



Issue 91

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Editorial

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Welcome to issue 91 of the ITF Coaching and Sport Science Review. This issue is the last one of 2023. It is available in the [ITF Academy](#) as well as in the new page of the journal, which can be accessed [here](#). This issue includes contributions from researchers and experts from all over the world that share their articles related to a variety of topics which include: the ITF WTN, tennis development at ground level, parent attitudes in tennis, public relations in college tennis, biomechanics and skill phases, the benefits of hitting against the wall, and the consequences of the changes made to the pro tennis tour, among others. This editorial will share the activities that the ITF Development Department has implemented throughout 2023 in the different pillars of its strategy.

In the education pillar, close to 600 coaches from 84 nations took part in the first ITF World Coaches Conference in South America in 16 years at the start of November.

The event, held in Bogota, Colombia on 31 October – 2 November saw 58 keynote and workshop speakers impart their knowledge and experience to 587 registered attendees in the first in-person event of its kind since 2019. The conference was themed around the concept of player-centred coaching – a crucial approach in nurturing the next generation of players in placing the player at the forefront of the coaching process, adapting and tailoring instruction to meet their individual needs, aspirations, and unique journey in the world of tennis. In a positive step forward for the event, 33 per cent of the speakers at the 2023 ITF World Coaches Conference were female – including the likes of Brazilian Billie Jean King Cup captain Roberta Burzagli. The ITF is committed to further building on this in the years to come. The biennial conference has been held on 23 occasions since its inaugural staging in Florida in 1982 and continues to provide huge value to participants from across the globe.

The event provided an optimal environment for a memorable interaction between all attendees. After the COVID pandemic, it was observed that the coaches wanted to physically see each other face to face again and share their experiences and knowledge after a period of great challenges. The feedback received to date has been extremely positive as the event has helped inspire and motivate coaches to continue providing the best tennis experience for all their players.

By year end, a total of 65 ITF-supported in-person courses will have been organised by 53 National Associations, as well as one virtual Play Tennis tutor training course for coaches in West & Central Asia. The in-person courses followed the standard ITF syllabi for ITF Play Tennis, Coaching Beginner and Intermediate



Players, Coaching Advanced Players courses and Coaching High-Performance Players courses. Within these figures, fifteen courses were funded by Olympic Solidarity (OS) of which nine were Regional Technical Courses for Coaches, enabling regional coaches to travel to the following nations to train alongside other coaches: Argentina, Dominican Republic, Egypt, Hong Kong, Kenya, North Macedonia, Trinidad, Uzbekistan, and Zimbabwe.

Another key educational programme is the OS Scholarships for Coaches. This year the OS Scholarship programme in Valencia focused on the delivery of the ITF Coaching Advanced Players (CAP) course for former players. In total 21 candidates attended the online delivery of the course, while 19 attended the residential and assessment weeks during May to June conducted in English and Spanish.

The ITF is also taking part in the Women in Sport High Performance Pathway (WISH Programme). The WISH Programme has been developed in cooperation with the IOC/Olympic Solidarity, ASOIF, AIOWF and several International Federations already engaged in projects to increase opportunities and pathways for high performance women coaches. The programme runs over 21 months and allows women who are involved or have the potential to be involved in elite coaching, to access leadership training, leadership mentoring and complementary sport-specific training led by the IF and with the engagements of the National Olympic Committees. To date the ITF has supported seven candidates to take part in this programme.

The ITF Academy, the ITF's education digital platform, continues its growth. ITF Data Sharing Agreements (DSAs) have been sent to 115 NAs who agreed to an ITF Academy NA package, of which 101 have activated their packages and are actively using the

platform to host national certification courses and education workshops or webinars. At the time of writing, the ITF Academy has more than 330,000 users of which over 96,500 are registered users who have access to more than 235 eLearning courses available in up to 12 languages. Over the past six months, more than 3.3 million page-views were recorded, with users spending an average of 22 minutes per session, browsing an average of 18 pages. The Library (former iCoach) content has also increased with more than 1,800 content items currently available online with the World Coaches Conference content to be added over the coming weeks.

In April 2023, the ITF Club Management course was launched while in June and November, the ITF Play Beach Tennis pilot certification course, delivered through the ITF Academy, took place in Brazil and Thailand. Since the start of 2023, eLearning courses for Wheelchair, Officiating, Safeguarding, Integrity, and the World Tennis Tours have been published.

Another programme that is conducted together with OS is the Development of a National Sport System (DNSS). The DNSS project in Bahrain concluded in April 2023. Ongoing DNSS projects include Burkina Faso, Mauritania, and Turkmenistan. DNSS allows National Olympic Committees (NOCs) to put into place a medium or long-term action plan to develop and strengthen their basic coaching structures and related sport systems.

Finally, the data from the ITF programme that recognises the Coach Education Systems of National Associations, indicate that to date, six nations have had their coach education system recognised by the ITF in 2023, while four are in progress. There are now 73 nations in total of which 18 are recognised at Gold, 11 at Silver, 23 at Bronze and 21 at White level.

As relates to the administration and resources pillar, the ITF Development department is organising regular specific and plenary meetings with the six Regional Associations to ensure continuous alignment on strategic priorities and effective project implementation. Coordination of the 2023 regional development calendar has also been a focus for discussion so that the department can ensure resources are allocated accordingly.

The 10 Development Officers have resumed their extensive, pre-pandemic travel schedules. The expertise, guidance and support they provide is invaluable to the successful implementation of the development strategy globally. They are the fundamental link between the nations, regions, and the ITF, conducting visits and implementing projects as ITF experts across all six pillars of the ITF Development Strategy.

Furthermore, towards the end of the year, the ITF will be asking its stakeholders to complete a short survey on the current 2021-2024 ITF Development Strategy. The information collected will be presented to the ITF Development Advisors and it will be used to inform the new 2025-2028 ITF Development Strategy.

In the facilities pillar, the application process for facility grants was changed last year so that National Associations can apply at any time during the year. The facility grant panel assesses applications as part of a rolling programme, allowing National Associations to spend more time on their submission without the pressure of a deadline. Since the new application process was launched, Bhutan, Cuba, Guam, and Jordan have all been awarded funding by the facility grant panel to improve existing facilities. The Development Officers are on hand to support National

Associations throughout the process and to introduce them to the ITF's official preferred court supplier California Sports Surfaces, for technical advice and to deliver facility projects.

National Training Centre (NTC) Recognition & Support has been identified as a priority programme for the Department and the target for 2023 is to have 20 more facilities recognised. The more nations that can provide a quality daily training environment for their players, the greater the chance more athletes will continue their journey up the player pathway. In early 2023, Lithuania was recognised at the Silver level, and Qatar achieved Bronze recognition while a further 22 National Associations have submitted their applications and have started the recognition process. The White recognition level, which was introduced in 2023 has been extremely well received, representing 72% of the new applications received.

In the participation pillar, the ITF supports 145 National Associations that are involved in the ITF Junior Tennis Initiative (JTI). Guinea Conakry from Africa, and Poland from Europe, became active nations for the first time in 2023 while Portugal rejoined the programme. Support for nations is in the form of financial assistance to subsidise an appointed National JTI Coordinator; donated ITF-branded equipment; as well as access to the ITF Academy, the ITF JTI online reporting platform, the ITF Toolkit, the ITF Tennis Festivals app, and guidance from the ITF Development Officers. The reporting process is critical, not only for monitoring and measuring the impact of the JTI, but also assessing the return on investment. All active JTI nations have been onboarded to the new reporting platform which provides nations with a digital footprint at grassroots level. The platform is also a national database of all venues and deliverers (schoolteachers and tennis coaches) involved in the national programme and provides insight on all the development activity and competitions organised. Report forms are available in 19 different languages and once submitted can be reviewed by the respective National JTI Coordinator using in-built analytics to see the progress being made, while a sophisticated assessment tool allows the ITF Development Officers to focus on the micro-level insight to identify areas for improvement.

Following a thorough review process, the ITF is developing a new equipment distribution platform for active JTI nations to access and order their respective equipment allocation annually. The new system will be available from 2024 and will allow for more customised shipments to be distributed to active JTI nations, whilst being more cost efficient and sustainable. During this review, the ITF has continued to support all active JTI nations with ITF-branded equipment, as well as grants for nations to purchase equipment locally. The ITF Development Officers continue to meet regularly with their respective National JTI Coordinators, organising regional conference calls - a process that has been in place since the start of the pandemic and has proved a positive addition for engagement across the JTI. The ITF is ensuring that all National Coordinators have access to continuous professional development and will be hosting a face-to-face global workshop for them to attend prior to the ITF World Coaches Conference in Bogotá, Colombia. Through the ITF Academy, all National Coordinators must complete four courses online: 'Understanding the JTI', 'Tennis Festivals', 'Safeguarding in Tennis' and new for 2023 the 'ITF Coaching Beginner and Intermediate Players Course - Introduction to competition'. No assistance is provided unless these pre-requisites are met, and the respective online JTI reports have been validated.

For the past few years, the ITF has been encouraging all active JTI nations to organise tennis festivals as the first introduction for many people to start playing tennis - particularly young people in schools and within the community. Earlier this year, the ITF published an ITF Tennis Festivals app on the Apple App Store to support their efforts and invited several nations to start using it. The ITF will use the feedback received from these nations to support the development of the next phase of the project. The ITF recommends that all National Associations encourage their tennis venues and deliverers to consider organising Tennis Festivals, or similar events, to provide free first-time playing opportunities to as many different people as possible. It is imperative that all participants at the Tennis Festivals know or be aware of when they can next play tennis and to ensure a positive retention from their first experience.

The first version of the National Association Development Framework for tennis has been shared with the initial contributing National Associations. The Framework has been devised following consultation with leaders in participation and performance from 25 nations and conducted by a team of researchers from Victoria University, on behalf of the ITF. The purpose of the project is to create an evidence-based framework for nations to compare and benchmark their current national delivery structures and operations to make improvements for the future. These nations are piloting the framework so that the ITF can refine the model. The tool will be accessible online for all to nations to use.

A new online platform will be available in late-2023 to collate insights on national tennis landscapes directly from all National Associations. This insight will be analysed and then published within the next ITF Global Tennis Report during the second half of 2024.

As per the events pillar, with tennis returning to pre-pandemic levels, of the 51 junior development events planned for 2023, 30 have taken place to date with all remaining events scheduled to be executed. Five 14 & under regional events funded by the Grand Slam Player Development Programme (GSPDP) will be held in 2023 providing more competitive opportunities in Asia, Africa, Central America and the Caribbean, South America, and Pacific Oceania.

At the time of writing, all 19 regional qualifying events have taken place across five regions. Turkmenistan played host to the Central Asia qualifying event in June, which attracted daily crowds of up to 4,000 people and the opening ceremony was broadcast live on national TV. The five regional finals are scheduled to be held between July and October.

Finally, as related to the performance pillar, in 2023, \$1.21 million is being provided as Grand Slam Player Grants to 51 players from 32 countries including two grants of \$50,000 to Juncheng Shang (CHN) and Victoria Jimenez Kasintseva (AND) who are just 18 and 17 years old respectively. Several 2023 player grant recipients achieved historic firsts this year including Rodrigo Pacheco Mendez from Mexico who became the first player from the Central American and Caribbean to reach the junior world No.1 spot since the rankings were combined in 2004 after winning a J500 in Milan. In June, Juan Carlos Prado Angelo made history for Bolivia after becoming the first player from his nation to reach a Grand Slam boys' singles final at the Roland Garros Junior Championships. Lucciana Perez Alarcon from Peru reached the girls' singles final at Roland Garros, becoming the first Peruvian girl to reach a Junior Grand Slam final and less than a month later she was making history again when she became the first girl from Peru to win a Junior Grand Slam match at Wimbledon since 1989.

At the time of writing, 37 of the 51 grant recipients (73%) have seen their rankings progress to date, during the 2023 season.

Nine International Touring Teams funded by the Grand Slam Player Development Programme (GSPDP) were planned for 2023 with four travelling in the first half of the year and the remaining five teams being organised between August and December. Highlights to date include Iliyan Radulov (BUL) who as a member of the 18 & Under team to Australia, reached the quarterfinals of the boys' singles event at the Australian Open Junior Championships while on the B team tour to Europe, Elizara Yaneva (BUL) won two J200 events in Italy and fellow teammate Nicolai Budkov Kjaer (NOR) won a J200 and a J300 event in Italy. As a member of the 18 & Under A team to Europe, Iliyan continued his winning ways on grass, reaching the finals of the J300 in Roehampton and the quarterfinals of Junior Wimbledon.

A highlight of the regional touring teams calendar funded by the GSPDP are the five 14 & Under teams that travel to Europe each year to complete in five tournaments in France, Germany, and Belgium. This year sees 43 players and 11 coaches from five regions travelling to Europe to take part in the tour with several players also being involved in the World Junior Tennis finals in Prostejov.

On January 30, the Africa Regional Training Centre (ARTC) officially opened with 14 full-time players (eight girls and six boys) from eight nations. Players have access to eight onsite hard courts, a fully refurbished fitness room, an onsite classroom, and three clay courts at a nearby facility. Since the Centre opened, players have competed in more than twenty events. Centre and player KPIs have been established and first half reports have been distributed to key stakeholders.

A new talent identification and development programme, the Road to Dakar 2026,

funded by Olympic Solidarity was launched this year in Africa with Kenya, Senegal, South Africa, and Togo being identified and approved to be part of the programme. The long-term goal of the programme is to increase the representation (on merit) of African players in the Dakar 2026 Summer Youth Olympic Games; the 2028 LA Olympics; and the 2032 Brisbane Olympics. Talent identification camps and competitions that have been held by the four nations, with a total of 180 players participating of which 78 players have been identified to start full-time high-performance training programmes in 2023.

The ITF continues to successfully roll out the ITF World Tennis Number (WTN) product with the aim to build a large, engaged community of global players in all nations of the world.

A large and accurate database containing 25 million match records from 70 nations is used to power both a singles and a doubles algorithm that updates globally on each Wednesday of each week.

In January 2023, the Intercollegiate Tennis Association adopted ITF World Tennis Number as its exclusive rating. The WTN and Team WTN is now seen on rosters and player profiles for all US College players.

Alongside the WTN is a programme to bring data consistency, quality, and the best digital tools to all the ITF National Associations. Creating this ecosystem will have long term benefits to tennis as a leading digital sport.

To find out more about ITF World Tennis Number please visit www.worldtennisnumber.com

We hope that you have found this editorial article useful. Its intention has been to present some of the activities that the ITF is implementing to develop tennis worldwide.

We would also like to encourage new submissions to the ITF CSSR through the new platform. Finally, we would like to thank all the authors for their contributions, as well as all of those who sent in proposals. Full guidelines for acceptance and publication of articles can be found in the most recent issue page on the ITF Academy. We hope that you enjoy reading the 91st edition of the ITF Coaching and Sport Science Review.

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World Tennis Number: The new gold standard, or a failure?

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ABSTRACT

The United States Tennis Association (USTA) has recently implemented World Tennis Number (WTN), as their official rating system. It is unknown if this rating system is accurate, therefore, the objective of this study is to determine the predictability of WTN in match outcomes, comparing it to the accuracy at which Universal Tennis Rating (UTR) predicts match outcomes. We collected matches from the 2022 USTA Boys' 16 & 18 National Championships. For WTN, UTR, and USTA ranking, we compared the predictability of match results using the Area-Under-Receiver-Operating-Characteristic (AUROC) Curve. Of the 806 matches analyzed, players with better WTNs, better UTRs, and better USTA rankings won in 76.8%, 76.7%, and 64.3% of matches, respectively. The predictability of WTN difference between players was comparable to that of UTR difference between players (AUROC, WTN: 0.847 vs UTR: 0.859, P-value = 0.14), and was superior to that of the difference in USTA rankings between players (P-value < 0.001). As WTN was superior to USTA ranking and was as accurate as UTR in terms of predicting match results, its use as a rating system is validated. This result can support the use of WTN for seeding criteria in USTA tournaments.

Key words: Tennis rating, World Tennis Number (WTN), Universal Tennis Rating (UTR), United States Tennis Association (USTA)

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INTRODUCTION

In the world of sports, rating systems are derived from competitive matches, and are used to determine the competitive level of play that a team or player competes at. Rating systems can be used in various scenarios, whether by fans and sports bettors for recreation, or by sporting associations to determine their rankings.

Tennis players often determine who they practice with based on their ratings. The closer their ratings, the more likely there will be a competitive environment, allowing for optimal practice. In tournaments, seeds, derived based on ratings and rankings, are of substantial significance, as they can change the outcome of the tournament. Inaccurate ratings can cause inaccurate seeding, which could result in unfair circumstances. When colleges recruit tennis players, coaches will initially look at the player's rating in order to grasp the level of the player. Ultimately, if a player's rating is accurate, it can lead to optimal practice environments, adequate seeding in tournaments, and proper college recruitment processes.

Currently in the sport of tennis, the most prominent player rating system is known as Universal Tennis Rating (UTR). UTR is on a 1.00 to 16.50 scale based on match results, where 1.00 is a rating for beginners, and 16.50 is a rating for top professionals (Vernon, 2022). It has been widely acknowledged as a gold standard of rating systems for tennis players (Kramer, 2017). The United States Tennis Association (USTA) has USTA Rankings for players, based on the amount of

points that a player has. Points are amassed based on how far into the draw a player reaches, and the level of the tournament (USTA, n.d.). As this is a ranking system, not a rating system, players in the same age division cannot have the same USTA Ranking. The International Tennis Federation (ITF) developed a rating system called World Tennis Number (WTN), which is on a 40-point scale, where 40 is a rating for beginners, and 1 is a rating for top professionals (Tennis New Brunswick, 2022). Recently, the USTA implemented WTN as the official rating system for the USTA, and it will be used as an aid for seeding in tournaments (USTA, 2022). However, as WTN has been newly introduced to the USTA community, one may doubt using WTN as the official rating system. In fact, there is no study supporting WTN as an accurate rating system, specifically when predicting match outcomes. Therefore, it is necessary to investigate the validity of WTN as a rating system. If WTN is shown to accurately predict match outcomes, not only does the decision by the USTA to implement WTN become supported, but using WTN as a rating system, just like UTR, also becomes supported.

