were unchanged, but differences were found in the antebrachium and brachium in the playing arm. No clear difference was demonstrated in motor unit recruitment pattern in the leg and shoulder muscles between using the smaller or larger balls. The mean occurrence of type I fiber in quadriceps and deltoid muscles was found slightly higher in deltoid muscle (44% VS 49%), whereas an inverse trend was shown in type IIx fibers in the same muscle (22% VS 13%). The heart rate reached 183-186 bpm after 30 min of exercise and remained slightly higher with the bigger ball from 10 min of exercise till the end of the experiment. The ventilatory response and oxygen uptake were proportional to the heart rate. No difference was observed in blood lactate concentration between ball sizes, but the recovery rate was faster with the larger ball.

In conclusion, the present study demonstrated that motor unit recruitment and metabolic responses were similar with the smaller and larger balls in table tennis.

Prediction of Rebound Power of Table Tennis Racket

- Comparison between the 40 mm and the 38 mm Balls -

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Key words: 40 mm ball, rebound power, impact force, contact time, deformation

This work predicts the effect of the larger 40 mm ball on the impact force, the contact time, the deformation of the ball and rubber, and the rebound power coefficient associated with the impact between the racket and the ball, when the impact velocity and the impact locations on the racket face are given. It is based on the experimental identification of the dynamic characteristics of the ball-racket system and an approximate non-linear impact analysis, where the contact time is determined by the natural period of the whole system comprising of the mass of the ball, the nonlinear stiffness of the ball and rubber, and the reduced mass of the racket at the impact location on the rubber face. It also considers the energy loss during impact between the ball and the rubber.

The racket performances obtained regarding the rebound power with a 40 mm ball were compared to those with a 38 mm ball using a racket (BISIDE) with mass of 171 g including 79.5 g of the rubbers (Sriver)

Compared to the 38 mm ball, the impact force with the 40 mm ball is slightly larger, the contact time is shorter below 15 m/s and longer above 15 m/s of impact velocity, the deformation of the ball is much larger but that of the rubber is almost the same, and the rebound power coefficient is slightly larger below 20 m/s but smaller above 20 m/s of impact velocity. Accordingly, the post-impact velocity of the 40 mm ball is slightly faster below 20 m/s of impact velocity and slower above 20 m/s compared with those of the 38 mm ball. Since the drag force of the 40 mm ball should be larger than that of a 38 mm ball, the velocity of the 40 mm ball should be slower.

The questionnaire indicated that:

- 1) 79% of the players felt that it was more difficult to induce spin in the 40 mm ball than the 38 mm ball
- 2) 80% considered the 40 mm ball speed to be slower
- 3) 73% considered the 40 mm ball to be heavier

These characteristics of the 40 mm ball may be associated with the longer rallies because it is easier to return the larger ball. In conclusion, the rallies during table tennis matches are lengthened with a 40 mm ball, which may result from slower flight and spin characteristics of the larger ball.

Distribution of Contact Points on the Racket with 40mm Balls

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Two experiments were performed on 40mm balls.

1. The velocities of 40mm balls (2.7g) and 38mm balls (2.5g) were measured by propelling the balls from a table tennis machine at three projection speeds: high, middle and low. Hardly any difference was shown in ball velocity between the 40mm ball and the 38mm ball at any of the projection speeds. This result agreed with that of the velocity simulation by Tsuji et al. (1999) using a personal computer.

2. Using 14 college table tennis players, the contact points on the racket were investigated. Each player hit a 40mm ball and a 38mm ball 40 times respectively and the center of distribution for the 40 contact points was calculated. The results showed that the center of distribution moved closer to the racket center (away from the top edge) with the 40mm ball than with the 38mm ball. The mean distance of movement was about 6mm among the 14 players. This phenomenon was observed in almost all the players, both pen holder and the shake hand. It is surmised that the increased ball weight requires the players to hit the 40mm ball at a point closer to the racket center to overcome the increased ball pressure.

Effect of the 40 mm Diameter Ball on Table Tennis Rallies

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Recently, the ITTF adopted a 40 mm diameter ball (2.7g) for table tennis matches believing this might decrease the ball speed typically appointed by the traditional 38 mm ball (2.5g), and consequently the rallies may last longer. The longer rallies may increase the interest of table tennis spectators and TV viewers. The purpose of this study was to compare the newly adopted 40 mm ball to the conventional 38 mm ball to determine whether diameter differences cause differences in number of hits per rally (rally counts). Rally counts for the 38 mm ball were conducted in the Japanese National Championships in 1993 and those for the 40 mm ball in the same competitions in 2000. The rally counts for the 38 mm ball were taken from the quarterfinals and the semifinals in both men's and women's singles and from the semifinals in both junior men's and women's singles. The rally counts for the 40 mm ball were taken from the quarterfinals and the semifinals in both men's and women's singles and from the quarterfinals, the semifinals and the finals in both junior men's and women's singles. The defensive players' matches were excluded. In addition to the rally counts, a questionnaire was given to the participating players to subjectively evaluate differences in spin, speed, resistance, etc. of the 40 mm ball as compared to the 38 mm ball. The mean of rallies per match was 3.1 vs. 4.1 in men, 3.8 vs. 4.6 in women for 38 mm and 40 mm balls respectively. The same counts were 3.0 vs. 3.3 in junior men and 3.6 vs. 4.6 in junior women. The combined means for men and junior men, and women and junior women were 3.1 vs. 3.8, and 3.7 vs. 4.6 for 38 mm and 40 mm balls respectively. The frequency distribution for the rally counts in all groups for both the 38 mm and 40 mm balls were concentrated toward the low end of the scale. The mean values for the above rally counts were all significantly higher for the 40 mm ball.

The questionnaire indicated that:

- 1) 79% of the players felt that it was more difficult to induce spin in the 40 mm ball than the 38 mm ball
- 2) 80% considered the 40 mm ball speed to be slower
- 3) 73% considered the 40 mm ball to be heavier

These characteristics of the 40 mm ball may be associated with the longer rallies because it is easier to return the larger ball. In conclusion, the rallies during table tennis matches are lengthened with a 40 mm ball, which may result from slower flight and spin characteristics of the larger ball.

Characteristics of Rallies in Table Tennis with 40mm Diameter Balls

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The size of the ball has been changed by the ITTF and the new ball has been used officially since October 2000. The diameter of the ball was enlarged from 38 mm to 40 mm and the weight from 2.5g to 2.7g. It is expected that this will change the playing style and the tactics. The purpose of this study was to compare the rally characteristics of the new ball (40 mm) and the old ball (38 mm) in order to show the effects on the players. The ball speed from the hitting point to the receiving point was calculated by using a serving machine (robot) and a speed measurement system. Initial velocities and ball spins were calculated by using a golf-swing robot and a high-speed video camera. The robot arm was equipped with a racket which hit the balls at various speeds and angles. Three kinds of shots (drive, chop and serve) were made in the rallies by skilled players, and average values of rally times for the two kinds of balls were measured.

The following results were obtained;

- (1) The initial speed of the new ball was 1-2%, and the ball spin 5-20%, less than those of the old ball.
- (2) The difference of the reduction ratio of speed between the new ball and the old ball was not observed.
- (3) The average rally times of the new ball for both drives and chops were 2-4% longer than those of the old ball.

Speed and Spin Characteristics of the 40 mm Table Tennis Ball and the Influence on Elite Players

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The 40mm table tennis ball has been used since October 2000. Coaches and players have been talking about the differences in speed and spin between the large (40mm) and small (38mm) ball. It is very important for players to understand these differences before they change their techniques to adapt to the large ball. The aim of this study is to identify the characteristics of the large (40mm) ball.

In this study, Singapore elite players received both top-spin and back-spin balls from the robot (NEWGY ROBO-PONG 2040). Three video cameras (Peak HSC-200) captured data for three-dimensional motion analysis at a rate of 200 fields/second. This was conducted in December 2000, after the players had been using the large ball for three months. Both speed and spin of 38mm and 40mm balls were calculated using Peak Motus v 4.3.

The male and female players, all of different styles and different techniques including attack, loop and service, were analysed and compared quantitatively, for example, the difference in speed and spin for forehand smash and forehand high loop. The loss of the speed and spin in the air was also considered. Finally, the influence of these differences on elite players was discussed.