Therefore, we conducted this study to determine if WTN is an accurate rating system in terms of the predictability of match outcomes by comparing it with UTR and USTA Rankings.

METHODS

We collected matches from the 2022 USTA Boys' 16 & 18 National Championships in Kalamazoo, Michigan, which started on August 5, 2022, and ended on August 14, 2022. The

reason we chose to retrieve match data from this tournament was due to several factors. We chose this tournament because it is a junior USTA tournament, which is relevant in the perspective of our study. Not only that, but the volume of data that can be collected from this tournament also surpasses nearly all other junior USTA tournaments. Also, as this is the biggest junior USTA tournament of the year, there are high level players, high level stakes, and as a result, there are many college coaches present. Consequently, these players are most likely to give it their all, and not “throw,” meaning that the skill levels between players in a match would not differ far from the ratings between the players, if the ratings are indeed accurate. In addition, the level of play at this tournament is very concentrated. Any good rating system should be able to easily predict match outcomes between players of vastly differing skill levels. However, the best rating systems are accurate at predicting match outcomes between players with similar skill levels. Therefore, through the data collected from a high volume of matches with highly concentrated skill levels, we will be able to have an accurate determination of the predictability of match outcomes by rating systems. In order to analyze anything, we needed to first determine the matches that would be analyzed. In the tournament, not every match would result in an accurate analysis of the predictability of the rating systems. If the match didn't start, there was no data. If opposing players had the same WTN or UTR rating, it would cause errors in the analysis. Therefore, to determine the matches that would be analyzed, we gathered all the matches, and then removed the matches that did not start, the matches where players had equal WTNs, and the matches where players had equal UTRs. The remaining matches would be used in our analysis.

We retrieved match data from the official USTA tournament website, including the draw stage, the round, games won by each player, sets won by each player, and the winner. We retrieved player data from the USTA and UTR websites, including name, residency, and section, and in addition, each player's WTN, UTR and USTA rankings, both prior to the tournament's start and after the tournament's conclusion. Between the players in a matchup, the higher the numerical value of the UTR, the better the player, and the lower the numerical value of the WTN and USTA ranking, the better the player. The main outcome was the match results of players with better WTNs, UTRs, and USTA rankings.

For each of the 806 matches, we collected data about the match and about the players in the match. In every match, we randomly assigned a player as “Player 1,” and the other player would be “Player 2.” Categorical data is shown as Frequency (Percentage) in the table. Quantitative data is shown as Mean (Standard Deviation) in the table. For matches, we collected the age division (16s or 18s), the draw stage (main or consolation), the round, number of games won and lost by Player 1, number of sets won and lost by Player 1, the match result in Player 1's perspective (win or lose), and if a player retired (yes or no). For players, we collected the USTA Rankings of Player 1 and Player 2, the UTRs of Player 1 and Player 2, the WTNs of Player 1 and Player 2, and the sections of Player 1 and Player 2.

Firstly, characteristics of included matches were analyzed. Categorical variables were presented as numbers (% proportions), and continuous variables were presented by means (standard deviations). Then we analyzed the correlation between difference in WTN and difference in UTR by using a correlation analysis. When calculating the values, the differences were based on how much better Player 1's rating was in comparison to Player 2's rating. As stated before, the lower the numerical value of the WTN, the better the rating, and the higher the numerical value of the UTR, the better the rating. Therefore, the difference in WTN was calculated by (Player 2's WTN) - (Player 1's WTN), and the difference in UTR was calculated by (Player 1's UTR) - (Player 2's UTR). We created one graph for all matches.

The main outcome was the match results of players with better WTNs, UTRs, and USTA rankings. We calculated the proportion of matches won according to the difference in rating (accuracy). To calculate accuracy, we divided the number of matches won by Player 1 within the particular rating difference, by the total number of matches within the particular rating difference. Using a classical confusion matrix model, we calculated the sensitivity and specificity of Player 1 match outcome predictions according to WTN, UTR, and USTA Ranking. To calculate sensitivity, we divided the number of correctly predicted wins by the sum of the number of correctly predicted wins and incorrectly predicted losses. To calculate specificity, we divided the number of correctly predicted losses by the sum of the number of incorrectly predicted wins and correctly predicted losses.

We calculated the win percentage based on whether Player 1's rating was higher or lower for each of WTN, UTR, and USTA Ranking. We also calculated the accuracy, sensitivity, and specificity with 95% confidence intervals (CIs) of each rating when predicting match results for all matches, for the Boys' 16 Singles Division, and for the Boys' 18 Singles Division. We compared the predictability of match results between WTN, UTR, and USTA ranking by comparing the Area Under Receiver-Operating-Characteristic (AUROC) Curve with Bonferroni corrected P-values. When interpreting the results of an AUROC curve, the higher the AUROC, the better the prediction of the model. Bonferroni corrected P-values were calculated by multiplying the number of comparisons with the P-values to reduce type I error. A P-Value < 0.05 was considered statistically significant. All statistical analyses were performed by using R software and State 17.0 (Statacorp, TX, US).

RESULTS

At the 2022 USTA Boys' 16 & 18 National Championships, there were a total of 886 singles matches in the tournament, with 443 matches in the Boys' 16 Singles Division and 443 matches in the Boys' 18 Singles Division. In 66 matches, the match did not start, due to players withdrawing or defaulting. In 11 matches, opposing players had the same WTN. In 3 matches, opposing players had the same UTR. There were no matches where opposing players had the same WTN and same UTR. Therefore, a total of 80 matches were excluded from the data, resulting in a total of 806 matches being analyzed, with 413 matches in the Boys' 16 Singles Division and 393 matches in the Boys' 18 Singles Division. This information is shown in Figure 1.

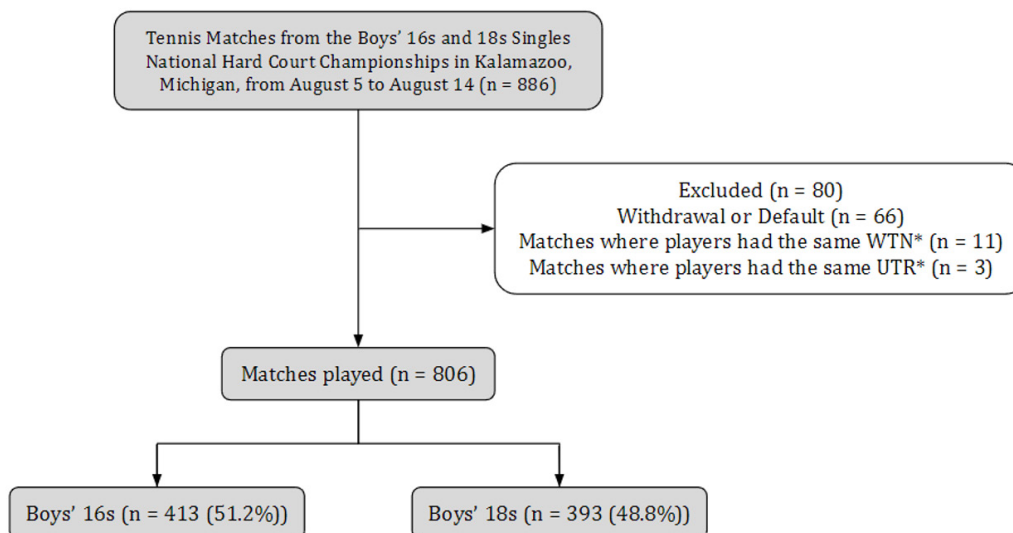


Figure 1. Flowchart for inclusion of matches. (WTN abbreviates World Tennis Numbers, UTR Universal Tennis Rating).

In Table 1, the characteristics of the 806 matches played are shown. On average, Player 1 won more games, sets, and matches, and had better USTA rankings, UTRs, and WTNs.

Table 1

Characteristics of the 806 matches played.

Total number	806
Matches	806 (100%)
Age Division (16 : 18)	413 (51.2%) : 393 (48.8%)
Match Distributions	
Main Draw Stage	433 (53.7%)
Consolation Draw Stage	373 (46.3%)
Main Draw Stage Rounds	
Round of 256	191 (44.1%)
Round of 128	126 (29.1%)
Round of 64	64 (14.8%)
Round of 32	30 (6.9%)
Round of 16	13 (3.0%)
Quarterfinals	5 (1.2%)
Semifinals	2 (0.5%)
3rd Place Playoff	1 (0.2%)
Final	1 (0.2%)
Consolation Draw Stage Rounds	
Round of 128 Qualifier	58 (15.5%)
Round of 128	117 (31.4%)
Round of 64 Qualifier	59 (15.8%)
Round of 64	53 (14.2%)
Round of 32 Qualifier	31 (8.3%)
Round of 32	22 (5.9%)
Round of 16 Qualifier	15 (4.0%)
Round of 16	5 (1.3%)

Quarterfinals Qualifier	8 (2.1%)
Quarterfinals	3 (0.8%)
Semifinals	0 (0%)
Final	2 (0.5%)
Match Information	
Games won by Player 1	9.73 (4.09)
Games lost by Player 1	9.27 (4.17)
Sets won by Player 1	1.18 (0.91)
Sets lost by Player 1	1.04 (0.92)
Match won by Player 1	434 (53.8%)
Retired	32 (4.0%)
Player Information	
Player 1 USTA* Ranking	144.61 (240.79)
Player 2 USTA Ranking	146.80 (172.82)
Player 1 UTR	11.21 (0.95)
Player 2 UTR	11.09 (0.92)
Player 1 WTN	12.51 (3.80)
Player 2 WTN	12.97 (3.61)
Section of Player 1 : Player 2	
Caribbean	2 (0.2%) : 2 (0.2%)
Eastern	81 (10.0%) : 90 (11.2%)
Florida	89 (11.0%) : 68 (8.4%)
Hawaii Pacific	8 (1.0%) : 5 (0.6%)
Intermountain	22 (2.7%) : 30 (3.7%)
Mid-Atlantic	33 (4.1%) : 36 (4.5%)
Middle States	31 (3.8%) : 27 (3.3%)
Midwest	82 (10.2%) : 63 (7.8%)
Missouri Valley	29 (3.6%) : 33 (4.1%)
New England	30 (3.7%) : 27 (3.3%)
Northern	15 (1.9%) : 18 (2.2%)

Northern California	69 (8.6%) : 63 (7.8%)
Pacific Northwest	22 (2.7%) : 21 (2.6%)
Southern	120 (14.9%) : 136 (16.9%)
Southern California	86 (10.7%) : 88 (10.9%)
Southwest	19 (2.4%) : 19 (2.4%)
Texas	68 (8.4%) : 80 (9.9%)

Categorical variables were presented as number (% proportions), and continuous variables were presented by means (standard deviations). (USTA abbreviates United States Tennis Association, UTR Universal Tennis Rating, WTN World Tennis Number).

The difference in UTR and the difference in WTN were strongly correlated ($r = 0.892$, $P < 0.001$) (Figure 2). Also, there are several outliers, suggesting that there may be disagreement between the rating systems for certain pairs of players.

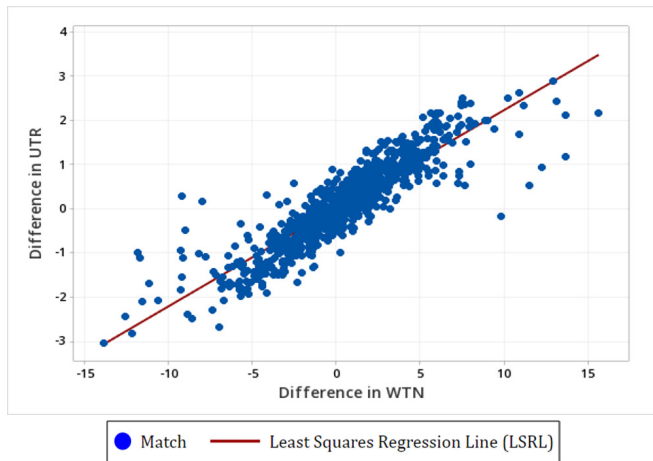


Figure 1. Scatter plot for correlation between difference in WTN and difference in UTR.

For both WTN and UTR, as the absolute difference in rating increases, the proportion of matches won by the player with the better rating increases. More than 80% of matches were won by the player with the better rating when the absolute difference in WTN ≥ 3 , and when the absolute difference in UTR ≥ 0.8 .

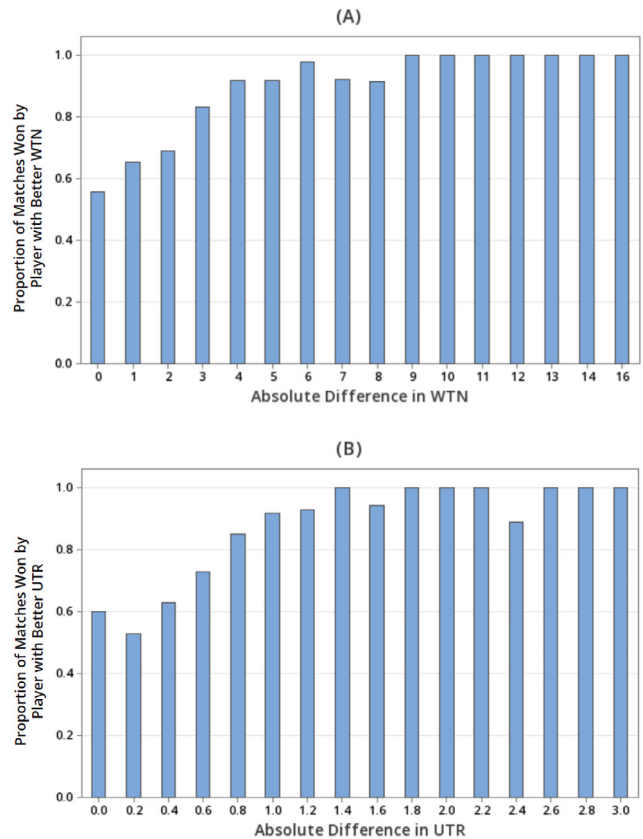


Figure 3. Relationship between the absolute difference in rating, and the proportion of matches won by the player with the better rating at those differences.

More than three quarters of players with better WTNs (77.9%) and those with better UTRs (78.0%) won the match. Differences in WTN and differences in UTR have comparable accuracy (76.8% [95% CI, 73.7%-79.7%] vs 76.7%[95% CI, 73.6%-79.6%]), sensitivity (79.5% [95% CI, 75.4%-83.2%] vs 79.0%[95% CI, 74.9%-82.8%]) and specificity (73.7% [95% CI, 68.9%-78.1%] vs 73.9% [95% CI, 69.2%-78.3%]) in predicting match results. Results were similar in the analysis for each division. However, USTA ranking has lower accuracy, sensitivity, and specificity when compared with WTN or UTR (Table 2).

Table 2

The accuracy, sensitivity, and specificity of predicting match results based on the differences of WTN, UTR, and USTA rankings between Player 1 and Player 2.