Differences Caused with the New 40 mm Ball in Structure of Competitive Activities of Top Table Tennis Players

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The subject of this research is the structure of competitive activities in a sample of about 90 top table tennis players (mostly players in the first 100 of the ITTF Ranking list such as Kong Linhui, Liu Guoliang, Samsonov V., Wang Liqin, Waldner J. O., Primorac Z., Ma Lin, Persson J., Gatien J. P., ...) in the 2000/2001 season (starting from October 2000), at the following competitions: French Open, Polish Open, Swedish Open, Finnish Open, European Men Super League, European Men Champions League, Pro Tour Grand Final, JOOLA Europe TOP 12. The results will be compared with those of previous research (Structure of competitors activities of top table tennis players; Master thesis at Faculty of Physical Education, University of Novi Sad YUGOSLAVIA, 1999.) in the 1996/97, 1997/98 and 1998/99 seasons (mostly in final matches at Pro Tour tournaments, European and World Championships, and European Champions League).

Competitors activities were analyzed in 61 activities (variables), in 3 groups of activities (variables):

1. System of variables for evaluation of frequency, way of realisation and effectiveness of technical and tactical elements (30 variables)
 - Frequency of technical and tactical elements
 - Effect of these elements
 - Stroke placement zone
 - Stroke realization zone
2. System of variables for evaluation of effectiveness of service stroke (and return of service) and effectiveness after service stroke (and returning service) (23 variables)
 - Effectiveness of service stroke (type of service and service placement zone)
 - Effect of service stroke and activity after the service
 - Type of service return
 - Effect of returning stroke
3. System of variables for evaluation of movement activities (8 variables)
 - Side and deep movements
 - Change of forehand and backhand position
 - Stroke in forehand/backhand position and arm swinging for forehand/backhand strokes

Research consists of the analysis of activities for all players, from the aspect of:

1. Success in play (winners and losers)
2. Quality of players (position at ITTF Rank list)

For every analyzed activity basic statistical data, frequency data, percentage in complete

activity and group of activity, are determined as characteristics from the aspect of success of play and quality of player.

The statistical importance differences between:

- Winners and losers
- Better and lower ranked are fortified, and interpretation of these differences from the aspect of expert analyses, which show the way of training process in producing the champion players with high performance in play and with great chances to play a winning play.

The research consists of interpreting the 3 part structure of competitors' activities of top table tennis players (as the results of Factor analysis) and interpretation of the main factors of modern table tennis. The structure of analyzed players is also fortified.

The basic aim of this research is rationalization and higher effectiveness of training processes in table tennis. Considering these results of research, which explain the modern concept of the game of table tennis, and factors which influence success of play and quality of play and players. This research consists of a lot of graphic showing and also, one of the products of this research is a software for analyzing table tennis match in all this activities. Finally, this research will give answers about the positive or negative changes caused with new 40 mm ball in top table tennis, consisting the most adequate research sample of leading World competitions in period October 2000 to February 2001.

At this Congress will be presented and computer software for table tennis analyses DJ2001 which is coo produced with TIBHAR this year.

The Use of the 40 mm Table Tennis Ball by the University of the Philippines Varsity Table Tennis Team

Oscar Yoshihiro Santelices

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The study investigated the use of the 40mm table tennis ball as experienced by the University of the Philippines Varsity Table Tennis Team during the 1st U. P. 40 mm Ball Table Tennis Championships held October 18 to 20, 2000, the first official local tournament using the 40mm ball. It also determined the significant effect of the new ball on the performance of competitive players.

Thirty-one players (21 male and 10 female) were given a 59-item questionnaire on the following areas: 1) Service, 2) Receive, 3) Offense, 4) Defense, 5) Individual Styles and Techniques, 6) Tactics and Strategies, and 7) Other. The responses were rated on a 5-point Likert Scale and analyzed using the descriptive method.

The results showed that 71% of the respondents improved their games mainly because the ball is slower and anticipation is easier. 67.7% prefer the 40mm ball to the 38mm ball while 83% could easily adjust to it. The T-test showed that there is a significant difference between male and female players at $p < 0.05$. No significant differences were noted between power and speed or agility and timing. Varsity level players who are less skillful than the regional and international competitors considered the 40mm ball most effective in defense since the ball is slower. The regional and international level players, however, experienced a big difference in terms of the speed of the ball in general. Due to the bigger diameter and weight of the 40mm ball, physiological factors were of significant importance.

In conclusion, the data indicated that Filipino table tennis players welcome the 40mm ball given the proper time for adjustments. Further studies are still under way to find more conclusive results.

The Role of the Coach

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In this session I intend to cover the main tasks and expectations of the coach, as prescribed by Canadian standards. These will include:

- The Philosophy of Coaching
- Goals of the Programme
- Reasons for Participating in Table Tennis
- Use of Table Tennis questionnaires
- Developing positive self-image
- Fair play and the Laws of Table Tennis
- The Training Facilities and Safety; Sport Science
- The Yearly Planning Instrument for Table Tennis

30,000	10,000	20,000	Men's
5,000	2,000	15,000	Women's

Based on the archives of the coaches and players, the archives are compiled to explain

clearly the tactics, technical characters and patterns to the coaches and players. The archives can be looked up at any time and some key contents will be mentioned. For a long time, coaches have been engaged in considering these phases: attack after service receive and rally. This method has been proven to be effective by the comparative study on table tennis tactics. Owing to changes in table tennis styles and techniques, the evaluation standard and the nature of the phases had to be corrected as the sport developed. Table 2 roughly shows the

With the hearty collaboration of the coaches and players, the archives are compiled to explain the important work that has been done, which gives strong support to the development of table tennis in Canada.

Now	Past	Phase
Service	Service	Attack after
Attack after	Attack after	service
service	service	Attack after
Attacked after	Attacked after	service
service		

An Evaluation of Training and Tactics of Chinese Table Tennis Players

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Chinese players swept up the gold medals in the 27th Olympic Games in Sydney, Australia, after doing the same in Atlanta in 1996. These results show that the Chinese table tennis team is the strongest in the world; it played an important role in the winning of 28 gold medals and China's third place standing in the Sydney Games.

In order to give more support to the Chinese table tennis team, a scientific group was organized in 1998 to focus on how to use tactics against different opponents in the Olympic Games.

The contents of the study are as follows.

1. Building up a Data-base

In order to make the study of the recent years' results more systematic and to simplify the comparative analysis, a data base with 50,000 pieces of data has been built up, supplying as much material as possible for the coaches, players and researchers. It is more convenient for the study of the tactics of the strong opponents and it is easier to make a comparative analysis of Chinese players and foreigners in the Sydney Olympics. The data are shown in table 1.

Table 1 Data Distribution

	Singles	Doubles	Total
Men's	20,000	10,000	30,000
Women's	15,000	5,000	20,000

2. Improving Methods

For a long time, matches have been analyzed by considering these phases: attack after service, receive and rally. This method has been proven to be effective by the comparative study on table tennis tactics.

Owing to changes in table tennis styles and techniques, the evaluation standard and the nature of the phases had to be corrected as the sport developed. Table 2 roughly shows the improvement in the first phase, which is attack after service.

Table 2 Comparisons of Methods

Phase	Past	Now
	Service	Service
	Attack after	Attack after
Attack after	service	service
service	Attacked after	Attacked after
		service

	service	No attack after
	No attack after	service
Shots	service	Attacked after
	3	attack
		Killing after attack
		5

3. A Comparative Analysis of Tactics

Knowing the opponent and setting up one's own playing schemes to deal with them is very important for a player to win the match. The comparative study between Chinese and foreigners is therefore the main task for the scientist in the Chinese team. This study includes playing styles, strong techniques, weak techniques, the opponent's placements and the ways to play against China. Data and edited videotape were supplied to the coaches and players to illustrate repeatedly with SP and LP to inform to the players about their opponents. To master the opponents' tactics, effective training methods can be chosen pointing to the different players' styles. It was proved in the Olympic Games that the choice of techniques used by the Chinese players were quite correct.

4. Training Evaluation

To help coaches know more about the players practice in preparation for the Olympic Games, the effect of training was evaluated through the calculation of data including the effective training time of each class, rally numbers of each point, winning and losing rates for each training plan, competitive ability in the practical matches and the extent of fatigue and concentration of the brain. The results with suggestions were written up and handed out to the coaches and players to improve the training in the next session.

5. Technical Archives

Based on the acquired data, technical archives of the opponents are compiled to explain clearly the tactics, technical characters and patterns to the coaches and players. The archives can be looked up at any time and some key contents will be memorized by the players' heart. Up to now, there have been 48 files with 50,000 words of the main opponents in the Chinese table tennis team. These technical archives supplied much important information for the development of effective playing plans for the Chinese players in the Sydney Olympic Games.

With the hearty collaboration of coaches, players and researchers, much useful and important work has been done, which gives strong scientific support to the sweep up of gold medals by Chinese table tennis players in Sydney.

The Filming of Table Tennis

Jota Ito

Sony Corporation, Japan

It is obvious that TV broadcasting has contributed to the accessibility and growth of modern sports. However, the TV camera can rarely capture the dynamics of the fast moving sport of table tennis. Camera techniques for capturing the action and skill of table tennis are not good enough to attract the attention of the sports public. Therefore, I studied the best way to film table tennis, in order to make it a true major sport.

There are three important considerations when filming table tennis: showing the clear and complete path of the ball from racket to racket, filming the player and the table in full frame, and filming the true speed of the ball (I named these the CFS criteria). Because table tennis is a small-scale sport, advanced camera techniques must be used to zoom in and show the true speed of the ball. Focusing my attention on these considerations, I began to analyze how to address the special camera techniques needed for filming table tennis.

First, I simulated TV images by calculating various camera positions in relationship to the field of play and the image to be filmed. Next, I evaluated actual broadcast images. The actual broadcast removed the camera so far from the game that the image appeared to be only two-dimensional: player to player ball movement only. The result is that we do not experience the true speed of the ball. Analyzing these problems, I will present the best camera position, which can capture the speed and movement of the game, and how to achieve it. Additionally I will address some idea for improving film editing and sound.

	Past	Now
	Service	Service
	Attack after service	Attack after service
Attack after service	service	Attacked after service
	Attacked after	service

Table Tennis in the 21st Century

- A Recommendation for Alternate Strokes with Both Hands -

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Because of its unique characteristics of exercise, competition, and amusement, table tennis is enjoyed by people all over the world. For many years, people have played it with one hand, thus making this hand agile and strong while the other one remains weak. According to information from the training center of the research institute of the national physical committee of China, a characteristic of the table tennis athlete's body physique is the comparative difference between the circumference of the arms of male and female players: it is 2.39 cm on the upper arms (2.29cm for female) and 1.88 cm difference on the forearms (1.55cm for female). It is obvious that the marked difference of the circumferences between the handed and not-handed arms bears a close relationship to the grips and strokes. It is worth noting that table tennis is played with only one hand. In accordance with the new demand of peoples' physical health care, conjoining the latest development of human encephalic science and physical science, and the authors present a new stroke method using both hands under the inspiration from Ito a Japanese world champion and the famous Polish player Grubba. The authors also have proposed new rules. The authors have matched under these rules and it seems that it will work in developing the right brain potentiality and enhancing the well-balanced development of both sides of the arms and brain.

Analysis of the Skills and the Tactics of Chinese World Champions by PC Video System

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Through an SMC-70GP PC video creating system, the authors have analyzed the skills and the tactics of 12 world champions including Furong Li, Yuehua Guo and Zhili He. Static frame and slowed frame techniques were used to obtain precise and quantitative data. Analysis was made on the velocity of the ball, the time and space relation of the striking spots on the ball and the bat angling of body joint. For instance, when Guo Yuehua and He Zhili strike a forehand forward-driving loop, they stand side on to the table, and swing the racket back to the right rear, tilting the bat forward. About 0.32 sec elapsed between the bounce and contact with the racket, when the elbow bent at about 115 degree. When the ball drops from its ascent, the arm swings from right-down to left-up at the time of contact, and the forearm flexes rapidly, rubbing the ball half way along its middle; at the same time the hip turns from right to left. It takes 0.3 sec from the contact to the descent. All this can be displayed on the screen precisely and can be viewed by players, coaches and amateurs.

Popularization of Table Tennis as Family Sport

Vladimir Schlamberger

ITTF Media Committee, Slovenia

How can the interest in table tennis in Slovenia be regained? It was the top sport in the country in 1965, when the World Table Tennis Championships was held for the first time in Yugoslavia or the Balkans. This is the goal of the experts of the Slovenian Table Tennis Association, an association in a small country. Table tennis has a 73-year long history in Slovenia, which is one of the former Yugoslav Republics. It has been independent since 1991. There are 1.99 million inhabitants and the capital is Ljubljana. We have 49 table tennis clubs with more than 600 members, and thousands of enthusiasts playing in companies, schools and other places. Main tournaments are the Slovenian Open in Velenje, the Slovenian Youth Open in Ljubljana and an International Veterans Event in Ljubljana).

The well-known Slovenian sports expert Dr. Miran Kondric believes that the chance for an increased interest of table tennis in Slovenia is possible. Anyone can play, from 6-year old children to 94-year old seniors, so the sport could be interesting and amusing for all members of the family. In Slovenia we have a special kind of amusing play - cross table tennis. This is a game for five or more players, who run around the table hitting the ball one after another.

Partly successful was a program run for the last three years, named 5000 ping-pong bats. Former table tennis representatives, sport teachers, table tennis officials, businessmen and politicians visited ten schools, even preschools (children aged 5 years old), played in exhibitions and various sponsors donated ten, twenty or more table tennis rackets, balls and equipment for future table tennis players.

This paper describes this program and our attitude towards table tennis as a family sport.

Computer Supported System for the Evaluation of Fitness of Slovenian Youth Table Tennis Players

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Key words: table tennis, computer

This paper describes the use of computer software for the evaluation of the fitness of Slovenian junior table tennis players. A Sport Measurement Management System (SMMS) has been developed to determine the optimal morphological and motor condition for table tennis players. In our case, 36 top male and female junior players in Slovenia were subjected to several morphological and motor tests, enabling us to observe the state of development of the player. We also discuss the importance of the test in determining the level of a player's pre-dispositions (talent) for table tennis and in evaluating his readiness or the effectiveness of his training. In the second part of the paper there is an overall presentation of the SMMS program, the hardware and software requirements for its use, its database and a number of presentations and reports on its applications in table tennis.

If we compare the data with those for juniors in other racket sports, we can see that there is considerable potential in the motor status of Slovenian table tennis players. Especially important are the longitudinal data on this status and evaluation of the results gained over a longer period of time. This information is necessary for good planning of the training process and its connection with the morphological status of a player.

With the SMMS program, table tennis coaches can regularly follow the results of morphological and motor measurements on the one hand, while on the other hand they can obtain an analysis of the results and an evaluation based on different models (Z-value and ND-models).

Slide Aerobic Exercise in the Table Tennis Physical Conditioning Program

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Key words: table tennis, slide aerobics, physical conditioning

All kinds of aerobic exercise programs are extensively implemented in sports recreation. A trend to increased application of these exercise systems is noticeable in areas of physical education, kinesitherapy, and even in top-quality sport. Aerobics has therefore become generally interwoven through all areas of physical culture. It is well known that aerobic classes of what ever type are powerful training units with regard to the components of the work-out load volume. This explains significant changes in functional, motor and morphological features in individuals induced by participating in the systematic aerobic exercising.

The authors present a new form of aerobic training and its basic theoretical premise as a constituent part of physical conditioning. An aerobic training program is proposed that is appropriate to be included as one segment of the physical conditioning of table tennis players.

On the basis of slide aerobics three aerobic training programmes have been designed which are respectively applicable to the three separate phases of the preparation cycle in table tennis. Since this is the first implementation of aerobics in table tennis training, the presented programmes are meant to be executed once within the weekly microcycle framework. The examples of the aerobic programmes are constructed so as to substitute largely for classical activities and forms of training. Since aerobics allows for the accurate determination of training intensity, each work-out session can be precisely programmed according to the fitness of a team. It is also possible to change intensity during a work-out. Variations of intensity are produced by music rhythm changes or by changing the intensity of stepping (from high to low intensity and vice versa), with no substantial changes in choreography which is planned in advance.

Proper Hydration in Table Tennis

Michael J. Scott

ITTF Sports Science Committee, United States of America

This oral presentation, although brief, will stress the importance of proper hydration in the sport of Table Tennis. athletes will be advised on the necessity of drinking fluids before, during, and after exercising. Adequate hydration can mean the difference between victory or defeat. More importantly, proper hydration can prevent muscular cramps, heat prostration, and hyperpyrexia.

Disciplinary Problems Associated with the Former USOC Drug Testing Policy

Michael J. Scott

ITTF Sports Science Committee, United States of America

This brief lecture will demonstrate that in the past there was more than just an appearance of a conflict of interest in determining the disciplinary action taken against

United States Athletes found positive for banned performance enhancing drugs.

It is hoped that the same problems will not occur in the ITTF.