		Player 1 wins the match, number (%)	Accuracy (95% CI)	Sensitivity (95% CI)	Specificity (95% CI)
Total (n = 806)	Player 1 WTN < Player 2 WTN	345 (77.9%)	76.8% (73.7%-79.7%)	79.5% (75.4%-83.2%)	73.7% (68.9%-78.1%)
	Player 1 WTN > Player 2 WTN	89 (24.5%)			
	Player 1 UTR > Player 2 UTR	343 (78.0%)	76.7% (73.6%-79.6%)	79.0% (74.9%-82.8%)	73.9% (69.2%-78.3%)
	Player 1 UTR < Player 2 UTR	91 (24.9%)			
	Player 1 USTA < Player 2 USTA	292 (66.7%)	64.3% (60.9%-67.6%)	67.3% (62.7%-71.7%)	60.8% (55.6%-65.8%)
	Player 1 USTA > Player 2 USTA	142 (38.6%)			
16s (n = 413)	Player 1 WTN < Player 2 WTN	175 (79.5%)	76.8% (72.4%-80.8%)	77.4% (71.4%-82.7%)	75.9% (69.2%-81.9%)
	Player 1 WTN > Player 2 WTN	51 (26.4%)			
	Player 1 UTR > Player 2 UTR	173 (79.4%)	76.3% (71.9%-80.3%)	76.6% (70.5%-81.9%)	75.9% (69.2%-81.9%)
	Player 1 UTR < Player 2 UTR	53 (27.2%)			
	Player 1 USTA < Player 2 USTA	162 (68.6%)	66.6% (61.8%-71.1%)	71.7% (65.3%-77.5%)	60.4% (53.0%-67.5%)
	Player 1 USTA > Player 2 USTA	64 (36.2%)			
18s (n = 393)	Player 1 WTN < Player 2 WTN	170 (76.2%)	76.8% (72.4%-80.9%)	81.7% (75.8% -86.7%)	71.4% (64.3%-77.8%)
	Player 1 WTN > Player 2 WTN	38 (22.4%)			
	Player 1 UTR > Player 2 UTR	170 (76.6%)	77.1% (72.6%-81.2%)	81.7% (75.8%-86.7%)	71.9% (64.8%-78.2%)
	Player 1 UTR < Player 2 UTR	38 (22.2%)			
	Player 1 USTA < Player 2 USTA	130 (64.4%)	61.8% (56.8%-66.7%)	62.5% (55.5%-69.1%)	61.1% (53.7%-68.2%)
	Player 1 USTA > Player 2 USTA	78 (40.8%)			

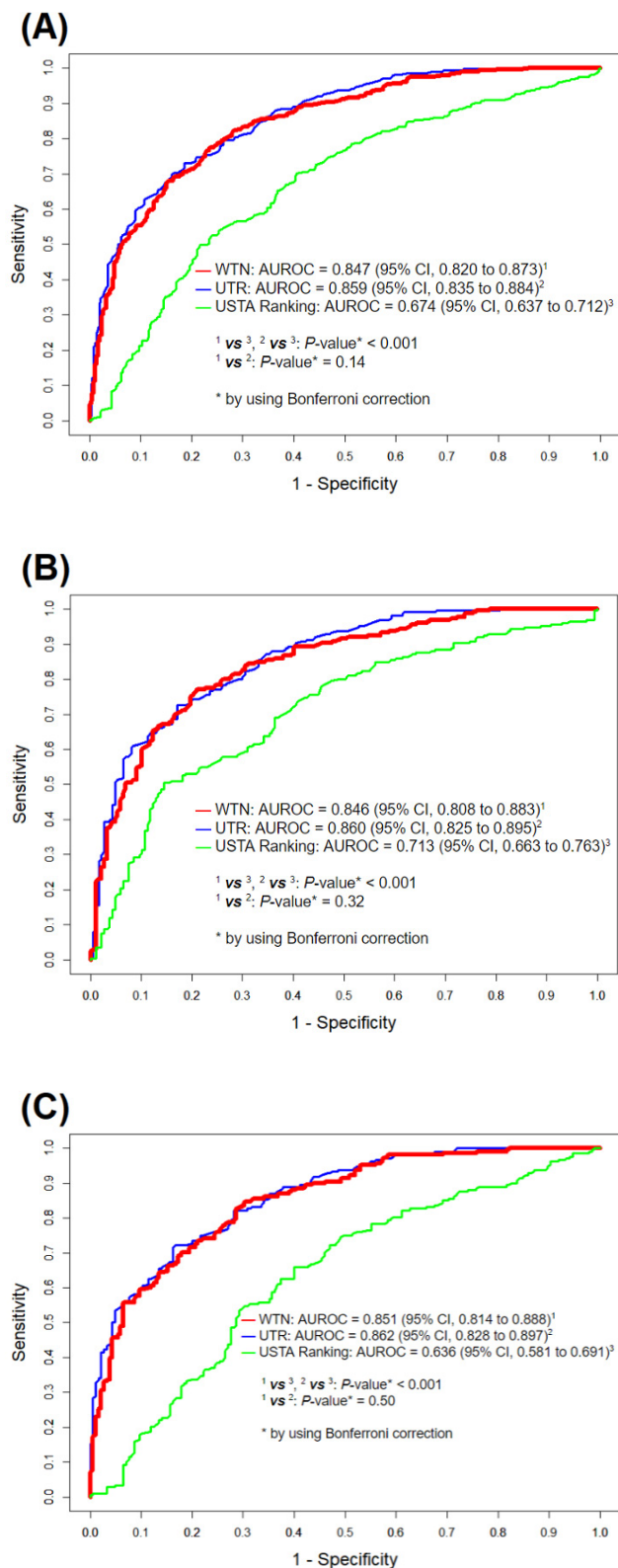


Figure 4. Receiver-Operating-Characteristic (ROC) Curves for match outcome predictability of WTN, UTR, and USTA in Boys' 16 Singles, Boys' 18 Singles, and All Matches. (A) All Matches (B) Boys' 16 Singles (C) Boys' 18 Singles. A classification model using WTN difference has a statistically comparable AUROC with that using UTR and has a significantly higher AUROC compared with that using USTA ranking. The results were similar regardless of age groups. (*WTN abbreviates World Tennis Number, UTR Universal Tennis Rating, USTA United States Tennis Association (ranking)).

WTN abbreviates World Tennis Number, UTR Universal Tennis Rating, USTA United States Tennis Association (ranking), CI Confidence Interval.

There were no significant differences in AUROCs between difference in WTN and difference in UTR in predicting match results. (0.847 [95% CI, 0.820-0.873] vs 0.859 [95% CI, 0.835-0.884]; $P=0.14$) However, differences in USTA Ranking had lower AUROC. Results were similar in analysis for each age division.

DISCUSSION

From our results, we can determine that WTN and UTR have similar predictability of match results, whereas USTA Ranking falls behind. WTN and UTR are consistent in predictability regardless of age division, whereas USTA Ranking has slight variations in predictability between age divisions.

To our knowledge, there has been no prior published study that investigated the predictability of WTN or UTR. Our study is the first to compare and analyze the predictability of those two rating systems. Although there is no other study for us to compare with, we will identify this study's strengths and limitations.

The main strength of this research is the reliability of the data. In this research, we were able to gather match data from 806 matches. In addition, all these matches were from a single tournament. This means that each player will have the same rating throughout the tournament, regardless of round. Therefore, this provides stability for the analysis. However, what really makes our research reliable is the reliability of the players' ratings. The tournament which we gathered data from is the biggest national tournament of the year for junior USTA players. This means that only the top players from around the nation would be able to play in the tournament, as selections were based mainly off of USTA ranking, and a few were selected based on UTR (USTA, n.d.). All these top players not only have high USTA Rankings, but in order to amass these points, they would have had to play a lot of matches. And for both rating systems, the more matches a player plays, the more reliable their rating can be. Therefore, by collecting match data from matches played between players with reliable ratings, our analysis becomes more accurate and reliable.

We acknowledge limitations of this study. We collected data from matches between high level players who frequently play matches, which means that this research provides definite validity for the aforementioned group of players. However, the results of this study may not guarantee validity for recreational players who play matches less frequently and at a lower level. Therefore, future research, spanning more tournaments of various levels, will be needed in order to guarantee validity for all groups of players.

WTN and UTR use similar algorithms to calculate ratings for players. Both rating systems analyze the pre-match ratings of the players. Then each respective algorithm predicts what the match outcome will be, with WTN predicting sets won by each player, and UTR predicting the percentage of games won by each player. Each player's rating will go up or down, based on the match results, when compared to the prediction based on ratings (Lawn Tennis Association [LTA], 2022).

Although WTN and UTR were very similar in match outcome predictability, they were not identical. This means that WTN and UTR did not agree all the time. If this were to be true, then the two rating systems would essentially be equal. That means that there must be factors to why there are similarities, but also differences between WTN and UTR.

WTN bases player ratings using match results from 2016 onwards. UTR bases player ratings on the thirty most recent matches played within the past year. For both rating systems, what matters is not the outcome of the match itself, but instead the number of sets won by each player, for WTN, and the number of games won by each player, for UTR. For UTR, if the difference between UTRs is +2, the match is not counted towards UTR. Also for UTR, each player is given a reliability of their rating. The more matches a player has, the more the reliability of their rating increases.

For both rating systems, recent matches carry more weight, whereas older matches carry less weight. For WTN, results from sanctioned competitions carry more weight, as opposed to results from club or recreational events (Tennis New Brunswick, 2022). For UTR, the longer the match format, the more weight is given. Also for UTR, the more reliable the opponent's UTR is, the more weight is given.

Both rating systems use nearly identical methods to determine player ratings. Therefore, it makes sense that they would be very similar. However, each system has its own way of choosing matches, and also weighing matches, which can cause a slight difference when rating players.

Reasons why WTN and UTR are similar, with USTA ranking lagging behind, could be explained by the difference between rating and ranking systems. WTN and UTR are rating systems, dependent on the player's match performance and opponent's rating, whereas USTA Ranking is a ranking system, dependent on the number of points a player has. Although it may not seem like a vast difference, it very much is. WTN and UTR, as rating systems, make it so that every player is "connected," in a way. Your rating is dependent on your performance, and also your opponent's ratings, which allows accuracy within relative skill. Although there may be a bit of "luck" played into it, such as certain players having strengths or weaknesses against others, ultimately, that is all part of skill. USTA Ranking is based on how many points a player has, and points are collected based on how far into the tournament a player gets to, and the tournament level. The further a player progresses into a tournament, the more points they will acquire, and the higher level a tournament is, the more points will be available. It may be true that the best player will win the tournament, therefore winning the most points. However, depending on where a player is placed in the draw, they could win varying amounts of points. This means that, although skill is obviously a factor in obtaining points for USTA Ranking, luck of the draw, which has nothing to do with skill, could very much change the outcome of the number of points a player comes out of the tournament with.

CONCLUSION

From this study, it is shown that WTN and UTR are similar, and both ratings are better than USTA Ranking, in predicting match outcomes. Therefore, as WTN is similar to UTR, the use of WTN as a rating system is validated. The results from

this study can support the use of WTN as the official rating system of the USTA and as a prominent factor in seeding criteria in USTA tournaments. The results from this study can also support the use of WTN in the college recruiting process, which is very important in both the junior tennis world and for colleges. As of the date of submission of this article, UTR is the only numerical-based rating system that colleges use for recruiting, but with the introduction of WTN, college coaches will be able to recruit new players more effectively because of the added reliability of another player rating system. With two reliable rating systems from different sources, there may be a race to create an even better rating system. In conclusion, the introduction of WTN, this newly improved rating system, into the tennis community, will create a ripple throughout the tennis world.

CONFLICT OF INTEREST AND FUNDING

The authors declare that they do not have any conflict of interest and that they did not receive any funding to conduct the research.

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RECOMMENDED ITF TENNIS ACADEMY CONTENT (CLICK BELOW)





Public relations strategy in a Japanese college tennis team during COVID-19: Factors for joining the team

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ABSTRACT

The spread of the novel coronavirus infection that began in 2020 has forced the cancellation of many competitive sports events. This has made it difficult for college sports teams to recruit top athletes at athletic venues and has also forced the cancellation of face-to-face recruiting activities for general freshmen. Under these unprecedented circumstances, online publicity strategies have become particularly important. In this study, we attempted to analyze the effectiveness of the public relations strategy of the Y tennis team of K University by focusing on the factors that were decisive in new students' decisions to join the team. The results showed that the decisive factors were "enriched practice environment" and "compatibility with academic work." It was also found that approximately 40% of the new members decided to join the team after receiving information on Twitter and participating in online information sessions. In this paper, we propose effective public relations strategies while drawing actual examples from public relations strategies in practice.

Key words: Public relations strategy, college sports, tennis

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INTRODUCTION

In recent years, the activities of college student athletes in particular have been attracting a great deal of social attention, and colleges have been expanding entrance examinations with sports recommendations as part of their public relations strategies to attract top athletes (Tomozoe, 2006). In fact, 87% of all universities in Japan have a sports recommendation entrance examination system (Japanese Association of University Physical Education and Sports, 2014), and accordingly, coaches and managers of college athletic teams conduct rigorous recruiting activities, such as visiting athletic competition venues, in an effort to enroll excellent athletes (Shimizu et al., 2011).

However, the spread of the novel coronavirus infection that began in 2020 (Ministry of Health, Labour and Welfare, 2021) deprived us of our daily lives and led to the cancellation of many competitive sporting events. This not only made it difficult to recruit top athletes at competition venues, but also led to the cancellation of in-person recruiting activities of new students (Yoshida, 2021).

Under these unprecedented circumstances, online publicity strategies have become particularly important. It is reported that 95.6% of high school students own a smartphone today, and that 53.6% of them have increased the amount of time they spend using it as a result of voluntary restraints on face-to-face activities following the spread of the novel coronavirus infection (Tokyo Metropolitan Government, 2021). Under such circumstances, it is beneficial for college athletic clubs



to execute online publicity strategies using social networking services (SNS), as an alternative to face-to-face recruiting and club enrollment activities. Regardless, it is expected that online public relations strategies will become increasingly important in the future, even after the novel coronavirus outbreak is under control.

Nevertheless, there have been few academic studies on public relations strategies of student-led college athletic teams. In fact, Amiso (2008), who examined public relations strategies for student recruitment in colleges, Taninouchi (2020), who studied college public relations departments, and Takeuchi (2010), who analyzed college public relations media, all

have studies focused on public relations strategies in larger organizations.

In this study, in order to examine effective publicity strategies for college athletic clubs, we analyze the effectiveness of the publicity strategy implemented by the K University Y Tennis Club (Y Tennis Club), which has its training base in Kanagawa Prefecture, Japan (Hotta et al., 2022a), with a focus on the factors that were influential in the decision of new students to join the club. The Y Tennis Club has a history of more than 80 years and is based at the tennis courts on the campus of K University. The club is characterized by the diversity of its members, and although it does not conduct entrance examinations with sports recommendations, it is known for its high competitiveness in the Kanto Polytechnic College Tennis League (Hotta et al., 2022b). The men’s team belongs to the first division out of 13 divisions and won the second place in 2019, and the women’s team also won the first place the second division in 2018. In addition, the team is also making efforts to nurture “supporting” personnel (Hotta, 2021), and has the largest number of certified officials of the Japan Tennis Association among Japanese college tennis clubs, with many members of the team having been hired as management staff at competitive international sporting events (Hotta, 2023). Furthermore, there are other college tennis teams at K University, such as K University H Tennis Club (H Tennis Club) and K University Tennis Circle (Circle). Considering how Y tennis club and the other tennis teams are in a competitive relationship in terms of recruiting new members, the Y tennis club is optimal for studying the effectiveness of public relations strategies, which is the objective of this study.

PROCEDURE AND DATA ANALYSIS

55 members of Y tennis club were targeted (Table 1). 46 responses (83.6%) were received, all of which were valid (100.0%). In the Y tennis club, the teams are divided into A, B, C, and D in order of the competitiveness of the members. The survey period was from June 16, 2021, to June 23, 2021.

Table 1
Demographics.

		Count	%
Grade (n=46)	Freshman	20	43.5
	Sophomore	13	28.3
	Junior	13	28.3
Gender (n=46)	Men	36	78.3
	Women	10	21.7
Competitiveness (n=46)	A	9	19.6
	B	12	26.1
	C	14	30.4
	D	11	23.9

The survey items consist of their demographics, items related to the operation of SNS and official homepages, items related to the brand image, and items related to the recruiting. All the items were filled out on the web using a survey form with Keio University Authentication System enabled. The survey form was protected by SSL/TLS encryption, server certification, firewall access control, and other security and privacy protection measures. Simple tabulations were performed for all survey items. Data collected was the following:

- Demographics: Grade, gender, and competitiveness were asked.
- Items related to the operation of SNS and official homepages: The respondents were asked to evaluate the frequency and content of their team’s SNS such as Twitter and YouTube, as well as their official website, using a five-point scale from “1: evaluate lowly” to “5: evaluate highly.” The respondents were also asked to provide free comments regarding their specific evaluations, if necessary.
- Items related to the brand image: The respondents were asked to evaluate brand image, including the contents of the logo and catchphrase, using a five-point scale from “1: evaluate lowly” to “5: evaluate highly.” The respondents were also asked to respond to multiple-choice questions (Goto et al., 2003) and to provide free descriptions regarding their specific evaluations, if necessary.
- Items related to the recruiting: The respondents were asked to respond to multiple-choice and open-ended questions regarding the media they used to gather information and the types of events they participated in before joining the club.

Regarding the ethical considerations of the study, prior to the survey, the purpose of the survey, the survey method, and the protection of information were explained in writing to the representatives of Y tennis club, and the method of conducting the survey was discussed. Then, the URL of the survey form was distributed to the 55 members of the Y tennis club through the representatives of the Y tennis club. In the survey form, the following explanatory text was written in a position easily recognizable by the respondents: (1) the purpose of the survey, (2) the voluntary nature of the responses, and (3) the fact that the information would not be disclosed to the public as personally identifiable information.

RESULTS

Items related to the operation of SNS and official homepages.

First, Twitter is a social networking service with 320 million users worldwide and 45 million users in Japan (Onodera, 2018), and the majority of high school and college students use it daily (Toyoda, 2015; Aoyama, 2018). In this respect, it is the most important medium for the Y tennis club in terms of publicity strategy to attract new members and to communicate with the outside world. In fact, in the survey of Y tennis club members, 39.1% of the total respondents answered that they first learned about the Y tennis club through Twitter posts. Therefore, during the period from October 2019 to September 2020, including periods amidst the COVID-19 Disaster, 330 posts were made. This is the highest number of posts per year since the account was opened in 2015, and 6.6 times the number of posts made from October 2018 to September 2019, periods unaffected by the COVID-19 Disaster. The posts were designed to appear at the top of Twitter’s algorithm (Onodera, 2018) by adding images and video content. This was also done in order to provide a more concrete understanding of the expressions and activities of the club members in the absence of face-to-face recruiting activities during the COVID-19 Disaster. In addition, in the period immediately prior to the September university enrollment, the information was also provided in English, since the the September university enrollment is mainly for foreign students. In terms of content, they sought

to enhance the introduction of the club members, facilities, and events, as well as the style of writing to make it seem more familiar to younger readers. In addition, the communication with the viewers was also emphasized by replying to all direct messages and comments on posts.

As a result, the number of followers increased from 440 as of October 2019 to 563 as of May 2021, and the cumulative number of postings viewed exceeded 1 million during that period. In fact, in a survey of Y tennis club members, the content of Twitter posts received a high rating of 4.50 on average. In the free comments section, the following comments were also made by the respondents: "It was very good that there were posts on a wide range of topics, such as introductions of members, events, and reports on external competitions," "It was easy to understand what kind of events were held and where to contact during the new member period."

Next, YouTube is a medium mainly for posting videos and is used by many high school and college students (Toyoda, 2015; Aoyama, 2018). Therefore, in addition to distributing videos of matches, the Y tennis club also focused on creating and posting image videos. The image video expresses the history of the Y tennis club and the diversity of its members, and it also tries to convey the atmosphere of respect for all the players, supporters, coaches, referees, ball players, and alumni (MEXT, 2017) who "experience, watch, and support" (MEXT, 2017). The video is composed mainly of images taken by individual members before the COVID-19 disaster, and was edited by the Public Relations Strategy Committee members using the standard Windows 10 application "Photos." The image video was completed in March 2021, and the completed video was posted not only on YouTube but also on Twitter.

As a result, as of May 2021, the video has been viewed more than 10,000 times in total. In a survey of Y tennis club members, the video received a high overall evaluation of 4.35 on average, and the following comments were also given by the respondents in the free comments section: "It was good that the passion for tennis was conveyed," "Many new students waver between joining the Y tennis club or a circle, but the former has more focus on tennis itself, while the latter is more about socializing."

Next, the official website of the Y tennis club was completely revised in February 2020, because the visibility of the website was not good. The design of the official website was mainly yellow and black, referring to the color tone of the official website of K University, and in terms of contents, the history and activity records of Y Tennis Club were enriched.

As a result, the site was viewed 6,086 times cumulatively from October 1, 2019 to September 30, 2020 (Period A), including the post-renovation period. This is 2.07 times as many as the cumulative number of views during the period from October 1, 2018 to September 30, 2019 (Period B) before the renovation. The average time spent in period A was also 3 minutes and 09 seconds, which is 1.3 times longer than that in period B. In fact, in the survey of Y tennis club members, the content of the official website was rated extremely high with an average of 4.59, and the design was also rated high with an average of 4.57. In addition, in the free comments, respondents reported that "the website is easy to read and provides a variety of information," and "the Q&A about joining the club helped me to resolve my doubts and concerns before joining the club."

Items related to brand image.

In the operation of SNS and official homepages, an important public relations strategy is how to present the Y tennis club to the target audience, i.e., the brand image of the club. In the case of Y Tennis Club, in order to win the championship in the Kanto Polytechnic College University Tennis League for both men and women, it was necessary to recruit new members with high competitiveness, and to recruit women in order to secure the number of members necessary for the women's team to participate in the team competition.

Therefore, when recruiting new members for the 2020 and 2021 academic years, we targeted (1) those who have played tennis before and (2) female members in our public relations strategy. In order to differentiate the Y-tennis club from competing clubs such as the H tennis club and circles, we created a catchphrase, "a club for anyone who values the joy of tennis," reflecting the characteristics of the Y tennis club as described in the introduction, and displayed it with the logo in each media. The catchphrase was displayed in each media along with the logo and logotype. In addition, the contents of each media were also considered to be in line with this catchphrase. The catchphrase received a high evaluation in a survey of Y tennis club members, with an average rating of 4.37. The results were as follows: "It is good that the rigid impression of an athletic association is dispelled," "It is good that we can enjoy tennis on the premise of having fun," and "It is good that we are firmly oriented toward competitions" and "It was easy to convey the attitude of facing competition firmly while assuming the enjoyment of tennis."

Next, 40 (87.0%) of the respondents chose "enriched practice environment" as the deciding factor in their decision to join the club, followed by 27 (58.7%) for "compatibility with academic work," 13 (28.3%) for "little difference in opportunities to participate in matches and practices based on ability."

The most common characteristic of the Y tennis club, which was not found in the H tennis club, was "Balance with schoolwork" with 30 (65.2%), followed by "Fewer differences in participation in matches and practices depending on tennis ability" with 24 (52.2%), "Social contribution activities such as refereeing" with 24 (52.2%), and "Interaction with various club members and friendly atmosphere" with 22 respondents (47.8%).

As for the characteristics of the Y-tennis club that were not found in the circle, 40 (87.0%) of the respondents selected "enriched practice environment" the most, followed by 35 (76.1%) for "good teaching environment," 30 (65.2%) for "social contribution activities such as refereeing," and 27 (58.7%) for "connection with alumni."

Based on these results, it can be seen that "enriched practice environment" and "good coaching environment" were recognized as superior characteristics by the Y tennis club members compared to the circle, and "balance with schoolwork" and "little difference in participation opportunities in matches and practices depending on the level of tennis ability" were recognized as superior characteristics compared to the H tennis club. These characteristics also appeared at the top of the decisive factors for the decision to join the Y tennis club, and the agreement between the characteristics of the Y tennis club and the decisive factors for the decision to join the Y tennis club was confirmed.

From the above, it can be concluded that the Y-tennis club's publicity strategy using SNS and official homepages has been effective in promoting the membership of the Y tennis club, as the club has been able to build up its contents with an awareness of the characteristics of prospective members and its differentiation from other clubs.

Items related to the recruiting.

Finally, we examined how the members of the Y tennis club decided to join the club. First, when the members were asked how they first heard about the Y tennis club before joining, the most common answer was "from an acquaintance" at 27 (58.7%), followed by "Twitter" at 18 (39.1%), "official website" at 7 (15.2%), and "Instagram" at 6 (13.0%) (Table 2). Based on the above, it can be understood that the Y tennis club's emphasis on publicity strategies using Twitter and Instagram has been effective. It should be noted here that none of the members of the Y tennis club had the opportunity to learn about the Y tennis club through the online welcome party officially conducted by K University amidst the COVID-19 Disaster. This implies that the Y tennis club could not have obtained new members unless they voluntarily carried out the public relations strategy. However, the most common answer was "from an acquaintance," which indicates that it is important not only to publicize the Y tennis club comprehensively through SNS, but also for each member to solicit his/her acquaintances to join the club personally.

Next, we asked the 22 members who joined the Y tennis club in FY2020 and FY2021 about the types of events organized by the Y tennis club that they attended during the welcome period during the COVID-19 disaster and found that "online information sessions" was the most frequent event with 18 respondents (81.8%), followed by "online exchange meeting" with 17 respondents (77.3%) (Table 2).

The online information sessions were a plan to explain about the Y tennis club in a format similar to a real-time lecture at college. Those who participated in the event said, "It was good that I was able to resolve my questions during the question-and-answer session at the explanatory meeting on club activities," "I felt the atmosphere of the club was well balanced, and I was attracted to the fact that it had not only the strictness of an athletic club but also an easy-going atmosphere."

The online exchange meetings are meetings between current club members and new students before they join the club, and those who participated in this meeting reported that the atmosphere was "homey and lively" and "very cheerful and reassuring." On the other hand, some of the participants said that they would like to have more individualized meetings.

The "Practice Experience" was a plan to have students participate in actual club activities, but most of the new students did not have a chance to participate in this program due to the declared state of emergency caused by the COVID disaster.

Table 2
Simple tabulation results of multiple-choice responses to items related to the recruiting.

Items related to the recruiting	Options	Count	%
How they first heard about the Y tennis club	From an acquaintance	27	58.7
	Twitter	18	39.1
	Official website	7	15.2
	Instagram	6	13.0
	Youtube	1	2.2
	Facebook Page	0	0.0
	Online welcome party conducted by K University	0	0.0
The types of events organized by the Y tennis club that they attended during the welcome period (answer only freshman)	Online formation sessions	18	81.8
	Online exchange meeting	17	77.3
	Practice experience	1	4.5

CONCLUSIONS

The process of deciding where to enter a college is generally divided into five stages: (1) learning about the college, (2) becoming interested in the college, (3) researching the college, (4) taking the entrance exam, and (5) sharing the information with others (Iwata, 2013). Applying this process to the case of the Y tennis club, we can observe the following:

1. Members learn about Y tennis club through SNS, acquaintances, and other publicity media,
2. The applicants become interested in Y tennis club through catchphrases, postings, videos, etc. on the SNS,
3. Those who are interested in Y tennis club visit the official website and online information sessions to obtain information,
4. Those who are interested in Y tennis club participate in online exchange meeting and practice sessions to get to know Y tennis club firsthand,
5. Those who are interested in Y tennis club exchange information with other prospective members and new students at the online exchange meeting and practice sessions.

Normally, steps (4) and (5) would all be conducted in person, but this was not possible during the COVID disaster. Even with such limitations, it can be evaluated that Y tennis club compensated for this problem of recruitment through online publicity strategies and events. From the above, we suggest that college tennis clubs should understand the characteristics of prospective members, disseminate information with the awareness to differentiate from other clubs, and provide opportunities to share information through social gatherings and other occasions.

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Biomechanical insights on Tennis Canada's skill fundamental phases: Ecological dynamics, force generation and reading gameplay

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ABSTRACT

Using an ecological dynamics perspective and informed by a game-based approach to coaching tennis, this paper applies a biomechanical analysis to Tennis Canada's five fundamental skill phases, namely recovery, impact point, set-up, hitting zone and grip, along with tactical concepts of time, space, force, and risk. The intent of this paper is to locate, within the player reading gameplay, the biomechanical principles for force generation in tennis strokes that inform Tennis Canada's five fundamental skill phases. We suggest that these fundamentals can be effectively employed during gameplay so that force can be considered a part of tactical awareness. From a game-based approach we consider gameplay as referring to a player's ability to read the emerging patterns of play, as critical to successful application of biomechanical principles to stroke mechanics. We propose that perception-action coupling ideas from ecological psychology, guided by the 4R model of read, respond, react, and recover for the stroke movement cycle, promotes both novice and advance tennis players ability to play tennis. The goal of this paper is therefore to help the tennis teaching professional combine ideas from sports pedagogy, biomechanics, and motor learning into the coaching of tennis players, so that their tennis players can experience the flow of forces from a well-played point.

Key words: Biomechanics, ecological psychology, percept-action coupling, game-based learning.

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INTRODUCTION

Studying force generation in sports is understood as biomechanics, as in the application of mechanical laws relating to the movement of the human body. By gameplay we refer to the player being able to read and be engaged in the emerging patterns of play as determined by the rules, game intent and other player's actions. The intent of this paper is to locate within the player reading gameplay, the biomechanical principles that inform Tennis Canada's five fundamental skill phases namely recovery, impact point, set-up, hitting zone and the grip, and how these can be effectively employed during gameplay so that force generation can be considered a part of tactical awareness. These fundamental skill phases are used in Tennis Canada's Tennis Professional Association coaching certification courses (Tennis Canada, 2015). In addition, we will apply an ecological dynamic perspective to understand how gameplay context triggers skill application as we develop insight on how the technical cues suggested by Tennis Canada promote skillful gameplay. An ecological dynamics approach views movement as emerging from a self-organizing relationship formed between an individual, the task being performed, and the environment (including the opponent) in which it occurs, creating a movement system (Hopper & Rhoades, 2022a; O'Sullivan et al., 2020). Skills applied effectively in the game are understood as dynamic functional movement solutions that emerge as the player

continuously interacts with an array of constraints related to the task and the environment. Therefore, forces generated by the player's actions to execute a successful skill, are adaptive in nature, becoming more efficient based on a holistic engagement that "seeks to encompass physical capacities embedded in perception...memory, anticipation and decision-making learning" (O'Sullivan et al., 2020, p. 452).

Efficiency in motor skill production refers to the ability to perform movements or skills with the least amount of effort and waste of energy, while still achieving the desired outcome (Knudson, 2021). It encompasses factors such as accuracy, speed, fluidity, power, and economy of movement. High efficiency in motor skill production allows for a player's more consistent performance, conservation of energy and movement endurance. In open skill sports like tennis, the repetitive nature of the sport and demands of using an array of strokes for different situations, requires the player to read, responding to the opponent's actions, and then select the most effective stroke to achieve the desired outcome. So, in this paper we unpack the biomechanical principles that inform Tennis Canada's five skill fundamental phases for novice to advanced players, and the capacity of the player to tactically read the situation to effectively respond with biomechanically efficient strokes.

PLAY-PRACTICE-PLAY: TACTICAL CONCEPTS, ATTUNEMENT AND BIOMECHANICS

In line with Tennis Canada's commitment to the play-practice-play approach (Tennis Canada, 2015), related to physical education game-centered ideas promoted by the Teaching Games for Understanding (TGfU) model (Bunker, Thorpe and Almond, 1986), a key premise is to understand skill fundamentals from a play a game first, then practice to re-play the focus game. The goal in this approach is for players to play a game that emphasizes the tactical application of a certain stroke skill fundamental, to then practice this fundamental through a series of progressive game-like tasks framed by a review, by the instructor, of a game related aspect of a stroke skill fundamental. After suitable practice with certain goals achieved, players then return to play the modified game that started the learning process (see video explanations in Hopper, 2022). This return to the game with tactical insights and practiced technical prompts, invites the player to build stroke mechanics in relation to basic game strategies, which in turn leads to the player's ability to read the game and select the appropriate shot.

Strategies refer to ways of playing that enable you to engage successfully in the structure of the game. For example, the International Tennis Federation (ITF) refers to strategic principles of play such as (1) keep ball in play, (2) positioning to cover court area, (3) placement of shot to make the opponent move, and (4) application of force on the ball based on your strengths and opponent's weakness (ITF-Academy, 2021). Tactics are understood as generalized ideas, based on a strategic goal, that can be combined to achieve a certain outcome in a game, to gain an advantage over an opponent in playing a point. As noted by sport pedagogy scholars Mitchell et al. (2021) and Hopper (2011), tactical concepts of Time, Space, Risk and Force can be used to implement strategic principles. These tactical concepts create a lens with which to interpret the demands of the game, the opportunities to gain an advantage, to win points. For example, Tennis Canada (2015) curriculum refers to these tactical concepts in relation to time, space, and risk. The following examples are taken from Tennis Canada module course materials (Tennis Canada, 2019):

1. "Buyback time when under pressure by sending a higher shot to gain time to recover" and "take away time to put the opponent under pressure by taking the ball early or hitting the ball harder" (ball on-rise or volley).
2. "Outlast the opponent by keeping the ball consistently over the net and in the court" and "move the opponent around by directing the ball to open court or the opponent's weakness."
3. The risk tactical concept refers to when to defend to keep the ball in play, when to attack to put pressure on the opponent, and when to play neutral to maintain engagement in the point.

In relation to force, Tennis Canada refers to the five skill fundamental phases that offer technical pointers within the reception and projection stroke movement cycle that involves footwork and body coordination to the trajectory of the ball. This cycle enables the player to generate controlled force on the tennis ball as they develop their ability to play the game, influencing the path, angle, and speed (PAS) of the racket face on the ball based on their intent for the stroke in the game situation. These skill fundamentals are only useful if learned

in relation to a game where the player has become attuned to the opportunities to execute a stroke by manipulating time, space, and force at a certain risk level within the process of playing a point. Ecological psychology refers to these opportunities as affordances.

Renshaw and Chow (2019) indicate affordances "consist of environmental properties that afford 'opportunities for action' for each individual" (p. 107). To take advantage of these affordances, a player needs to be able to read the game, to anticipate what the opponent will do next in relation to space, time and force on the ball. As gameplay happens, the player plans their next actions based on the emerging patterns of play, their personal ability to generate force on the ball, and the level of risk they wish to take. This reading refers to a perception action coupling where the "individual is [both] a perceiver of the environment and a behavior in the environment. Hence, what we see in our environment, determines what we do" (p. 106). Perception-action coupling is the coordination between vision (including time and space) and movement. From dynamics systems perspective this means the player becomes attuned to the relevant affordances (invitations for action) within their environment including the actions of their opponent. In a tennis competition, this perception-action coupling involves many different information forms but essentially, the focus should be on the court, how to manipulate the equipment to direct the ball, the opponent's actions (their strengths and weaknesses), and the score in the game. As noted by Carvalho et al. (2013) these affordances are generated by coach designed practices and games by setting up constraints in tasks "to guide players' attention to relevant informational sources based on their own actions" (p. 10).

TECHNICAL CUES AND BIOMECHANICS

Often when referring to biomechanics coaches and PE teachers think of technique. As noted by Martinez-Gallego (2021) as part of the ITF Tennis Academy program, it is important to understand however, that the two, while related, are not the same. Biomechanics is a sport science which studies the principles which affect human motion. Technique refers to a given player's practical application of these principles in a certain stroke or movement. For example, two players can have very different techniques when serving a ball, yet use the same biomechanical principles (i.e., coordination chain, elastic energy) in such a way that both shots are effective. Therefore, to understand how to apply the biomechanical principles a player needs to understand their own abilities and the gameplay context in which the principles will be applied (tactical understanding). Through game-like, problem-based experimentation in relation to well design constraints and coach guidance (Carvalho et al., 2013), the player can come to appreciate how they can effectively generate the desired force and direction on the ball.

Technical cues are used as a guide to biomechanical principles. They are general in nature to allow for individual interpretation but based on a commitment for the player to generate the effective flow of forces within the tactical demands of the game. To teach the technical cues within a game-based approach, Tennis Canada focuses on four categories to guide a tennis lesson. The first category, "I can play point," encourages players to play different opponents, promoting games with a quick scoring system that causes

players to rotate opponents and typically scoring points for their team (Tennis Canada 2015, p. 13). Tennis Canada then groups strokes into three categories of (1) 'I can rally,' (2) 'I can start a point,' and (3) 'I can play net.' Based on these stroke categories, Table 1 highlights Tennis Canada (2019) five skill fundamental areas to analyze stroke categories: (1) recovery

including footwork between shots, (2) impact point where to contact the ball in relation to the body, (3) body set-up before striking the ball, (4) hitting zone based on PAS of the racket face before, during and after impact with the ball (see videos at Hopper, 2022), and (5) how to grip the racket (eastern forehand, backhand grip, continental for the volley and serve).