Biochemical and Physiological Examination of Intellectually Disabled Table Tennis Players

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In Japan table tennis is one of the most popular sports for disabled as well as non-disabled people. Table tennis (including wheelchair and blind table tennis) is an official individual event of the 1st National Sports Games for the Disabled in Japan (in October, 2001). Blind table tennis is getting popular independently in Japan. Players enjoy the game as the equipment and the rules are modified in accordance with the characteristics of the disabilities.

The table tennis is one of the sports that can pursue skill improvement. The table tennis event for the intellectually disabled people was introduced into the 2000 Sydney Paralympic Games for the first time and the players participated from Japan. A table tennis strength-training camp including the Paralympic players with intellectual disability was held in Tohoku Fukushi University in September 2000. Four men and four women players took part. We studied whether the practice of table tennis placed a big burden on the intellectually disabled people. The following biochemical and physiological examinations were employed to assess the mental and physical conditions of players with intellectual disability: salivary cortisol, urinary 17-ketosteroid, urinary 17-hydroxycorticosteroid, the systolic blood pressure, the diastolic blood pressure, the heart rate, the center critical fusion frequency etc.

Prediction of Rebound Power of Table Tennis Racket

- Analysis of Factors Associated with Impact between the Racket and the Ball -

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Key words: racket performance, rebound power, impact force, contact time, deformation

Advanced engineering technology enables manufacturers to discover and synthesize new materials and new designs for sport equipment. There are rackets of all compositions, sizes, weights, shapes and rubbers. At the current stage, very specific designs are developed to match the physical and technical levels of each player. However, the ball-and-racket impact in table tennis is an instantaneous phenomenon, complicated by the involvement of a human. Many unknown factors are involved in the mechanisms that explain how the specifications and physical properties of the racket and the ball influence the racket capabilities.

This work investigated the physical properties of the racket and the ball, and predicts the impact force, the contact time, the deformation of the ball and rubber, and the rebound power coefficient associated with the impact when the impact velocity and the impact location on the racket face is given. It clarifies the origin of ball speed. It is based on the experimental identification of the dynamic characteristics of the ball-racket system and an approximate non-linear impact analysis, where the contact time is determined by the natural period of the whole system composed of the mass of the ball, the nonlinear stiffness of the ball and rubber, and the reduced mass of the racket at the impact location on the rubber face. Also considered is the energy loss during the impact. The diameter and the mass of the ball are 38 mm and 2.5 g respectively and the mass of the racket (BISIDE) is 171 g including 79.5 g for two sheets of rubbers (Srriver). This work enables us to predict quantitatively the factors associated with impact between a racket and a ball.

The results show that the rebound power coefficient peaks at 18 mm from the center of the racket face and then diminishes because of the mass distribution of the racket. The rebound power coefficient decreases remarkably with increasing impact velocity.

The Web Server of the Japan Table Tennis Association

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In April 1996 the Japan Table Tennis Association (JTТА) started running its official web server at <http://jtta.ge.niigata-u.ac.jp/>. Since then its hit counter has recorded a steady rise in the annual rate of access by the internet users, with the total access to its home page exceeding 580 thousand hits over the last five years. This web server was originally conceived as a joint project, "the development of a computer network to disseminate sports science information", between Niigata University and JTТА.

Since its birth the web server has been physically located at Niigata University, and connected to the Internet over the academic network system.

Today as the Internet has become a part of daily activities of the general public, we deem that the purpose of our pilot mission has now been served. In concluding our project, therefore, we report our major accomplishments of this project before we turn the web server over to JTТА.

This web site contains a number of valuable information, including the tournament results from major domestic events, a link to the official ITTF world ranking, the annual schedule for the upcoming events, a comprehensive list of table tennis related publications, the sports science home page, the conference room, a collection of links to table tennis related web sites, a questionnaire page.

In particular, since the sports science has been the core of our project, the full coverage of both the Sports Science Hand Book and the Japanese Olympic Committee report of Sports Medicine and Science is presented. In addition, we have recently developed a rapid communication system and applied it to publicize all the match results from the 2000 National Table Tennis Championships real time on our web site. We will illustrate how this system works.

Rebound Characteristics of the New Table Tennis Ball - Differences between the 40 mm (2.7 g) and 38 mm (2.5 g) Balls -

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Key word: ball velocity, rotational frequency, diameter of ball, mass of ball

The International Table Tennis Federation changed the diameter of the ball from 38 mm (2.5 g) to 40 mm (2.7g) after the Olympic Games in Sydney, 2000. It is expected that this will change the playing style and the tactics. The purpose of this study was to clarify the physical characteristics of the rebound of the new ball just after the impact against a racket with pimples inward-reversed rubber.

Method

To measure ball spin a ball marked on its surface was shot against the surface of a racket, by a robot machine, downward at 35° from the vertical in a laboratory controlled at 25°C and at 70 % relative humidity. The velocity of incidence just before impact against a racket ranged from 14.19 m/s to 14.71 m/s, with three values of spin forward, 120 rps (High), 60 rps (Medium) and 5 rps (Low). The contact was filmed at 9000 Hz with a high-speed video camera. To calculate the velocity of the ball, the distance traveled in the 50/9000 sec from just before the collision and until just after was measured on a computer display, and the spin was measured by the time taken for one rotation. They were measured at least ten times for each experimental condition.

Results

As the initial spin before the impact was increased, the final spin after the impact showed a progressively larger decrement with the 40mm balls than 38mm balls. Therefore, it is expected that it will be more difficult for players to spin the 40mm balls than 38mm balls.

In the experimental condition of High and Medium spin, the reflection angle for the 40mm ball was different from that of the 38mm ball, but with Low spin there was no difference between in the reflection angle between the two balls. However, the coefficient of restitution showed little difference between the two balls under any conditions.

Conclusion

When the ball spin is small, rebound characteristics of 40 mm and 38mm balls are not very different, as the spin is increased, both kinds of balls begin to show difference. At the prescribed collisional speed of about 14m/s, the post/pre ratio of the velocity of 40mm balls shows more significant decrease than the tangential velocity ratio of 38mm balls.

In my opinion this suggests that in order to impart equal amounts of spin, combined with a proper change in the racket angle a player must have a larger swing at 40mm balls than

Differences in the Racket Movements between Flick Strokes against Backspin and Float Services

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The purpose of this study was to clarify the differences in racket movement between the flick strokes against backspin services and those against float services.

Four top Japanese male players participated in this study. Each performed 5 forehand flick strokes against each of the two types of services, which were identified beforehand. Cartesian coordinates (X, Y, Z) and orientation angles (azimuth, elevation, roll) of the racket were measured by an electromagnetic motion sensor. The timing of the contacts with the server's racket and the receiver's racket was determined by sudden change of acceleration as measured by accelerometers that were attached to the end of the racket handles.

The results are summarized as follows:

- 1) The mean time from the initial movement of forward swing to contact with the ball on flick stroke for each subject was about 0.2sec.
- 2) For all subjects, racket faces at the instant of ball contact against backspin services were 10-20 degrees more open than against float services.
- 3) The timing of the change of the racket face from close to open against backspin services for all subjects was around 0.4 sec before the instant of ball contact. Against float services it was around 0.3 sec before the instant of ball contact.
- 4) The upward velocity of the center of the racket at the instant of ball contact against backspin services for all subjects was faster than against float services.

Kinematic and Kinetic Analysis of the Racket Arm during a Hard Forehand Counter-drive

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The purpose of the present study was to analyze kinematically and kinetically the motion of the racket arm during a hard forehand counter-drive. Three male and 3 female advanced table tennis players participated in the experiment. They were asked to hit crosscourt hard, and then continually hit several top spin balls from a ball machine beyond the table. The motions of the trunk, dominant arm and racket were filmed with two phase-locked cine-cameras. The markers attached to the subject's body were digitized with a motion analyzer, and then were reconstructed into 3D coordinates using a DLT method. Torques of the shoulder, elbow and wrist joints were determined using an inverse dynamics with a link segment model and a free body diagram of the arm.

The angular velocities of horizontal flexion, internal rotation and abduction at the shoulder joint were larger than the velocities of flexion and supination at the elbow joint immediately before and at ball impact. The peak torque of horizontal flexion at the shoulder was 40-60 Nm, followed in order by the torque of internal rotation and that of abduction.

The peak torque of elbow flexion was 10-20 Nm, and was relatively small. The peak torques of palmar flexion and radial flexion were 3-15 Nm. The value of 15 Nm would be too large compared with a standard maximal isometric torque. However, a part of the torque might be exerted by connective tissues and/or bones because the wrist joint was near its end of the range of motion when the peak torques were observed.