Table 1
Tennis Canada Five Fundamentals Checklist*

SKILL PHASES	GROUNDSTROKES	SERVE	VOLLEY
<p>RECOVERY <i>In an athletic ready position, feet slightly staggered, facing the opponent.</i></p>	<ul style="list-style-type: none"> • Footwork to 'home-base' in a balanced ready position with head up. • Push-off using shuffle, crossover or running steps as distance determines 	<ul style="list-style-type: none"> • From serve locate behind baseline or beyond service-line • Before the opponent impacts the ball • <i>Forward balance with weight in motion</i> 	<ul style="list-style-type: none"> • In a ready position, weight forward, <i>keeping the body in motion.</i> • Before the ball bounces on other side • Racket supported by non-dominant hand
<p>IMPACT POINT <i>Centre of strings. Ball comfortable distance from body</i></p>	<ul style="list-style-type: none"> • At knee to waist height • Slightly out and in front • Comfortable distance in front and to the side of the body 	<ul style="list-style-type: none"> • Upward Extended arm • Slightly out and in front • 1 o'clock (right), 11 o'clock (left) 	<ul style="list-style-type: none"> • At chest height • Slightly out and in front • At a comfortable distance • <i>Body adjusts to ball height</i>
<p>SET-UP for stroke <i>Arm and body move as one unit (unit turn) before the ball enters the court on the player's side.</i></p>	<ul style="list-style-type: none"> • Move to proper location with balance • Get sideways by preparing foot, body & racquet (unit turn) • Racket taken back high • Before the coming ball bounces • <i>Keep racket in motion during take back</i> 	<ul style="list-style-type: none"> • Stand sideways behind baseline • Coordinate both arms into a 'Trophy Position' throwing set-up with tossing arm reach up, held high before ball comes down • Toss the ball up & in front of the body slightly above impact point • <i>Keep racket in motion</i> 	<p>Based on side ball comes:</p> <ul style="list-style-type: none"> • Step out preparing racquet behind impact point making a slight shoulder turn • Backhand side hold and prepare the racquet with the non-dominant hand • Prepare before ball crosses the net • Step-out/Catch/step forward action to the ball.
<p>HITTING ZONE <i>Strings move with stability to the intended target. Laid back wrist</i></p>	<ul style="list-style-type: none"> • 'Extend' the racquet face towards the target as long as possible • Maintain a stable & laid-back wrist at the contact • <i>Low to high path for topspin, high low path for slice</i> 	<ul style="list-style-type: none"> • 'Throw' the racquet face up at the ball and towards the target • Use shoulder rotation (<i>from high tossing arm to low racket arm</i>) and forearm pronation (rotate forearm outward) 	<ul style="list-style-type: none"> • Maintain a 'catching' action to ensure the racquet faces the target before and after hitting the ball • Keep a stable racquet face before and after hitting the ball. • <i>On the ball, from the wrist, use 'chop' action based on the angle of the racket face.</i>
<p>GRIP (Basic) <i>Grip changes as the player develops.</i> Eastern forehand Continental Eastern Backhand</p>	<ul style="list-style-type: none"> • Continental (top/side bevel) • Eastern Forehand (side bevel) One-handed BH: • Eastern Backhand (top bevel) Two-handed BH: • Bottom hand: Continental • Top hand: Eastern grip 	<ul style="list-style-type: none"> • Initial Continental (top/side bevel) • Allows a stable racquet face at impact • Extend with Eastern backhand grip increase wrist action • Feels like hammering the edge of the racket 	<ul style="list-style-type: none"> • Continental (top/side bevel) • Allows a stable & open racquet face at contact • <i>Eastern backhand if time for grip change</i>

*Adapted from Tennis Canada (2019) instructor course, April 2019. Italic text added to emphasize key points linked to biomechanical properties.

THE 4RS AND THE STROKE MOVEMENT CYCLE

To analyze the skill fundamental areas it is important to note that every stroke is contained within a stroke movement cycle from striking the ball to recovery, to then reading the situation, responding as the opponent sets up to execute a stroke, then preparing to play a stroke in response by reacting to the arriving ball in order to execute another stroke and then, if needed, repeat the cycle. Hopper (2003, 2007) and ITF-Academy (2019) label this as the 4R model. Figure 1 shows this stroke movement cycle. Note in this diagram how the “Base” positioning either located behind the backline or at the net, refers to a RECOVERY position between shots, that is critical to initiate any stroke. This phase then sets up the player to READ the situation and decide about where to go in the court in anticipation of the opponent's next shot and their potential response. Critically, this decision-making movement is based on how the opponent is shaping up to play their shot. The decision made from the READ phase informs the RESPOND phase where the player selects a shot as the opponent plays the ball, and the player puts their body in motion with a jump or skip step to cover the target area as the opponent strikes the ball. In the REACT phase the player adjusts their positioning relative to the ball arriving in their court and executes the selected shot, but with the ability to make final adjustments, to Respond, to what the opponent does or a mis-bounce. The cycle then moves back to the RECOVERY phase, and the process starts again if the ball is still in play.

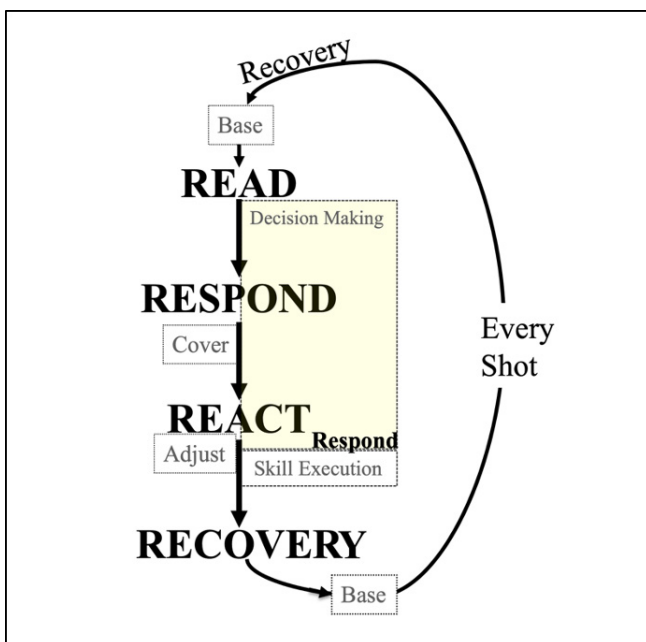


Figure 1. The 4Rs model for reading play in the stroke movement cycle.

The 4R model creates a decision-making movement cycle for each stroke. With this in mind, we can now unpack the biomechanics for each skill fundamental area. To do that we adapted Martinez-Gallego (2021) mnemonic BIOMECS framework by adding stability (S) to focus on racket face. Using the BIOMECS framework we then have basic definitions for biomechanical principles applied to tennis outlined in Table 2.

Table 2

Definition of key biomechanical terms for tennis labeled BIOMECS.

Balance (B)
Balance refers to the capability of the player to control and/or manipulate the relationship between their center of mass (CM) and base of support. Creating a wider base of support increases the overall stability. Shifting balance from back to front foot develops linear momentum in the direction of shift. Static balance is the ability to maintain a base of support with minimal movement. Dynamic balance is the ability to perform a task while maintaining a stable position. Additionally, balance is improved by lowering the CM. A lower CM reduces the leverage that the body has and increases the amount of force necessary to move the CM outside of the base of support. However, a higher CM provides a mechanical advantage to move the CM outside of the base of support, by creating a longer lever arm and increasing movement potential.
Inertia linear and angular (I)
Inertia is the tendency of a body at rest to remain at rest or a body in (angular or linear) motion to remain in motion unless disturbed by an external force. Angular inertia is a product of mass and radius (squared) and the amount based on length of lever and the weight of the object. For example, a player chasing down a drop shot will have the tendency to remain in motion (maintaining constant linear inertia) unless acted upon by an outside force. The muscles of the player's lower limbs will help generate a force using the ground to slow the player down and then recover court position.
Opposite force (O)
Opposite force refers to the law that for every action/force there is an equal and opposite reaction/force. Ground reaction force (GRF) refers to force obtained from the ground when the player pushes against it. For example, jumping for a smash has preparatory movements where the player will bend their knees, lowering their body, and in effect push against the ground. In return, the ground reacts and pushes back against the players, which in turn assists the players with their jump. The reason that the player moves, and the ground does not, relate to the difference in weight of the player as compared to the earth.
Momentum (M)
Players wanting to increase their racquet speed need to increase the momentum they generate. It is important to understand that the development of both linear and angular momentum starts with ground forces generated by the players through their footwork. There are two different types of momentum: angular and linear. Linear momentum is the quantity of linear motion that a body possesses (product of mass and velocity) and best seen in closed stance forehand where weight is transferred from back foot to front. Angular momentum is the quantity of angular motion that a body possesses, best seen in the open stance forehand where momentum comes from the rotation of the upper body in relation to the more front facing lower body stance. Impulse refers to the amount and direction of momentum applied at one time, such as the racquet swing in the serve.

Elastic energy (E)
Elastic energy is the energy stored in muscles and tendons because of stretching the muscle (i.e., during the backswing phase of a stroke). This is also known as the passive contractile component of muscle tissue; it requires no active contraction to store or release this energy. The stretched muscles (that are in a higher active muscle state than they were when at rest) and tendons recoil back to their original shape and in so doing a portion of the stored energy is recovered and assists the movement.
Coordination Chain (C)
Coordination can be summarized as the combination of muscle contractions and skeletal leverage system that allow for the efficient performance of different movements, either simultaneously or separately. For example, a coordination or flow of movements from the ground, via the trunk to the racquet-arm is required for effective stroke production. In the volley, where precision is needed, body segments will move more as a unit, while in the serve and drives, body segments will be coordinated sequentially such that high racquet speeds can be generated from optimum timing of the kinetic chain of actions in the body segments.
Stability (S)
Related to balance, stability refers to executing movement or a stroke with resistance to both linear and angular acceleration, or rather, resistance to disruption of equilibrium. Generally, athletes increase stability to prevent unwanted movement, for example in controlling the face of the racket at contact with the ball. The difference between stability and balance is that balance is your ability to control your body without movement against gravity. Stability is your ability to control your body and related body parts during movement. For example, when contacting the ball, the racket swing and hand controls a stable and flat racket face on contact with the ball allowing the player to control the direction, height, speed, and spin of the ball.

In the next section, referring to Table 1, we will apply the BIOMECS framework to each skill fundamental phase, selecting key biomechanical principles implied by the technical prompts. In the final section we will then return to Figure 1, the player reading gameplay, to locate these biomechanical insights for force generation within the 4R stroke movement cycle.

ANALYSIS OF SKILL FUNDAMENTAL PHASES

Applying BIOMECS to each skill fundamental phase in Figure 1 allows us to indicate the biomechanical principles that are implied by the suggested technical cues. For each phase below, we have highlighted at least three biomechanical principles.

Recovery and footwork

The recovery into an athletic position refers to the recovery movements in tennis after completing a stroke. It means moving into a base position either behind the baseline or located just in front of halfway between the service line and the net, to defend the court area, whilst facing the opponent. The key for any stroke is the opposite force push back from the GRF that allows quick movement recovery. Players select between running steps to move quickly back into the court, cross-over steps to cover more ground as they face

an opponent, and side-stepping to cover immediate court space. Here stability through dynamic balance is critical as the player moves, observing the opponent's actions and preparing to set-up for the next stroke. The key is to overcome stationary inertia. If a player stops then inertia sets in which takes time and more force to overcome. Therefore, ideally, a player always wants short quick skip steps, in motion, whilst positioning themselves during a point.

Impact point

The impact point refers to the place where the ball is struck in relation to the body. Ideally, the impact point wants to be a comfortable distance from the body, just in front and to the side. The player wants a feeling of poised instability as they contact the ball and then move effortlessly into recovery. The intent for locating the ideal impact point is the coordination of all the body segments to move and adjust in relation to the ball and the selected shot. Key is to anticipate where to go in the court to contact the ball in the ideal place to execute the forces, generated by the body for the stroke, to be released from the racket strings onto the ball with the desired direction, speed and power. For drives, this tends to be at the waist-to-knee height, just in front of the body, at a comfortable distance for the racket arm to extend into the shot. For the serve, this impact point is slightly to the side of the body (see Table 1). The toss is higher than the extended racket and arm and just in front, about a foot or so, from the leading foot, if the ball was to bounce. For the volley, the impact point is ideally around chest height (range from knee to head at times), with legs bending and flexing to adjust body height. And like drives, for the volley a similar distance from the body, but the key is minimal racket swing with a focus on a stable racket face at contact.

Set-up for stroke

This phase focuses on how the body prepares to execute a tennis stroke. In setting up to strike the ball the body needs to be in a static balance, stable with resistance to both linear and angular acceleration, with weight shifted somewhat (but not entirely) onto the back foot in relation to the stroke being executed. Before the ball arrives, the player set-up for volley is "step-out" action; groundstroke (before the ball bounces) is to get sideways somewhat with upper body rotation; and serve is loading on the back foot sideways (at a right-angle) to backline, ready to release forward, as the player prepares to toss the ball. Elastic energy is generated in the body through coiling of the body segments in a unit turn (upper body and hips with legs fixed). This unit turn is minimal for the volley with shoulder turn and racket supported by the non-dominant hand creating all the coil needed for the "step-out/catch/step" forward action. For the groundstroke the unit turn is more pronounced with high racket take back allowing both arms and upper body to create a coil with the lower body, the elbow is bent to create a shorter lever arm that is ready to extend as swing forward. Elastic power is stored up in the rotation stretching of the larger muscles of the shoulders, back and torso (including hips). The high racket when the racket is taken back allows gravity to be used to overcome inertia before swinging forward as the racket head drops when initiating the stroke. In the serve, the "trophy position" noted in Table 1 refers to a slightly rotated upper body and arms with racket hand arm and shoulder lower than tossing arm in the shoulders. This set-up creates a first-order lever (like a seesaw) to release the racket into the hitting zone. Elastic

energy is stored in the hip that pushes forward and bends back from the lower body, with the opposite shoulder pulled back and lower than the front shoulder, ready to release forward to the ball tossed up to the impact point.

Hitting Zone

Hitting zone is an area at the impact point where the stable path of the racket generates an impulse (length force applied) onto the ball. It refers to contact of the racket strings on the ball based on PAS before, during, and after impact with the ball. The key for the player in the hitting zone is to overcome the oncoming inertia of the approaching ball and use the forces generated by their body through the set-up, to generate momentum on their racket swings, which in turn creates racket head speed for force onto the ball. The laid-back wrist noted in Table 1, referred to as wrist lag (Tennis Without Talent, n.d.), plays a critical role in transferring the momentum from the body onto the ball. The laid-back wrist creates a short level lever, meaning that a large force from the body muscles acts over a shorter distance to create a smaller force at the other end of the longer lever of the racket with the racket face generating speed with force. Lagging happens mostly at the wrist; extension happens at the elbow. Most full strokes start with a bent elbow that ends straightening, lengthening the lever arm and increasing leverage as the generated force travels through the forearm to the wrist. In the serve the key is to generate racket head speed and stable racket face contact with the ball. During the acceleration phase of the serve, the racket trails the wrist, creating lag as it is pulled, butt-end first, towards the point of contact. Simultaneous to that motion the elbow extends until the arm is completely straight before the moment of contact at the impact point. By lengthening the lever 'arm', you can optimize leverage, racket head speed and pace. For the volley the "catch" idea is the reaching for the ball with minimal swing. In the volley the hitting zone is focused on resisting momentum on the ball and redirecting the ball back into the court towards the intended target. Stable racket face with "catching" action based on the idea of reaching forward to the ball, and then using a "jab" or "chop" action, to redirect and control spin imparted on the ball for the volley shot.

The longer the strings stay in contact with the ball, flat at contact as in perpendicular to the ground, within the hitting zone, the greater the momentum passed onto the ball. The angle of the racket face influences the trajectory of the ball as it leaves the racket, assuming a stable racket face at contact. In addition, the action of the racket face on the ball, from low to high generates topspin on the ball (trajectory curving down and kick on bounce), or from high to low to generate underspin or backspin (trajectory flat and low bounce). This type of spin is referred to as the Magnus effect. The effect is caused when a ball is propelled forward and rotates clockwise so that the air runs over it and provides resistance by exerting a drag force making the ball curve down as it travels (McKeithen, 2019). As the ball spins, one side moves in the direction of the airflow, while the other side moves against the direction of the airflow creating downward drag so as ball slows it curves down. In contrast, the backspin propels the ball with a backward rotation. To generate backspin a player slices under the ball, sliding the racket beneath the ball after flat contact. The drag generated by the Magnus effect from the backward rotation makes the ball stay lower than the topspin, and the ball travels further. Similarly, for a slice serve the racket string hits the ball from the back to the side, causing the ball to swerve in the direction of the ball rotation and to break in the same direction when it bounces.

Grip

The grip refers to how the hand holds the octagonal shaped racket handle to control the racket face and then direct the forces channeled from the body, through the hand, onto the ball. The basic grips of continental, eastern forehand and eastern backhand enables the tennis player to feel a stable, flat at contact, racket face with the ball. Top of the racket is based on the outside edge of the racket face and bevel refers to the diagonal link from top to the side of the racket. Continental grip means the player can use the same grip (top edge, like knocking a hammer with the edge of a racket) to hit both forehand and backhands. Eastern means the hand grips the racket with a focus on the top side bevel of the racket. In a backhand continental grip a player can add the other hand (double-handed top hand) with an eastern forehand grip to gain more control of the racket face on the ball, and this is the basic double-handed backhand. Key for grip is feeling firm contact of the racket face with the ball to transfer generated forces and redirect ball inertia. The grip controls the racket path onto the ball, as well as angle of racket face for ball height trajectory and the spin generated by the action of the racket strings on the ball. Spin is generated with wrist action, noted in the hitting zone, but can be exaggerated as the player gets stronger with western type grips. These grips focus the side of the racket, increasing the flex of the wrist further (creating more lag), generating more racket head speed and string action on the ball at contact.