These results suggest that large torque exertion around the shoulder joint is important for a hard forehand counter-drive.

Motion Analysis of the Backhand Flick in Table Tennis

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The backhand flick is one of the advanced techniques in table tennis. Because of its quickness the detailed motion of the dominant arm and the racket was not known. The purpose of this study was to analyze it kinematically. Seven shake-hand undergraduate players who had been playing table tennis for more than 10 years were asked to flick backhand against short under-spin serves (37.3 rps) from a ball machine beyond the table. The motion of the dominant arm and racket was recorded with two high-speed video cameras (240 fps). The coordinates of markers attached to the subject's body and the racket were digitized with a motion analyzer, and then were reconstructed into 3D coordinates using a DLT method. The movements of the arm and racket were determined from the coordinates.

The movement of the racket was similar to that of a backhand counter-drive except its quickness. The angle of the racket face was almost vertical at impact. The racket speed at impact in the vertical direction was mainly produced by the external rotation of the shoulder joint (rotation of the upper arm around its long axis): the larger the motion of the external rotation, the higher the racket speed. A higher racket speed in the vertical direction is advantageous for producing higher topspin. However, a smaller flick motion is desirable to delay the opponent's judgment. Hence, we think that players have to decide on their flick styles by taking account of their physical strength.

Table Tennis for Persons with a Disability **- The Current Circumstances and the Organization System -**

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We have two classes of table tennis for Persons with a Disability at the Paralympic Games which are as follows:

1. Table Tennis for Persons with a Physical Disability
2. Table Tennis for Persons with an Intellectual Disability

Persons with a visual disability and persons who are hearing impaired have also managed their own championships at national and world levels.

In Japan, after the Japan Table Tennis Association for the Disabled and the Japan Table Tennis Federation for Players with an Intellectual Disability were combined last year, the Japan Table Tennis Federation for the Disabled was established and became a full member of the Japan Table Tennis Association. This means that the Japan Table Tennis Federation for the Disabled is now connected with the International Table Tennis Federation through the Japan Table Tennis Association, which is a very significant development.

Research on the Use of 40mm Table Tennis Balls and the Training Adjustment of Chinese Adolescent Table Tennis Players (13-15 years)

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The official use of the big table tennis ball (40mm) has produced some effect on the old table tennis skill training system. Since the speed and spin of the big ball have decreased and the rounds of competition have increased, appropriate adjustments must be made in the training content of adolescent players.

Research methods: literature and data study, interviews with experts, and statistics.

Conclusions:

1. The focus of the training of individual skill should be switched from quick hitting to the production of power at the player's initiative.
2. When training the combination skills, the focus should be switched from speed to change (line, placement and spin).
3. The focus of tactics training should be switched from the first three hits in the attack after service to the fourth and the fifth. In addition, attention should be paid to the change from control skill to attack skill.
4. The proportion of footwork and body training should be increased from 20% to 25-30% in order to ensure abundant energy and reasonable movement of footwork.

Guoliang Liu and Lin Ma's Technical Analysis and the Developing Trend in Pen-hold-grip-attack Play

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Key words: pen-hold-grip-attack play, service and attack, returning service and attack, rally

By watching video tapes of many important world matches in which Guoliang Liu and Lin Ma took part, consulting the two players themselves and some coaches and specialists, and looking up a lot of relevant data, the authors diagnose and analyze their techniques and strategies in the phases of service and attack, return of service and attack, and rally.

The authors conclude that Guoliang Liu has obvious advantages in service and attack, and in return of service and attack, but seems relatively weak in the rally phase; Lin Ma's service and attack have great menace, and he has a good ability in forehand looping in the middle court and the back court, but he needs to add some means of returning service and to strengthen his backhand.

Thus, the authors conclude that what can make the pen-hold-grip-attack play keep its place in the table tennis world is to make further progress in raising the consciousness and ability of the three-ball attack, even the five-ball attack, to enhance the menace of the forehand attack and the ability to maintain the pressure after initiating an attack, to improve the backhand offensive, to make more changes with the block, and to improve the ability to deal with loop and the ability to switch between attack and defense.

Some Problems Worthy of Note in Training Juvenile Table Tennis Players

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Key words: early training, relaxing exercise, big ball

Table tennis is a sport that combines brains and physical strength. So improving training efficiency and quality, fostering a crop of players with hard style and good skill are the same tasks for sports teams and spare-time PE school. Every powerful table tennis nation pays more attention to juvenile players' early training and hopes for training talented players in function, psychology, body, sports ability etc. in order to have topnotch players for future achievement. During juvenile table tennis training, the training of technique, pace, quality etc. all have their own specific requirement. In Chinese primary juvenile table tennis school, the differences in training conditions and the coach's level bring much influence on juvenile players growth and development. We sum up some common problems worthy of note according to the long-time training of juvenile table tennis players.

They are as follows:

1. The character of juvenile physiology and psychology
2. The suitable age for commencing juvenile table tennis training
3. The aim for planning juvenile training
4. The variety and interests of contents and means of juvenile training
5. Paying attention to scientific training
6. Value of the preparation activity before training and relaxing exercise after training

Willpower Training of Table Tennis Players in the Age of the Large Ball

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As world table tennis has developed, the technical strengths of the top players have become much closer, and will continue to do so as speed and spin are decreased by using the big ball. In this situation, results will mainly depend on the willpower of the players. It will be almost impossible to achieve excellent results without the hard training of willpower. Therefore, more and more coaches, players and psychologists are paying attention to the training of willpower.

The paper focuses on the characteristics of using the big ball. The authors also put forward the theories and methods of training willpower.

Eleven world-ranked players, Wang Tao, Kong Linghui, Ma Wenge, Liu Guoliang, Waldner, Persson, Gattien, Saive, Roszkopf, Primorac, and Karlsson, were successively evaluated by using this Diagnostic Method to test its validity.

Development of Table Tennis Conception for Table Tennis Players

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The course of a table tennis match can change suddenly. Advantages and disadvantages, superiority and inferiority can change in the blink of an eye. Elite athletes play with their wits and courage. The optimum psychological makeup is one of the most important factors in making use of tactics and advantages to win. The first goal of this paper is a psychological study of training methods to help players at various stages to improve their agility, flexibility, logic and creativity in thinking, to learn how to take advantage of the opponents' weak points and to adjust tactics quickly under different conditions. Another purpose is to provide a theoretical and practical basis for further study.

During juvenile table tennis training, the training of technique, pace, quality etc. all have their own specific requirement. In Chinese primary juvenile table tennis school, the differences in training conditions and the coach's level bring much influence on juvenile players growth and development. We sum up some common problems worthy of note according to the long-time training of juvenile table tennis players.

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6. Value of the preparation activity before training and relaxing exercise after training

Establishment and Application of the 10-item Technically Diagnostic Method for Table Tennis Attacking Players

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In recent years, attacking table tennis players gained clear ascendancy over defense players, for they won almost all the important competitions such as the World Championships, Olympic Games and World Cups. It can be predicted that attacking players will still play an irreplaceable role in the future. So, setting up a scientific, effective, and practical diagnostic method for table tennis attacking players is very important.

Statistical methods were used for the first time to set up an evaluation method consisting of 10 criteria for evaluating the technical strengths of elite table tennis attacking players. To help coaches and researchers analyze players better, the authors set up standards of those ten criteria. Eleven world-ranked players, Wang Tao, Kong Linghui, Ma Wenge, Liu Guoliang, Waldner, Persson, Gattien, Saive, Roszkopf, Primorac, and Karlsson, were successively evaluated by using this Diagnostic Method to test its validity.

2. There are many table tennis techniques and many obvious sequences in the training of different kinds of basic skills. In topspin teaching, the sequence of drive-loop obtained good results. In backspin skill teaching, better results were achieved in the sequence of chop and over-the-table chop. In drive teaching, fairly good results were obtained in the sequence of forehand, pivot drive, backhand drive, drives close to the table, far from the table over the table, drive topspin and drive loop.

3. Table tennis techniques are also characterized by precision and there are certain principles in their perfection. In training, fairly good results can be achieved by applying the following principles: training off the table and on the table, diagonal line, rectilinear line, single line, multiple line, single skill and combined skills.

4. Grasping the basic characteristics of the techniques and following the basic principles of the technique-development process can shorten the teaching process and improve its quality.