THE 4RS, TACTICS AND BIOMECHANICS

How do we locate these biomechanical principles that inform Tennis Canada's five skill fundamentals into gameplay? The 4R model in Table 1 prompts the player to develop perception-action couplings to guide the force-generation process in emerging situations when playing a point in tennis. As Carvalho et al., (2013) notes, this means that players develop "perceptual attunement to the on-going match characteristics" (p. 11). Figure 2 builds on this model in relation to the Tennis Canada skill fundamental phases. By reading the game we are referring to the player's ability to anticipate, through perceptual attunement, where the ball will be sent next by the opponent, how well the opponent will send the ball in relation to the biomechanical forces they are generating, and where the player should move next as they select an appropriate stroke to perform.

Key in Figure 2 is the connection between recovery to read and preparation to receive the ball (respond and react) at the impact point. When reading the player needs to be attuned to how the opponent is preparing in relation to their impact point on the ball and applying technical cues like recovery footwork and set-up unit turn. As the ball is struck by the opponent, the player starts their preparatory movements as they select their next shot for the anticipated impact point that they want for an effective shot execution. Note how the 4Rs, located in the space between two eclipse shapes in Figure 4, create a zone of possible adjustment that would allow the player to gain an advantage or stay neutral in the point as they perceive the information flow to make early adjustments. As the player continuously reads, they make decisions, reflected in their recovery footwork from a previous stroke, responding to whether the opponent's set-up is effective for their impact point on the ball. The perceiving player can either defend by moving back if the opponent looks like they will be able to attack, stay neutral to current positioning (usually just behind the baseline), or move forward to attack an anticipated less

effective stroke. The technical cues within Figure 2 are the indications of the opponent's force generation potential at different stages in the movement cycle. These technical cues work as signposts to biomechanical efficiency for the player,

but also as external cues to read to make tactical decisions about the opponent's skill execution to gain a strategic advantage.

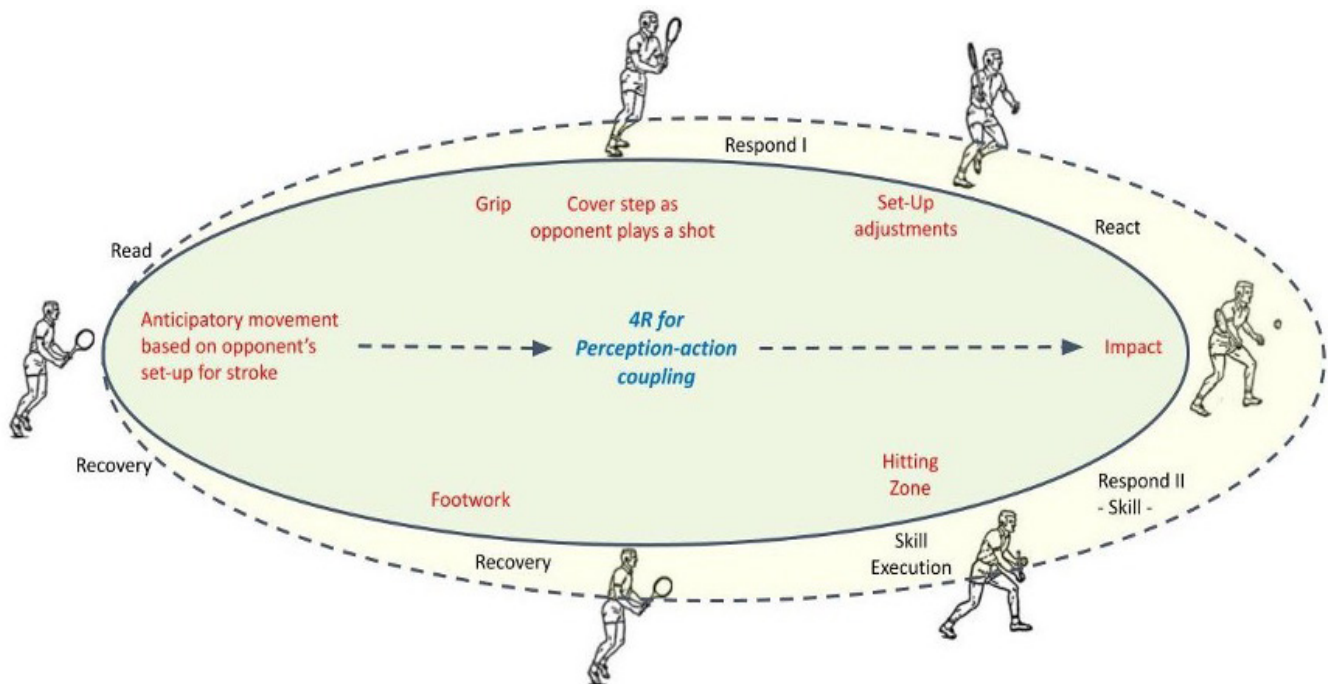


Figure 2. 4Rs combined with the Skill fundamental phases within a stroke cycle.

CONCLUSION

The player reading gameplay means using technical pointers, such as those in Tennis Canada's five skill fundamental phases, to anticipate the opponent's next shot, but also to adjust and refine their own play. Though the scope of this paper is not on how to teach these fundamental skills and tactical concepts, we have done that in other articles (Hopper and Rhoades, 2022a, 2022b), it is worth noting that when players learn to read gameplay they pick up on what the opponent does well and what they need to do in response. Ecological psychology focuses on generating skillful performance, the gradual efficient and appropriate use of biomechanical processes to generate forces on the ball, by the player learning to adapt to variability (internal and external) promoted by the manipulation of constraints (Carvalho et al., 2013; Renshaw & Chow, 2019). Manipulation of constraints are designed by coach and the player, to promote functional variability that is linked to the complexity of reading the opposing player's stroke performance and adapting your own play in the prevailing conditions.

In Hopper and Rhodes (2022b) we suggest that if the game is close, where both players feel they can influence the outcome of the game, we have observed that often the biomechanical features noted in BIOMECS in Table 2 seem to be mimicked between the players. In essence, they become synchronized to each other's successful play where the forces flow between them, creating what sports players have referred to as being

in the zone or flow in sports (Jackson & Csikszentmihalyi, 1999). This we feel is critical in a play-practice-play approach advocated by Tennis Canada and therefore compels coaches to consider how to create games that adapt to players to make close encounters. In Hopper and Rhodes (2022a, 2022b) we advocate the use of modification by adaptation games where the outcome of winning a competitive game is that the game structure is adapted to challenge the successful player. For example, court space of the successful play to cover could be increased allowing the losing player to take advantage of the space with an increased target area, or the scoring system (i.e., handicap scoring such as 15-0 lead) could favor the losing player, so they have more scope to take risks. Such games challenge the winning player whilst enabling their opponent to see affordances whilst also noticing what their initially successful opponent is doing to be successful. Therefore, to teach biomechanical efficient strokes we need to consider how we create the conditions to teach players to notice, to read the opponent in the situation, to note how they are generating force on the ball in relation to space, time and risk, to become attuned to the affordances in the game that they can exploit.

CONFLICT OF INTEREST AND FUNDING

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[RECOMMENDED ITF TENNIS ACADEMY CONTENT \(CLICK BELOW\)](#)





The impact of the changes made to the men's professional tennis tour system: A case study of Japanese players

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ABSTRACT

In 2019, the International Tennis Federation implemented major changes to the men's professional tennis tour system in order to (1) reduce the number of professional players who cannot make a living, and (2) create a system that allows talented junior players to quickly transition to the professional level. These changes in the tour system are considered to have had a significant impact on the players' environment and psychological aspects. The purpose of this study is to examine the impact of the tour system changes on Japanese male tennis players. The subjects of the study were four Japanese male tennis players who participated in the ITF World Tennis Tour held in Japan. They were interviewed one-on-one for approximately 40 minutes using a semi-structured interview method. The interview was centered on the question "How did the change in the tour system affect you?" Interviewees were asked to give specific reasons for their answers. Following a qualitative inductive analysis of the verbatim transcripts of the interviews, five areas of impact were identified: feeling, game plan, status, environment, and requests.

Key words: Tennis professional, environment, competition system, qualitative research.

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INTRODUCTION

In the world of professional tennis, the top ten most talented players in the world tend to earn relatively large amounts of money compared to the top players in other sports. For example, Roger Federer, the long-time world number one in men's tennis, had the seventh highest income among all athletes in the world in 2021 (Forbes, 2021). Also in 2021, the top two highest earners among all Japanese athletes were Naomi Osaka (women's tennis) and Kei Nishikori (men's tennis) (Forbes, 2021). This is due to the fact that the top players in professional tennis attract the attention of many people, and this leads to a large amount of sponsorship income. In fact, tennis has about 1.1 billion fans worldwide, the fifth largest after football, cricket, basketball, and field hockey (Sports Show, 2021). It is also the only one of these five popular sports that has a 50-50 ratio of male and female fans (Gemba, 2020). Furthermore, a small number of players (two or four) play a match on the court for a long time (Hotta, 2023), and the Grand Slam tournaments, which are called the four major tournaments, are televised from beginning to end (Gregg et al, 2006).

On the other hand, it is clear that most of the professional players registered with the International Tennis Federation (ITF) do not earn enough money, despite the spectacular success of these top players. In fact, of the 8,874 men and



4,862 women tennis players who played in international tournaments at the professional level in 2013, only the top 336 men and 253 women players were estimated to have income equal to or higher than their activity expenses (ITF, 2017). In other words, with the exception of a few top players, most professional players do not earn enough to sustain their livelihood. This is due to the fact that the organizers do not televise professional tennis tournaments in the lower tournaments, hence sponsorship income cannot be expected, and prize money is extremely low. In fact, the prize money for winning a singles title in the lower tournaments is only about

150,000 yen: approximately US\$1100 (Asia University, 2015). Under these circumstances, it is impossible for prize money to cover even the cost of overseas tours (Ide, 2016). And the lives of many professional players are not affluent. It has also been pointed out that this situation is a factor that induces match-fixing (ITF, 2017). Furthermore, it has been reported that the professional players playing in these lower tournaments are getting older, which is an obstacle for talented young players to enter the market (ITF, 2017).

In response to this situation, in January 2019, the ITF implemented major changes to the professional tennis tour system to (1) reduce the number of professional players who cannot make a living and (2) create a system that allows talented junior players to quickly transition to the professional level (ITF, 2019). In fact, in the men's professional tennis tour, the ITF Futures was abolished and a new lower-level tournament, the ITF World Tennis Tour (WTT), was established. The changes are shown in Figure 1.

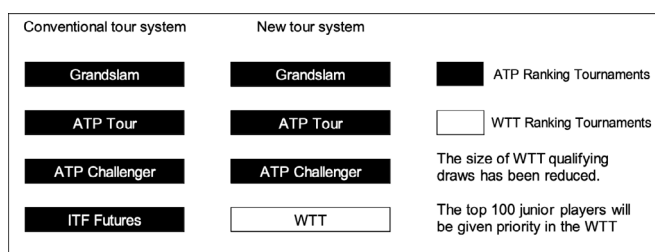


Figure 1. Men's Professional Tennis Tour System Changes for January 2019.

Previously, all matches in the ITF Futures were ranked based on the ATP Ranking, which meant that all professional players, regardless of their ranking or the level of tournament they played in, were listed on the same ranking. Consequently, lower-ranked players who primarily competed in lower-level tournaments had the opportunity to compete in higher-level tournaments, including ATP Challenger and ATP Tour tournaments.

On the other hand, in WTT, only points counted towards the WTT ranking are awarded with the exception of a few matches. In principle, only the top ranked WTT players are given the opportunity to participate in the ATP Challenger tournaments where they can get the ATP points. In other words, the WTT results are no longer directly related to the entry of the Grand Slam tournaments or ATP Tour tournaments. Thus, the ITF aimed to eliminate players who could not break out of the WTT and reduce the number of professional players who could not make a living by clearly positioning the WTT ranking as lower than the ATP ranking. In addition, the WTT aimed to reduce the cost of tournament management by reducing the size of the qualifying draw and by setting the tournament schedule within 7 days. In addition, the top 100 players in junior tennis were given priority to play in the main draw of the WTT, and a system was established to enable talented young players to quickly move up to the professional level.

However, even though ATP rankings cannot be earned in the WTT, the ATP ranking holders are given priority in the selection of players to participate in the WTT, and since this change in the tour system, opportunities to participate in the WTT have been effectively taken away from those with low or no WTT rankings. Therefore, in May 2019, the ITF implemented another change to the tour system, returning

the ATP ranking to the WTT and re-expanding the size of qualifying draws (ITF et al, 2019). In addition, the priority quota for junior players was reduced and the number of tournament days was extended up to eight days. However, the WTT ranking is maintained and the ATP ranking and the WTT ranking are used together.

Thus, the repeated changes in the tour system are considered to have a great impact on the players' activity environment and psychological aspects. Therefore, it is important to understand how these changes in the tour system have affected the players and to take measures to help their competitive activities.

Until now, issues and conditioning related to overseas travel of top athletes have been examined for various athletic events. For example, Gould et al. (2002) reported that travel to the venue, availability of sponsors, relationship with sponsors, schedule during the tournament, and time difference affected the performance of athletes who participated in the Olympic Games. Greenleaf et al. (2001) conducted an interview survey of athletes who participated in the Olympic Games and reported that psychological and physical preparation including sleep and motivation, support from surroundings, and adaptability to the Olympic environment were important factors for their performance. The results show that psychological and physical preparation including sleep and motivation, support from surroundings, and adaptability to the Olympic environment are important factors for performance. In other words, athletes feel a great deal of stress during overseas expeditions due to environmental factors such as travel, time differences, and difficulties in maintaining motivation. In response to this, Murakami et al. (2011) examined the psychological conditioning of Japanese athletes who participated in the Olympic Games. As a result, it was reported that the success factors of performing well included "demonstration of psychological skills," "usual feelings and behaviors," and "support from surroundings," while the failure factors included "lack of psychological skills," "maladaptation to the Olympic environment," and "inadequate support system." Therefore, it is pointed out that psychological aspects may have a significant influence on the performance in a long-term expedition.

However, as seen in the situation where the ITF has implemented two major changes in the touring system in a short period of time, there have been few studies that have analyzed the impact of the change in the tournament system itself on the athletes. Therefore, the purpose of this study is to examine the impact of the change in the men's professional tennis tour system on Japanese players from environmental and psychological perspectives.

PROCEDURES

The attributes of the subjects of this study are shown in Table 1. The subjects were four Japanese male athletes who were competing in the WTT held in Japan.

Mr. A is a veteran player in his 30s and has a high ranking among the WTT competitors. Mr. B and Mr. C are in their 20s, the average age of professional athletes, and their ranking is middle to low among WTT contestants. Mr. D is young, in his teens, and his ranking is in the upper to middle level of WTT competitors, which is amongst the top in Japan in his generation.

Table 1
Demographics.

Player	Age	Career-high ranking
A	Early 30s	200 - 300
B	Early 20s	1000 - 2000
C	Early 20s	701 - 1000
D	Late teens	501 - 700

The survey period was from April 2019 to July 2019. In this study, the semi-structured interview method was adopted from two viewpoints: (1) to keep the structure of the interview so that there is no difference in the interview content among the subjects by preparing the interview items in advance, and (2) to secure the freedom to change the wording and order of the questions according to the subjects' situations and responses. After obtaining the subject's consent, a one-on-one interview of about 40 minutes was conducted. The interview was centered on the question "How did the change in the tour system affect you?" and the interviewees were asked to give specific reasons for their answers.

DATA ANALYSIS

A qualitative inductive analysis was conducted. First, we made a verbatim transcript of the speech data recorded by an IC recorder during the interview. Next, sentences that were considered to be related to the influence on the players themselves were extracted from the verbatim transcripts. Extracted sentences were separated by meaningful phrases and coded. The sentences were grouped according to the similarity of their coded contents and subcategorized with appropriate and concise words. Similar sentences in the subcategories were combined and categorized.

In the process of this analysis, a total of three analysts, two sport psychologists with tennis coaching experience and one with tennis experience, discussed the results until they reached a consensus. Afterwards, a new sports psychologist with tennis coaching experience, who did not participate in this discussion, was added to the group and the results were re-examined. According to Lincoln & Guba (1985), repeating this procedure establishes triangulation and improves the reliability of the analysis results. The responses with ambiguous contents and those with unclear meanings were excluded in the process of analysis.

ETHICAL CONSIDERATIONS

Prior approval was obtained from the Research Ethics Review Committee of Senshu University (Approved on April 25, 2019, Reception No. 2018-1219). In addition, the consent of the organizer of the WTT held in Japan was obtained prior to the implementation of the survey. The purpose of the study was explained to the survey subjects both in writing and orally, and the following conditions were also given: (1) the results would not be used for any purpose other than the research purpose, (2) cooperation in the interview would be voluntary, (3) no disadvantages would arise from nonparticipation in the study, (4) participation in the study could be cancelled even during the course of the study, and (5) that the interviewee could ask any questions or clarify any doubts about the

research at any time, and obtained consent in writing. It was also informed that the privacy of the contents of the interview would be strictly protected.