Research on Sports Competition Methods

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Competition is the core of sport. To have a profound understanding of the internal rules of sports competition is a must of the constant development of sports. Sports competition is extensively related to many other research fields and competition methods are in the forefront of sports competition.

Based on the special position and importance of competition methods in sports competition, the urgent requirement of sports competition practice and the current research on the lag between theory and practice, this project mainly dealt with competition methods, aiming to reveal the common characteristics, essential connections, and internal rules of competition methods.

This project adopted literature review, interview survey, logical analysis and math proof to advance and solve systematically the major problems of the theory and practice of competition methods.

1. Reveal the common characteristics, essential connections and internal rules. The primary task is to establish scientifically the system of sports competition methods. Competition methods are involved in sports competition which is based on competition events. The project successfully established the sports competition method system.

A Study on the Principles Governing the Development of Table Tennis Techniques

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How to master various techniques at high standard within a short time is an important problem in the teaching and training of table tennis. This paper used such methods as literature review, interviews and experiences to study the principles governing the perfection of table tennis techniques. The results showed that:

1. Table tennis techniques are "open-ended"; their development has two obvious stages: The first is the maneuvers, to skillfully master techniques under relatively stable conditions; the second is the improvement of techniques under relatively changed conditions. Soon after the teaching and practice of the first stage is over, the second stage begins. During the first stage, the best conditioned- stimulus combination is 80-90 percent stable-conditioned stimuli and 10-20 percent variant-conditioned stimuli; during the second stage, it is the opposite 70-80 percent variant-conditioned stimuli and 20-30 percent stable-conditioned stimuli. The intensity of conditioned stimuli affects greatly the perfection of technique. During this stage, the effect of using normal stimulus is not the best: The ideal conditioned stimulus intensity is made up of around 80 percent normal stimulus and 20 percent super-normal stimulus.

2. There are many table tennis techniques and many obvious sequences in the training of different kinds of basic skills. In topspin teaching, the sequence of drive-loop obtained good results. In backspin skill teaching, better results were achieved in the sequence of chop and over-the-table chop. In drive teaching, fairly good results were obtained in the sequence of forehand, pivot drive, backhand drive, drives close to the table, far from the table over the table, drive topspin and drive loop.

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4. Grasping the basic characteristics of the techniques and following the basic principles of the technique-development process can shorten the teaching process and improve its quality.

Comparative Analysis of the Games of the Finalists of the Top International and Bulgarian Competitions in 2000

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What are the similarities and differences between playing styles of the best players- Bulgarian and foreign - in table tennis? The answer to this question is extremely topical and has great practical significance.

Subjects of the investigation were the finalists from.

- 1) Olympic Games Sydney 2000: Kong Linghui (China) vs Waldner (Sweden); Wang Nan (China) vs Li Ju (China)- 22nd European Championship - Bremen; Carlson (Sweden) vs Primorac (Croatia); Gotch (Germany) vs Steff (Romania);
- 2) Bulgarian Top "12" (Sofia) : Doichinov vs Parapanov; Simeonova vs Shirilinkova.
- 3) Individual Republican Championship: Asenov vs Parapanov; Kasabova vs Shirilinkova.

The aim was to determine the styles of execution and effectiveness of the single strokes. The play was video filmed and then analyzed mathematically and statistically. The results allow us to conclude that the best Bulgarian competitors are less skilled than the world elite.

Systematization of Critical Situations during Table Tennis Matches

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One's mental state after making an error during a critical situation in table tennis demands adequate perception about the origin of the error, a mental preparation for coping with such a situation, a specific strategy and enough time to use it. Athletes who are not systematically prepared to self-regulate perhaps do not understand the real consequence of what they are doing at those moments.

The purpose of this study is to systematize such critical situations, which is an essential stage in the process of the psychological preparation of the athlete for coping with competitive stress. This systematization considers the time in the match – or a game – when the situation occurs, whether the score is positive or negative, the frequency of the critical situations and the level of difficulty of the match.

In determining what is critical one needs to consider the athlete's self-perception and the systematic observation by the coach, as well as to make use of the self-confrontation method and the relevant scientific bibliography available.

The table tennis simulator can measure the speed of deep and simple movements (speed of 'brain' and 'body') and the components of these movements; and speed (times of movement initiation and execution), level of behavioral fluctuations (capability of optimum attention concentration, motivation, arousal, resistance to disturbance), ability to anticipate, degree of benefit of anticipation of different ball flight directions, speed of movements in different directions, and transfer of possessed anticipatory and motor experience.

The research has demonstrated individual differences and differences between the groups tested with respect to the measured factors. Most of the factors examined correlate strongly with sporting results in professional table tennis play. These factors can be treated as aptitude for table tennis play and can be used to estimate the degree of sporting aptitudes, and the strong and weak aspects of the psychomotor efficiency of particular players. Cluster analysis can be used to undertake a comprehensive assessment of sporting aptitudes. This enables the groups tested to be divided according to aptitude level and is useful for selecting very talented players. The research based on cluster analysis enabled the two most talented players to be selected from the senior male Polish national team. One of them achieved world class results. Aptitude

Structure and Conditioning of "Ball Feeling" in the Opinions of Table Tennis Players and Coaches

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Key words: definition, symptoms and structure of "ball feeling", "feeling of rotation", table tennis, tennis coaches, tennis players

The condition which is essential to success at table tennis is a high level of motor coordination. "Ball feeling" is one of its elements. So far it has been an area little penetrated scientifically (Starosta, Felbur 1996). Hence, the aim of this research was:

- 1) To define the symptoms of bad and good "ball feeling".
- 2) To define the differences in the "feeling" in respect to each training stage.
- 3) To specify other conditions of "ball feeling".

According to those questioned, "ball feeling" is the ability to foresee (anticipation) and take for granted the opponent moves, and the ability to learn from sound and the specific place on the table. It is manifested by "feeling of rotation", the velocity of the flight, the direction and the force of the ball hit. The structure of the table tennis players' "ball feeling" consists of a racket, hand and ball; technical skills; ability to predict the kind of ball hit; analysis of the single action including the passing of the impulses to the hand; motivation; trust in one's own strength and knowledge on the application of the rotation principles during the match itself. These elements are strictly related with each other and they are applied by the competitors within fractions of seconds during the game.

Diagnostic and Training Possibilities of a Table Tennis Simulator

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The construction and use of the table tennis simulator is presented in the paper. The simulator consists of a simulator station, controller and computer. The simulator station, which allows play conditions to be simulated, consists of a stimuli board, a set of sensors and a special table tennis bat. There are seven lamps – stimuli – on the stimuli board. These lamps (anticipatory stimuli) simulate where the ball is struck by one's opponent. There are other lamps in the seven sensors (target stimuli), indicating the spot where the simulated ball is to be struck by the subject. Programming enables the different directions and speed of the ball's flight to be simulated: The flight direction is simulated by pairs of lamps on board and in the sensors, which are switched on sequentially, and the interval between the lighting of the two lamps determines the speed of the simulated flight. This enables the simulation of 42 directions of ball flight and 7 ball-hitting movements specific to table tennis. The simulated strokes, which may be forehand or backhand, require that flexible straps attached to the sensors be hit with a special table tennis bat. The instant when the simulated ball is hit is identified photo-electrically, so the strokes can be executed at maximum speed. The simulator may simulate a single stroke or a series of strokes or may play for points, and it can have diagnostic and training applications. The diagnostic and training possibilities of the simulator were verified by studies of children playing table tennis, highly skilled female players, as well as the junior and senior Polish male national table tennis team. The diagnostic application of the simulator can be used to examine psychomotor efficiency, degree of sporting aptitude, and readiness for competition. Psychomotor efficiency can be regarded as the capability of rapid and effective motor behavior in different situations.

The table tennis simulator can measure the speed of anticipated movements (speed of 'brain' and 'body') and simple movements (speed of 'body') and the components of these movements; and speed (times of movement initiation and execution), level of behavioral fluctuations (capability of optimum attention concentration, motivation, arousal, resistance to disturbance), ability to anticipate, degree of benefit of anticipation of different ball flight directions, speed of movements in different directions, and transfer of possessed anticipatory and motor experience.

The research has demonstrated individual differences and differences between the groups tested with respect to the measured factors. Most of the factors examined correlate strongly with sporting results in professional table tennis play. These factors can be treated as aptitude for table tennis play and can be used to estimate the degree of sporting aptitudes, and the strong and weak aspects of the psychomotor efficiency of particular players. Cluster analysis can be used to undertake a comprehensive assessment of sporting aptitudes. This enables the groups tested to be divided according to aptitude level and is useful for selecting very talented players. The research based on cluster analysis enabled the two most talented players to be selected from the senior male Polish national team. One of them achieved world class results. Aptitude

profiles can be used to indicate psychomotor deficiencies. This information may be very useful for coaches to individualize the training process.

The table tennis simulator can also simulate play for points. This score can be treated as a complex factor of psychomotor efficiency and used to estimate the level of readiness for competition. The scores of the junior male Polish national team showed that the best players in this simulated play achieved very high rankings in real tournaments.

The training application makes it possible to improve the speed of single, freely-chosen strokes (for example, a return or an attacking stroke), special speed (short series of different strokes repeated in short time), and special speed endurance (longer series of different strokes repeated over a longer time). The junior male tennis team was trained with the simulator just before the European Championships in Paris in 1999; they went on to win the championship title. Improvements of 35 % in special speed and 33 % in special speed endurance were found after training with the simulator. The research proved the very wide possibilities of diagnostic and training application of the table tennis simulator.

A Method of Measuring Transfer in Sport on the Basis of the Psychomotor Learning Curve

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Key words: transfer, learning curves, the method of measurement, simulator, table tennis, index of transfer.

The presented method of measuring transfer was illustrated on the basis of research into 12 senior and 10 junior members of the Polish male national table tennis team, 6 highly-skilled, adult, female table tennis players, 23 children practicing table tennis, 13 highly-skilled male tennis players, and 9 adult competitors, highly skilled in other, non-racket sports. The term 'psychomotor learning' was introduced. This learning was divided into movement, skills and situation motor behavior. The research depended on the multiple repetition of a series of 17 simulated ball hitting movements and measuring the speed of these movements. The results were approximated by an exponential curve. Transfer was measured on the basis of the speed and range of learning calculated with respect to learning curves. The ratio of these two magnitudes was treated as the index of transfer. This reflected the transfer of the anticipatory experience and motor skills learned in real table tennis play to the conditions of simulated play. The index of transfer was highest among female seniors and children, less among seniors and juniors practicing table tennis and tennis, and lowest among the group representing other sports.

The research demonstrated the greater flexibility of anticipatory schemas and ball hitting skills in the group of female seniors and children than among the male seniors and juniors. The lowest transfer occurred in the group of other sports because of the small number of anticipatory and motor skills useful in table tennis play.

Anticipatory Model of Human Situation Motor Behaviour

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The basic forms of human motor behavior are movement acts, motor activities, and situation motor behaviors. Movement acts are single movements of part or all of the body, which are characterized by a specific spatial form, as well as an independent control, for example, a single step. The spatial form of movement can be treated as a generalized picture of movement in space determined by a definite order of displacement directions in space but which can have different shape and range. For example, the oval form of a movement can include movements that are elliptical or circular and have different magnitudes (ranges). The spatial form and the muscles chosen to realize this form determine the kind of movement act, for example, a 'right-leg-step'. Motor activities consist of a single movement act or a series of such acts intended to achieve a variety of utilitarian, sporting or professional objectives.

Situation motor behaviour consists of the realisation of the different aims of this behaviour by the application of different kinds of movements or motor activities depending on the situation. In the case of motor activity, the situation only affects the aim and the way of execution of the movement act constituting this motor activity (shape and speed of movement). In situation motor behaviour, the situation determines the choice of movement (act) or motor activity which the subject can and does apply in definite situations. Movement acts, motor activity and situation motor behaviour can be treated as a psychomotor process, i.e. a process in which the psychic and motor spheres are involved. The psychic sphere is responsible for the control processes, whereas the motor sphere is responsible for setting the human body in motion and supplying the muscles with energy. The two spheres are connected by the sensory-neural-hormonal system.

In its full form, the *control of human movements* involves recognition of the situation, decision making, movement programming, the execution of this program and controlling the performance of the movement and its result. This control takes place in closed and open feedback loops. *Closed loop control (movement regulation)*, which occurs in slow movement and in motor learning, is based on feedback comprising information received by the brain from extero- and proprio-sensory and from external sources such as a coach or referee. *Open loop (automatic) control*, on the other hand, occurs during the execution of fast movements and in motor reacting. The term 'open feedback loop' refers to the interruption of the proprio-sensory information feedback during the execution of the movement.

One can differentiate two kinds of aims of motor activity, which have a hierarchical character and different natures. The first of these aims, which can be called the 'goal of motor activity', plays a super-ordinate role in this activity and reflects the utilitarian, sporting or professional nature of this activity, for example the winning of points (ball) in tennis. The second aim, the 'target of movement', is subordinate to the aim of motor activity and is of a physical nature, for example, the ball's location on the tennis court.

Learned motor behaviors, which enable definite targets and goals to be achieved, become skills. Schmidt (1988) has divided human motor skills into closed and open skills. In the present conception, it is intended to introduce the terms 'movement (motor) skills' and 'situation motor skills'. A learned motor activity becomes a movement skill, and learned situation motor behavior can be treated as 'situation motor skills'. Movement skills are only a simple form of situation skills, for which, in control processes, the decision making process is limited to the choice of target of a known kind of movement skill. Control of situation motor skills also requires choosing the kind of movement skill that the subject decides to apply in a given situation. In this conception, the basis of the motor control of movement and situation skills is psychomotor anticipation. The purpose of this paper is to explain the role of psychomotor anticipation in control processes of situation motor behavior on the basis of the *anticipatory schema theory of motor control and learning*.

Methods

1. Literature and questionnaire studies. The authors reviewed the literature on the development of early training and paper on the development of table tennis skills in China. The trends in the development of the table tennis scientific activities in China are analyzed. The age at which the players reach their maximum performance and the time he/she needs to reach his/her maximum performance. The relationship between the sensitive period in the development of sports quality which plays a leading role in the sport of table tennis and the early training of the sport.
2. The method of investigation and interview. Data on 23 male players and 19 female players of the Chinese table tennis team were investigated and the players were interviewed.

Conclusions

1. Analyzing from the sensitive period of sports quality which plays a leading role in the sport of table tennis and the results from the investigation on the elite Chinese table tennis players, the authors hold that it's appropriate to start training at the age of 5.
2. The average age at which the elite Chinese table tennis players reach their the maximum performance is 20.7 and the time they need to reach their maximum performance is 13.8 years.
3. In the two periods of the early training of table tennis, the game aspect of table tennis skill training should be emphasized in the enlightening period, while in early special training systematic, basic strategy and tactics training should be given more attention.

Development and Trends in Table Tennis Scientific Activities in China

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Scientific study is one of the most important reasons why Chinese table tennis remains at the top level in the world. Therefore, making a comprehensive summary of the history of table tennis scientific activities in China is critical for the further development of the sport

The author consulted the indexes of all the sport periodicals in Chinese from 1950 to 1999, selected 2828 papers as the materials of this study, and divided them into ten categories, making a statistical analysis of the trend of development in each category.

Two conclusions are made in this study:

1. Chinese table tennis scientific activities experienced five phrases: start, development, stagnancy, recovery, and steady development.
2. The trends in the development of the table tennis scientific activities in China correspond to the players' achievements in the major competitions.

In its full form, the *control of human movements* involves recognition of the situation, decision making, movement programming, the execution of this program and controlling the performance of the movement and its result. This control takes place in closed and open feedback loops. *Closed loop control (movement regulation)*, which occurs in slow movement and in motor learning, is based on feedback comprising information received by the brain from extero- and proprio-sensory and from external sources such as a coach or referee. *Open loop (automatic) control*, on the other hand, occurs during the execution of fast movements and in motor reacting. The term 'open feedback loop' refers to the interruption of the proprio-sensory information feedback during the execution of the movement.

One can differentiate two kinds of aims of motor activity, which have a hierarchical character and different natures. The first of these aims, which can be called the 'goal of motor activity', plays a super-ordinate role in this activity and reflects the utilitarian, sporting or professional nature of this activity, for example the winning of points (ball) in tennis. The second aim, the 'target of movement', is subordinate to the aim of motor activity and is of a physical nature, for example, the ball's location on the tennis court.

Research on the Early Training of Table Tennis Players in China

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Early training in table tennis is a new concept put forward in connection with the age at which table tennis players in the 50s to 70s began their training. Its research is a necessity in the development of the sport. In the competition of table tennis, people will inevitably pay close attention to the problem of early training when anticipating who will win and who will keep a high level of skills and strategies. This paper will discuss systematically in theory the problem of early training and set up a theoretical framework for it so as to provide scientific basis for the practice of early training in table tennis.