RESULTS

Following a qualitative inductive analysis of the verbatim transcripts of the interviews, five areas of impact were identified: feeling, game plan, status, environment, and requests.

Feeling

The "feeling" category consisted of three subcategories: anxiety, motivation, and goals. First, in the subcategory of "anxiety," respondents indicated their anxiety about the decline in ranking and the transition to the ATP Challenger level, such as "I have anxiety about the tournaments I cannot participate in, regardless of my current ranking" (Mr. A), "I am anxious and impatient that I will not be able to move up to the Challenger level no matter how long I stay active" (Mr. B), and "I am anxious that I will not be able to participate in tournaments that I was able to participate in before" (Mr. C).

On the other hand, one respondent said, "I had ATP points, so it didn't make much difference, I was a little lucky" (Mr. D).

Next, in the sub-category of "motivation," there were responses related to decreased motivation, such as "I wonder how long I should continue my activities as an athlete without being able to participate in my target tournaments" (Mr. B), "I felt depressed because I thought I would not be able to get ATP points" (Mr. C), and "I lost my motivation because I thought I couldn't get ATP points" (Mr. D). On the other hand, there were also answers related to increased motivation, such as "I have to keep fighting and grab the Challenger's qualification, I have to be determined to do it" (Mr. A), "It is a chance for me" (Mr. D), and so on.

In the sub-category of "goals," some respondents answered that they would like to improve their goals, such as "I would like to aim for more ATP points if I have the chance, and my goal is to become an ATP Challenger" (Mr. C) and "I used to be able to aim for the top 300 by only competing in ITF Futures, but now I have to compete in ATP Challenger tournaments to reach the top" (Mr. D). Mr. D also answered, "Since the ranking points are divided between WTT and ATP, I have started to think strategically about which ranking to focus on".

Game plan

The category of "game plan" consisted of two subcategories: changes in the level of tournaments entered and increase in the number of tournaments played. First, in the sub-category of "changes in the level of tournaments played", there were responses such as "I now select more M25 tournaments (WTT tournaments with a prize pool of \$25,000), than M15 tournaments (WTT tournaments with a prize pool of \$15,000) because I can earn ATP points if I make it to the finals" (Mr. A). These responses reflect a focus on playing in higher-level tournaments.

On the other hand, there were some responses regarding the decline in the level of the tournaments they participated in, such as "Compared to the WTT, the Japan Tennis Association (JTA) tournaments earn more prize money, so I have been participating in those tournaments more" (Mr. C).

Next, in the sub-category of “increase in the number of tournaments”, there were responses related to an increase in the number of tournaments entered, such as “I have entered more ITF tournaments in order to move to the challenger level” (Mr. A). And Mr. C said, “After the change in the system, I made a point of actively participating in the competitions I was able to enter” (Mr. C).

Status

The “status” category consisted of two subcategories, ranking and player selection. First, in the subcategory of “ranking,” there were responses related to improving one’s status, such as “I am now seeded” (Mr. D). In contrast, there were some responses regarding the decline in their ranking, such as, “I used to have a high ranking, but I am no longer seeded, and it has become more common for me to participate in the qualifying instead of the main draw” (Mr. B).

Next, in the sub-category of “player selection,” there were responses related to the decrease in the number of tournaments options, such as “For the first time, I was not able to participate in a tournament I had planned to participate in” (Mr. A) and “In the past, I had a chance to qualify for the ATP Challenger tournament in Japan” (Mr. B). Mr. A added, “The rule is not fair to junior players who cannot compete in ITF junior tournaments due to financial or academic reasons, players who want to become professionals after going to college, and veteran players who believe in their chances”. On the other hand, there were some responses regarding the increase in the number of tournaments options, such as “junior players can enter the main tournament based on their junior world ranking, so it is easier for them to move up, and there are more opportunities for young players” (Mr. D).

Environment

The category of “environment” consisted of five subcategories: sponsors, schedule, expenses, clarification of goals, and tournament level. First, in the subcategory of “sponsors,” respondents answered that “it is a disadvantage when acquiring new sponsors” (Mr. B), “it is tough if you do not have at least ATP points, and ATP ranking is important for acquiring sponsors” (Mr. D) regarding the loss of sponsors. On the other hand, some respondents answered that there was no impact on their sponsors, such as “There is no impact on sponsors at this time” (Mr. A) and “I was able to renew my contract this year, and I was told to continue to do my best” (Mr. C).

Next, in the sub-category of “schedule,” there were responses regarding the busy schedule, such as “It depends on the tournament, but sometimes I play two qualifying matches a day on Mondays, and I am exhausted by the time I play the main draw” (Mr. B). Related to this, there was also a response regarding the change of training method, such as “We changed our training method to two-part training in order to fight through the tournament” (Mr. A).

In the sub-category of “expenses,” there were responses related to cost reduction, such as “The tournament is now held from Monday to Sunday, so the cost of lodging has been reduced” (Mr. B). Mr. A also made a similar comment regarding the reduction of accommodation expenses.

In the sub-category of “clarification of goals,” there were responses related to the clarification of the path to the top, such as “It is easier to understand the path to the top, and if you are really good, you can get to the top faster in this system”

(Mr. D). In addition, Mr. A said “While I was worried about the system change, I was determined to win if I had the chance to participate in the tournament, and my goal was clear” (Mr. A).

Furthermore, in the sub-category of “tournament level,” there were responses regarding the improvement of the tournament level, such as “It is tougher than before, there are more strong opponents and young players from the first round, and only players who are really aiming for the top are competing” (Mr. D). Mr. A also said, “I can’t participate in any qualifying matches of the challenger tour, and I feel that it has become more difficult than before” (Mr. A).

Requests

The “requests” category consists of five subcategories: improvement of treatment, method of holding tournaments, number of tournaments, domestic tournaments, and provision of information. First, in the sub-category of “improvement of treatment,” there were responses such as “Compared to overseas tournaments, Japanese tournaments are inconvenient because there are no parking lots, few practice courts, and practice balls are not prepared” (Mr. B), “If transportation from the hotel is more thorough, it would be easier for overseas players to come. (Mr. B), “I think it would be easier for foreign players to come to Japan if they are thoroughly picked up from their hotels” (Mr. B).

In the “Method of holding the tournament” subcategory, participants made comments about tournaments held in Japan every March for six consecutive weeks, traveling across various regions of the country. One participant said, “I would like organizers to stop holding the tournament for six consecutive weeks in March because it is difficult to move around” (Mr. B), while another participant mentioned that “It’s pretty hard to fly around the country every week” (Mr. C).

In the sub-category of “number of tournaments,” there were responses related to increasing the number of tournaments, such as “increase the number of M15 and M25 tournaments in Japan” (Mr. B) and “double the number of ATP Challenger tournaments in Japan” (Mr. D) and so on.

In the sub-category of “domestic tournaments,” there were responses regarding the enhancement of domestic tournaments, such as “Players should take the initiative in enhancing domestic tournaments, rather than leaving it to JTA and tournament organizers” (Mr. A).

In addition, in the sub-category of “provision of information,” there were responses regarding the provision of more information on the changes in the system, such as “I would like to know about the changes in the tour system and the conversion method of ATP points in the JTA rankings as soon as possible”. In response to these requests, there were also responses regarding concrete actions, such as “I also raised the issues of the tour system changes on my blog via Facebook, and players responded to it, so I compiled their opinions and submitted them to the ITF” (Mr. A).

DISCUSSION

Feeling

The “feeling” category consisted of three subcategories: anxiety, motivation, and goals. First, in the sub-category of “anxiety,” Mr. A, Mr. B, and Mr. C, who have different rankings and ages, reported their concerns that they would not be

able to participate in some tournaments due to the change of the tour system. On the other hand, since Mr. D is a young teenager and his ranking is sufficient to participate in the WTT, he thinks that the change in the tour system will be more advantageous to him than other competitors, and feels little anxiety about it. Therefore, it is considered that the change of the tour system has caused anxiety to the players, except for young players who already have the necessary ranking to participate in the WTT.

Next, in the sub-category of "motivation," Mr. B and Mr. C, who were anxious about whether they could participate in the WTT or not, reported a decrease in their motivation for playing tennis. On the other hand, Mr. A, who was ranked higher, was determined to aim for a higher level and was rather excited about it. In addition, Mr. D, who thinks that the change in the tour system will be advantageous to him, reported an increase in his motivation. This suggests that the change in the tour system may have had an effect of decreasing motivation on the players in the middle to lower rankings.

Next, in the subcategory of "Goals," the respondents reported that their goals had improved. This may be because it is no longer easy to maintain the ATP ranking without competing in ATP Challenger tournaments.

Game plan

The category of "game plan" consisted of two subcategories: Changes in the level of tournaments entered and increase in the number of tournaments played. First, in the subcategory of "changes in the level of tournaments entered" the participants reported an increase or decrease in the level of tournaments competed in. Mr. A, who has a high ranking and is capable of winning the WTT, selected M25 tournaments more often than M15 tournaments because he could earn ATP points if he reached the finals. On the other hand, Mr. C, who is in the middle to the bottom of the ranking, has decreased in the number of tournaments he participates in. He chooses domestic JTA tournaments where he can earn more prize money more often. This may have had the effect of increasing the level of tournaments for the top-ranked players and decreasing the level of tournaments for the middle to low-ranked players.

Next, in the sub-category of "increase in the number of tournaments played," the impact of the increase in the number of tournaments played was reported due to the difficulty of competing in the ATP Challenger tournaments.

Status

The "status" category consisted of two subcategories, ranking and player selection. First, in the subcategory of "ranking," the effects of gaining and losing status were reported. The one who improved his status, such as being seeded, was Mr. D, a young player in the top to middle ranking. On the other hand, Mr. B, who was ranked lower, experienced a decline in his status, as he was no longer seeded or participated in the qualifying instead of the main draw.

Next, in the sub-category of "selection of players," the effects of the tournaments were reported in terms of an increase and a decrease in the choices of tournaments. The number of choices increased for the top-ranked, middle-ranked, and young players (Mr. D), while the number of choices decreased for the top-ranked players (Mr. A) and the low-ranked players

(Mr. B). This may reflect the reduction of draw sizes in the ATP Challenger and WTT, and the introduction of the junior priority quota.

Environment

The category of "environment" consisted of five subcategories: sponsors, schedule, expenses, clarification of goals, and tournament level. First, in the sub-category of "sponsors," some players reported the loss of sponsors. This may be due to the fact that the WTT ranking is not directly related to the participation in Grand Slam tournaments, and thus the benefits of sponsors have decreased.

Next, in the sub-category of "schedule," some players reported that they had a busier schedule, and some of them changed their training methods to cope with the schedule change.

In the sub-category of "expenses," there were reports on cost reduction. This is considered to be due to the reduction of travel expenses caused by the shortening of the tournament schedule.

In the sub-category of "clarification of goals," there was a report on the clarification of the path to the top. This is considered to be due to the clarification of the point that only those players who have the ability to get out of the WTT can take the next step to the Grand Slam tournaments.

Furthermore, in the sub-category of "tournament level," there were responses concerning the improvement of the level of tournament. This may be due to the fact that higher ranked players are now competing in the WTT due to the reduction of draw size and other reasons.

Requests

The "requests" category consists of five subcategories: improvement of treatment, method of holding tournaments, number of tournaments, domestic tournaments, and provision of information. First, in the sub-category of "improvement of treatment," it was reported that the parking lots, practice courts, and practice balls are not adequately prepared for WTTs in Japan. It was also pointed out that transportation to and from the official hotels is also insufficient.

Next, in the sub-category of "method of holding tournaments," it was requested that the WTT be held in the same venue as the WTT is held in Japan for six consecutive weeks in spring every year. Furthermore, these tournaments are run by university tennis club members, so it is also important to ensure the governance of the club (Hotta et al., 2022a; Hotta et al., 2022b).

In the sub-category of "Number of tournaments," there was a request to increase the number of M15, M25 and ATP Challenger tournaments in Japan.

In the sub-category of "domestic Tournaments," the need to enhance the domestic JTA tournaments was pointed out.

In the sub-category of "provision of information," it was reported that the information to the players regarding the changes in the tour system should be provided more promptly and better.

From these requests, it can be understood that the improvement of the professional tennis tournament

environment in Japan is what is desired (Hotta, 2021), while the changes in the men's professional tennis tour system by the ITF have affected Japanese players in various ways.

CONCLUSIONS

Following a qualitative inductive analysis of the verbatim transcripts of the interviews, five areas of impact were identified: feeling, game plan, status, environment, and requests.

This study clarified the impact of the change in the men's professional tennis tour system on Japanese players from both environmental and psychological perspectives, and is considered to have provided valuable suggestions for the development of the tennis world. In the future, it is necessary to take measures to make it easier for professional tennis players to compete in international tournaments, based on this study.

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CONFLICT OF INTEREST AND FUNDING

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RECOMMENDED ITF TENNIS ACADEMY CONTENT (CLICK BELOW)





Acute effect of HAL (limb type)-assisted cybernic voluntary control squat exercise on tennis serve speed

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ABSTRACT

The fastest serve at the 2022 US Open Tennis was 141 mph (226.9 km/h, Alexander Bublik, KAZ) and 128 mph (205.9 km/h, Coco Gauff, USA) for men and women, respectively. This speed is expected to increase in the future. Most studies focused on improving serve performance have been conducted in the fields of sports biomechanics and exercise physiology. There are no studies focusing on the voluntary control of the brain, spinal cord, motor nerves, musculoskeletal system, and service performance. Recently, a wearable cyborg, Hybrid Assistive Limb (HAL), has been utilized as a rehabilitation device in patients with stroke, cerebral palsy, and spinal cord injury. We aimed to determine the acute effect of Cybernic Voluntary Control squat exercises using HAL on the serve speed. Four male tennis coaches with extensive teaching experience (mean age: 32.5 ± 0.6 years, teaching experience: 10.5 ± 0.6 years) were included in the study. The results showed an increase of approximately 7% in the in serve speed after HAL-assisted squatting. This was attributed to the interactive biofeedback between HAL and the participants, which may have produced the immediate effect. HAL use could maximize the physical functions of tennis players and guide post-injury rehabilitation exercises.

Key words: Motor learning, rehabilitation, interactive biofeedback.

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INTRODUCTION

The fastest serve at the 2022 US Open Tennis was 141 mph (226.9 km/h; Alexander Bublik, KAZ) and 128 mph (205.9 km/h; Coco Gauff, USA) among the men and women, respectively. This speed is expected to continue increasing in the future (Tables 1 and 2) (USTA, 2022).

Until now, most studies on improving serving performance has come from the fields of sports biomechanics and exercise physiology. No study has focused on the voluntary brain → spinal cord → motor nerve → musculoskeletal system pathway in the field of neuroscience. Recently, the Hybrid Assistive Limb (HAL) (Kawamoto et al., 2010), a wearable cyborg developed by Sankai et al. (2014), has been utilized and is effective as a rehabilitation device in patients with stroke, cerebral palsy, and spinal cord injury (Nakajima, 2011). Yasunaga et al. (2022) evaluated the immediate changes in low back pain and hip flexibility and adverse events after biofeedback physical therapy using HAL; they reported significant positive changes. However, the potential use of HAL in sports remains unknown. Furthermore, it is necessary to verify its usefulness in improving performance and guiding exercises. We aimed to determine the effect of Cybernic Voluntary Control (CVC) squat exercises using HAL on the serving speed.

Table 1

2022 US Open Tennis rankings of the fastest serves among men (USTA, 2022).

Fastest serves in US Open 2022 MEN			
Rank	Matches	Player	Fastest Serve Speed
1	2	A. Bublik	141 mph
2	3	T.Paul	139 mph
2	1	B. Shelton	139 mph
4	2	B. Van de Zandschulp	138 mph
4	5	F. Tiafoe	138 mph
4	1	J. Sock	138 mph
4	5	M. Berrettini	138 mph
8	5	N. Kyrgios	136 mph
8	2	G. Dimitrov	136 mph
8	1	F. Verdasco	136 mph
8	1	J. Munar	136 mph
8	2	J. Thompson	136 mph
8	3	J. Draper	136 mph
8	2	A. Popyrin	136 mph

Table 2
2022 US Open Tennis rankings of fastest serves among women (USTA, 2022).

Fastest serves in US Open 2022 WOMEN			
Rank	Matches	Player	Fastest Serve Speed
1	5	C. Gauff	128 mph
2	4	L. Samsonova	123 mph
3	2	B. Haddad Maia	120 mph
3	3	P. Martic	120 mph
5	3	S. Williams	119 mph
5	3	X. Wang	119 mph
7	3	M. Keys	118 mph
7	1	V. Williams	118 mph
7	5	C. Garcia	118 mph
7	1	O. Dodin	118 mph

METHODS AND PROCEDURES

Subjects

Four experienced tennis coaches (mean age: 32.5 ± 0.6 years), with a teaching experience of 10.5 ± 0.6 years, were included in the study. The physical characteristics and teaching history of the participants are shown in Table 3. These coaches were selected for the study because the learning curve of their serve skills had already plateaued.

Procedure

Before the experiment, a semi-structured interview was conducted to obtain the coaching history (e.g., injuries). Subsequently, a sufficient warm-up time was allowed prior to conducting the experiment. The serve speeds and hitting points were measured using a HEAD Tennis Sensor (U.S.A.) attached to a special racket. Keaney & Reid (2018) confirmed that the stroke volume and intensity captured by HEAD Tennis Sensors are as reliable and valid as those captured by motion capture systems. The DUNLOP Fort tennis ball was used (DUNLOP). The participants were asked to hit 10 flat serves as hard as possible to a target set up in front of them. After each experiment was completed, a sufficient rest period was allowed to avoid the learning curve being affected.