Methods:

1. Literature and information study. The authors have consulted books on sports training and papers on the early training of table tennis and formulated two problems:

The age at which a table tennis player reaches his/her maximum performance and the time he/she needs to reach his/her maximum performance.

The relationship between the sensitive period in the development of sports quality which plays a leading role in the sport of table tennis and the early training of the sport.

2. The method of investigation and interview. Data on 23 male players and 19 female players of the Chinese table tennis team were investigated and the players were interviewed.

Conclusions:

1. Analyzing from the sensitive period of sports quality which plays a leading role in the sport of table tennis and the results from the investigation on the elite Chinese table tennis players, the authors hold that it's appropriate to start training at the age of 5.
2. The average age at which the elite Chinese table tennis players reach their the maximum performance is 20.7 and the time they need to reach their maximum performance is 13.8 years.
3. In the two periods of the early training of table tennis, the game aspect of table tennis skill training should be emphasized in the enlightening period, while in early special training systematic, basic strategy and tactics training should be given more attention.

Test of Special Motor Fitness for Advanced Table Tennis Players

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Key words: special motor fitness, "feeling" for the ball, table tennis, accuracy test, steering the ball at the target

As we know from previous research, one of the most decisive elements in the effectiveness of the table tennis game is the "feeling" for the ball. Therefore, the aim of our work was to construct an objective set of tests of the accuracy of the aim of advanced table tennis players: that is, the ability to direct the ball into a precisely defined place. In order to achieve this goal we formed a set of 18 tests that evaluated the accuracy of the performance of the most important technical elements of table tennis. Through the use of the set, tests on 30 advanced competitors were conducted twice. The research applied the set of tests for special proficiency, and statistical calculations. The set included three basic strokes used in table tennis; serve, receive, attack. Each of the tasks were performed using forehand and backhand.

Conclusions:

1. "Feeling" for the ball was strongly connected with the length of the training period of each of the tested players. Their feeling improved along with the age and length of the training period.
2. Male players scored better results than female, that is, they had a better feel for the ball and simultaneously of sort proficiency.
3. A better feel for the ball was observed among competitors with a more advanced sport proficiency (results achieved during competitions in their sport class).
4. The verification of the suggested set of tests of special proficiency demonstrated its high relevancy and reliability. This means it can be considered an approved and objective test.

History of Mongolian Table Tennis

Boldbaatar Zagat

Mongolian Table Tennis Federation, Mongolia

The table tennis has been played in Mongolia since 1953 and our federation was founded in October 1959 under the name of the National Table Tennis Federation. Since that time MTTF has directed its activities to the improvement of athletes' professionalism so that their success could reach international level. In addition the government paid special attention to sport in general, and organized much work for the development of coaches, officials and athletes. A result of this policy over 400 clubs where around 10000 athletes have been trained, including around 2000 professionally ranked.

The members of the Federation have grown from 17 to 2000 as result of 13 national championships, six All-Mongolian people's national sport competition meetings, Mongolian Trade Union championships, Countryside youth championships and around 50 events yearly at the levels of cities, districts and sport clubs. Our Federation also has paid special attention to exchange for experiences with foreign sport organizations, clubs and athletes. During the last few years we have also organized joint training courses and competition with athletes of clubs in Korea, Russia, Hungary, China, Bulgaria, etc.

Mongolia became a member of the ITTF at the annual conference of the federation held in Beijing in 1961 and our athletes participated in the 26th World Championships for the first time.

Our athletes won 5-7th place in the team competition in the Asian Games held in 1966 in Phnom Penh, Cambodia, and reached 49th place out of the 66 countries at the World Championships held in 1973 in Sarajevo, Yugoslavia.

In 1980, our men's team won the first place in the inter-cities competition of the former Soviet Union held in the city of Chita and master of sport Mr. M. Nergui won the men's singles title.

Since 1985 with the beginning of the economic crisis in Mongolia and due to diminishing attention on sport by the state, the table tennis at the federation and club levels has been stagnant. The MTTF still organizes competitions, but plays only internally within the country, very rarely sending athletes abroad, and only at their own expense.

In 2000 we have organized nine competitions on different levels within the country and have participated in four international competitions; our team won the fourth place in the Second Asian Children's Games. Our male athletics constantly participated in the world championships and our athlete Mr. Galbadrakh in ranked at 534th with Mr. Bayarmagnai at 559th.

In recent years, with support by organizations and companies sympathetic to table tennis, the association has organized several championships and competitions at the country and city levels, and has reorganized the structure of the Federation; we now have 5 clubs involving about 200 athletes. The president of the newly recognized association is Mr. R. Amarsaikhan,

Member of Parliament, and Mr. O. Chuluunbat is the Deputy President; there are two Presidium members.

You may know that during the current democratic changes in Mongolia, obtaining financial support for sport development from the State is very difficult. The MTTF is financing its activities only by membership fees and sponsorship, which are not adequate.

Despite these difficulties facing the association, we intend to take table tennis training to a new level, to participate constantly in the competitions organized by the ITTF and Asian TTF, and to extend relations with foreign clubs. With this in mind, we would like to ask the respected authorities of the ITTF for their kind consideration in rendering support to the Mongolian Table Tennis Federation.

Finally, I would like to express our heartfelt gratitude to the Organizing Committee of this Congress for their kind invitation, which has given to us an opportunity to be acquainted with the participants of this forum, and for the warm hospitality of our Japanese friends who have organized this conference on an excellent level.

Thank you for your kind attention.

A Comparison of the Table Tennis Capabilities of China and Sweden

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This paper compares the strengths of the Chinese and Swedish table tennis athletes by analyzing the skills data of Linghui Kong and Guoliang Liu of China and Waldner and Persson of Sweden during the finals of the 45th World Table Tennis Championship and the semi-final and finals of the 27th Olympic Games. According to the data, the average serve-and-attack percentage of the Swedish team was 26.6%, and Chinese was 19.3%. The Swedish team was higher than the Chinese team by 7%, showing that the Swedish team was more aware of the value of serve-and-attack. In more detailed analysis, it was found that the average percentage of winning serves and attacks by the Chinese team was 67.0%, compared to 58.1% by the Swedish team, a difference of 8%; the Chinese team was superior to the Swedish in this skill. A comparison of the serving, receiving and attacking percentages shows that the Chinese athletes averaged 27.6% and, for winning serves and attacks, 40.1%. The Swedish team averaged 18.6% and 31.3%. This means that the Chinese athletes were superior to the Swedes in serving, receiving and attacking. The Chinese players were skilled in various playing styles and were successful with winning serves. It shows that the serving power of the Chinese team was a threat to the Swedish team. In periods of extended play, Waldner and Persson averaged 50.9% and 51.8%, respectively, and 54.6% and 53.8% for winning serves and attacks. The Chinese players, Guoliang Liu and Linghui Kong averaged 44.7% and 54.1%, respectively, and 34.4% and 51.47% for winning serves and attacks. This shows that the Swedish players were superior to the Chinese during periods of extended play, especially Persson. On the other hand, it shows that the ability of Chinese players during extended play was not as good. Guoliang Liu has made progress in the last two years in extended play ability; however, he was not able to play well during the two games because of this limitation. Linghui Kong played as well as the Swedes. Our conclusion from this study is that athletes who wish to succeed should improve their abilities for extended play and their skills in initiating attacks.

Understanding and Training Table Tennis Players' Sense of the Ball

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The sense of the ball is a special sense, which the table tennis player should have. It is a professional quality which such player uniquely has. It is also an important criterion of the level of an elite player. The sense of the ball is the good muscle sense of the player's reaction to the ball. It is also the observation, thought and judgment of the moving ball. Training the player's sense of the ball should start from childhood, because the sensitive period often appears at 12-16 years of age. We should lose no time in training the children at this best period. The sense of the ball must be trained both in practice and in competition. This is the key to training elite players. The sense of the ball should be trained in holding the development of both general and specific character. In the given environment, training the sense of the ball has apparently general character. For example, so far as the evolution of the ball technique, it forms that the style of speed and dropping place represented by China and South Korea, and the advantage of European Strength. It also has a variety of developments formed by both styles. The factors involved in the sense of the ball are many, and also a person's ability to understand and body quality are different. A person's sense of the ball shows various patterns. We should encourage the development of strong character in the right skill and tactics. Only in this way, it can be unified by the general and specific character.

We should also pay attention to the long period in training the sense of the ball: it takes a lot of time to obtain the sense of the ball.