Table 3
Physical characteristics and teaching history of the participants.

	Age (years)	Height (cm)	Body Weight (kg)	BMI	Teaching experience (years)
Subject A	32	165	64.4	23.5	10
Subject B	32	173	70.2	23.4	10
Subject C	33	179	73.5	22.8	11
Subject D	33	176	75	24.2	11
Mean ±SDs	32.5 ± 0.6	173.25 ± 6.0	70.8 ± 4.7	23.5 ± 0.6	10.5 ± 0.6



Figure 1. Tennis racket-mounted motion analysis sensor (HEAD Tennis Sensor; ZEPP).

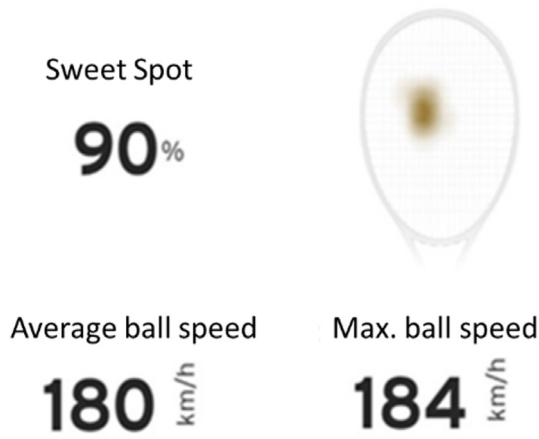


Figure 2. Average and maximum ball speeds and hitting points as calculated using HEAD Tennis Sensor.

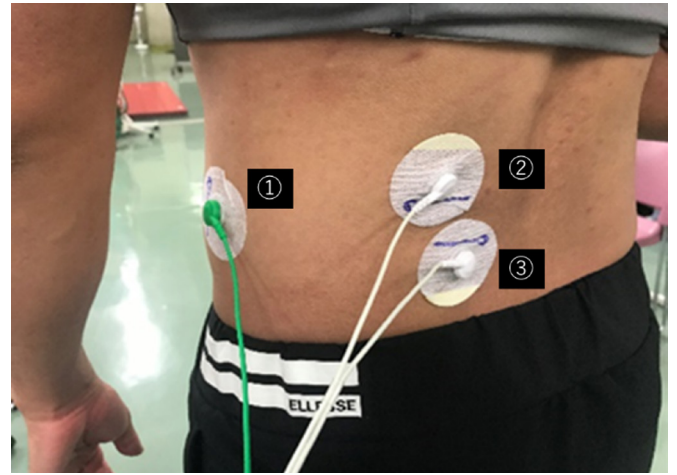


Figure 4. Electrode positions over the back. 1: Grounding. 2 & 3: Erector spinae muscle.

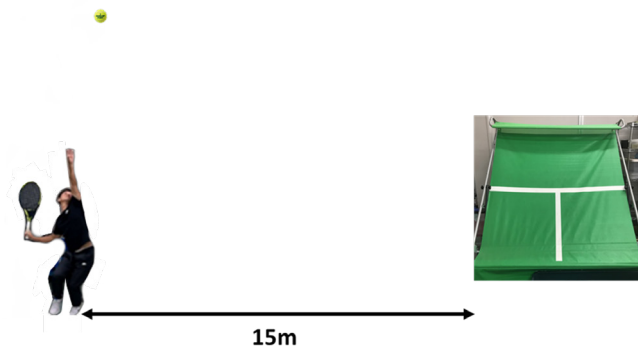


Figure 3. Experimental setup.



Figure 5. CVC squat exercise with the Hybrid Assistive Limb®.

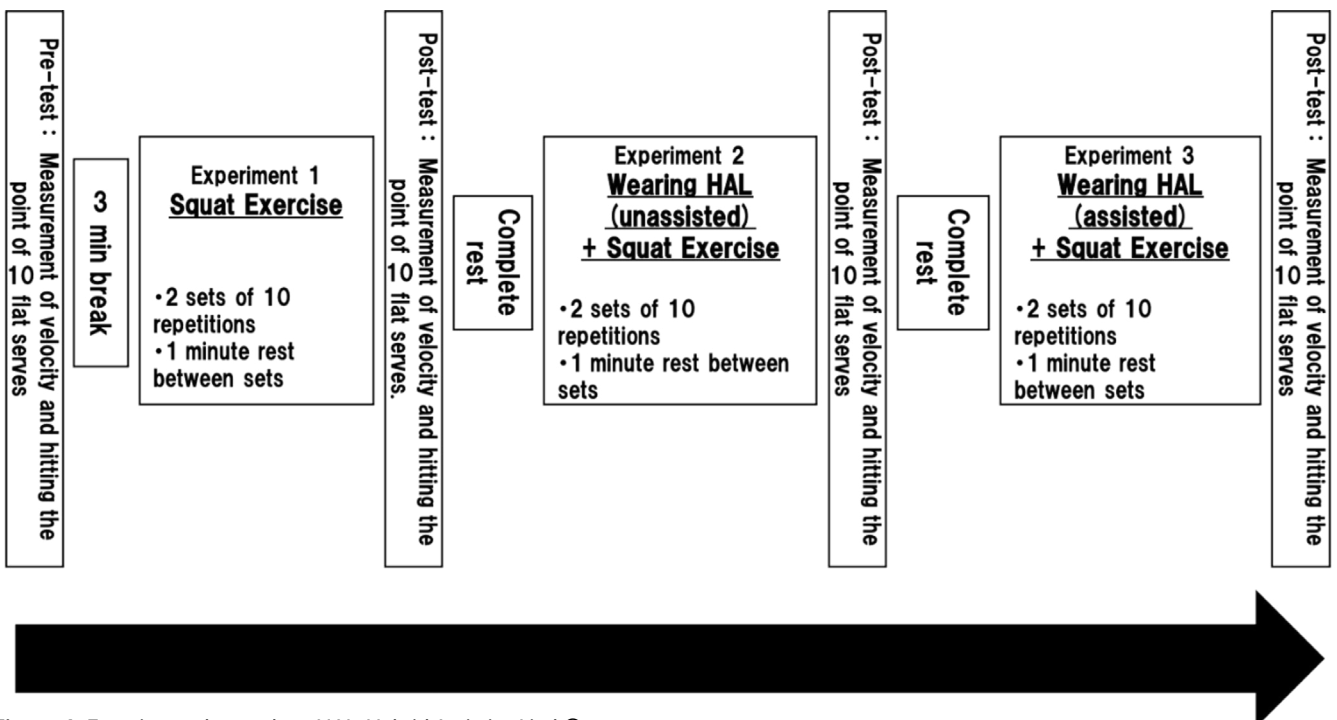


Figure 6. Experimental procedure. HAL: Hybrid Assistive Limb®.

Statistical analysis

Serve speeds following (1) squat, (2) squat wearing HAL, and (3) squat wearing HAL in the CVC mode were compared to the pre-experimental serve speed (two-group comparisons). Wilcoxon's signed-rank test was used for the comparison. SPSS (version 28.0; IBM Japan, Tokyo, Japan) was used for all statistical analyses. Statistical significance was set at $p < 0.05$.

Ethical considerations

This study was approved by the Ethics Review Committee of Meiji University (No. 557). The participants were provided with written and verbal information regarding the purpose and content of the study. It was explained that the results would not be used for anything other than for this study and that participation was voluntary. In addition, it was explained that there would be no disadvantage to not participating in this study. Finally, the participants could leave during the study.

RESULTS AND DISCUSSION

The average serve speed of the four participants was 166.9 ± 12.3 km/h, 170.1 ± 12.4 km/h, 171.9 ± 11.6 km/h, and 179.1 ± 7.0 km/h in the pre-test, squatting under body weight, squatting without HAL assistance, and squatting with HAL assistance (CVC mode) conditions, respectively. The speed increased significantly in all test conditions compared to the pre-test values (Experiment 1: $p = 0.003$, Experiment 2: $p < 0.001$, Experiment 3: $p < 0.001$).

There was a 2%, 3%, and 7% increase in speed in the squatting under body weight, squatting without HAL assistance, and squatting with HAL assistance (CVC mode) conditions, respectively (Figure 7).

Kovacs & Ellenbecker (2011a) classified serves into eight phases from start to completion: (A) initiation, (B) release, (C) loading, (D) cocking, (E) acceleration, (F) impact, (G) deceleration, and (H) completion. The loading phase is important because the lower limb drive generates a large ground reaction force. The importance of leg drive in efficiently transferring lower limb power to increase the serve velocity has been tested using various methods, including lower limb stance techniques. Their disadvantages and advantages have also been reported by several coaches and researchers (Bahamonde & Knudson, 2001; Elliott & Wood, 1983; Martin et al. 2012). Serve speed is related to the amount of muscular force exerted by a powerful leg drive during the loading phase (Bahamonde, 1997). In addition, elite players exert greater horizontal force and use the body's pushing motion to create a series of backward-to-forward movements to hit a fast serve (Girard et al., 2005). Squats and front and side lunges using the body weight are effective exercises, and exercises performed on an unstable balance board improve serve performance (Kovacs & Ellenbecker, 2011b).

HAL can detect weak "bioelectric potential signals" generated from an individual's body surface using sensors and can assist in muscle activity. The driving torque generated by the biopotential signals of the wearer's erector spinae muscles gets transmitted to the trunk and lower limbs via both fixed belts (Abe et al., 2018). Subsequently, the brain and nervous system (brain → spinal cord → motor nerves → musculoskeletal system → HAL → musculoskeletal system → motor nerves → spinal cord → brain) and interactive bio-feedback between the brain/nervous system, body, and HAL (brain → spinal cord → motor nerves → musculoskeletal system → HAL → musculoskeletal system → motor nerves → spinal cord → brain) strengthen and adjust the interconnections and improve its function (Grüneberg et al., 2018; Nakajima et al., 2021; Sankai, 2014; Sankai & Sakurai, 2018).

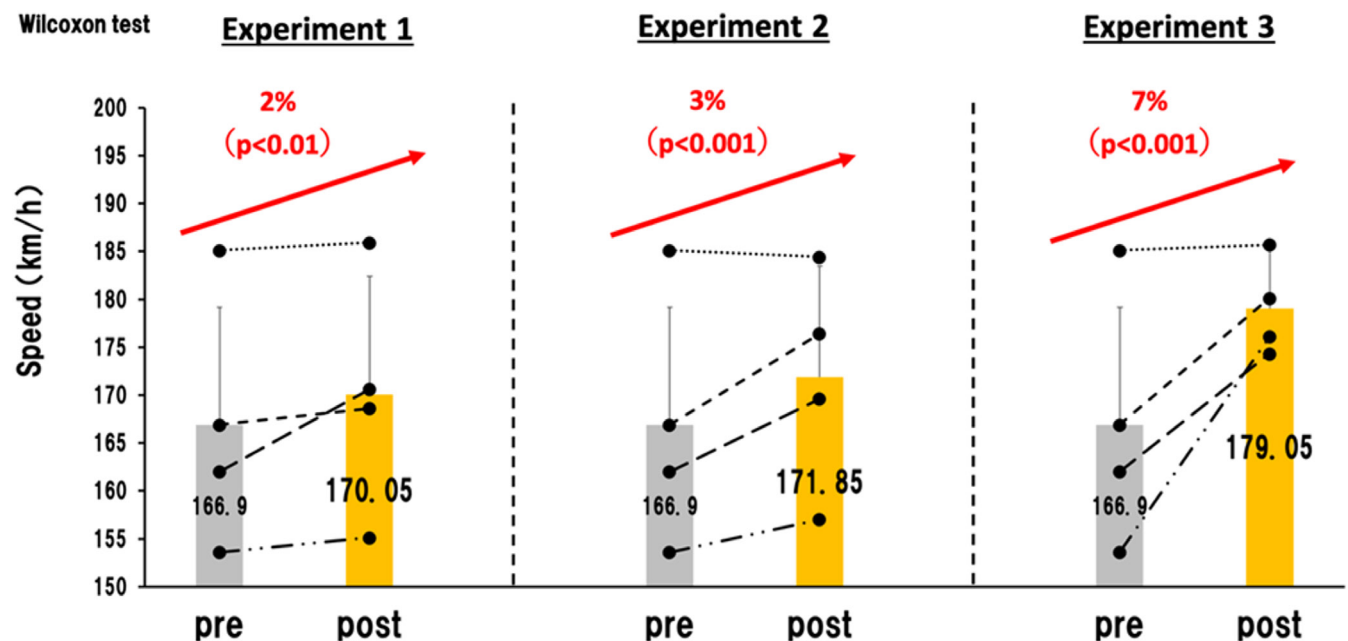


Figure 7. Change in serve speed from pre-test to post-test condition.

Squatting using HAL is a CVC exercise that provides voluntary assistance based on bioelectrical signals, which is an evolution from the commonly practiced body weight-based squatting. HAL-assisted squatting stimulates and mobilizes the lower limb muscles and nerves that have not been used up to this point, establishing efficient interactive biofeedback learning and possibly increasing the serve speed.

Limitations and future research

Because this study used a special experimental apparatus (HAL), only four participants were included in the study. Future studies with a larger sample size and other methods, such as group set-ups for measurement, will be required. In addition, "leg drive," which is thought to be a major factor in increasing the serve speed, was not analyzed in this experiment using force plates and a three-dimensional motion analysis device. We would like to perform further studies considering these factors.

CONCLUSION

This study aimed to determine the effects of HAL-assisted CVC squat exercises on the serve velocity. We found a 2%, 3%, 7% increase in speed in the body weight-based squatting, squatting without HAL-assistance, and squatting with HAL-assistance (CVC mode) conditions, respectively. The use of HAL could help tennis players recognize and utilize their latent physical abilities and motor functions. Additionally, it could maximize their physical functions and provide guidance during post-injury rehabilitation.

CONFLICT OF INTEREST AND FUNDING

The authors declare that they do not have any conflict of interest and that they did not receive any funding to conduct the research.

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[RECOMMENDED ITF TENNIS ACADEMY CONTENT \(CLICK BELOW\)](#)





What is it like to be a parent of an elite junior tennis player?

Callum Gowling

Great Britain.

ABSTRACT

This paper is an Interpretative Phenomenological Analyses (IPA) into the experiences of parents of elite junior tennis players. “Performance narratives” have received attention in professional sports settings, but research has yet to fully investigate the effects on parents of junior tennis players. Parents are a psychologically significant network member of coach-athlete relationships. Narrative theory states that through creating personal stories people can make sense of their lives. A “performance narrative” is a story of dedication to sport performance, where, winning, results, achievements are pre-eminent and link closely to the story tellers’ identity. The purpose of this study is to examine the experiences of 8 parents of elite junior tennis players and describe what it is like to be a parent in the elite junior tennis context. An Interpretative Phenomenological Analysis of 8 parents of elite junior tennis players describes their experiences of elite junior tennis tournaments. This study found that (a) parents struggle with the development versus winning paradigm in junior tennis (b) “performance narratives” influence how parents evaluate player improvement (c) “performance narratives” influence parents’ behaviours at competition. This paper recommends more face-to-face coach-parent communication to help parents adhere to development narratives and increasing the frequency / relevancy of parent education workshops that give a realistic depiction of the elite junior tennis pathway.

Key words: Junior tennis, Parent attitudes, Performance narratives.

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WHAT IS IT LIKE TO BE A PARENT OF AN ELITE JUNIOR TENNIS PLAYER?

Parents are not merely a taxi service who ferry their children to tennis and sit disinterested whilst their child competes. Parents are a psychologically significant network member of coach-athlete relationships who give their young tennis playing children opportunity, support, and information that has a strong influence over coach-athlete dyads. The information that parents communicate to their children has a significant impact on their relationship with the coach and their enjoyment of tennis more generally (Jowett & Timson-Katchis, 2005). Coaches work tirelessly to give the best support to young tennis players so they can maximise their potential in tennis, but they cannot do it alone. Parents are critical in supporting their children to excel in tennis, and it is important governing bodies, coaching programmes, and coaches support parents along the junior tournament pathway to ensure consistent adherence to developmentally rich, coaching messages. Thus, parent education and support are crucial additives to develop and maintain effective coach-athlete relationships so young tennis players experience of tennis is as positive as possible.

Parents face significant emotional challenges in junior tennis when ‘expected’ tennis experiences, such as, improving, having fun, and enjoying competition are contradicted by ‘actual’ tennis experiences, such as, needing to win, the race for



selection, and comparison with peers on websites (Peet et al, 2013). For as long as junior sport has existed, there have been (and will continue to be) challenges with the development versus winning paradigm. In other words, do parents focus on skill acquisition as a measurement of development; or do parents focus on results / ranking as a measurement of development? The search for a “one size fits all approach is a

fools' errand", so how do we support parents in tennis while they try to learn, understand, accept and adapt to a unique sporting context, whilst seeking the most appropriate balance of coaching, competing, learning, improving, developing, and enjoying, for their child (Cassidy, Jones, & Potrac, 2016).

Increased support for parents that is considerate of the nuances of competitive junior tennis can help them focus on healthy development narratives for their child's development. Development narratives tell a story of commitment to improvement and long-term personal development – often rewarding improvement over results (Douglas & Carless, 2012). Junior tennis is known to have a competition system which prioritises ranking / selection / representation (Lauer et al., 2010); rely on considerable financial investment from parents (Dunn et al., 2016); contain high levels of interpersonal conflict (Wolfenden & Holt, 2005; Smoll, Cumming, & Smith, 2011); and display contradictory values associated with development and winning (Gowling, 2019). Without careful monitoring and criticality of the conscious or sub-conscious messages that parents absorb along the junior tennis journey, it is possible that flawed learning outcomes are internalised and 'winning' takes on too much importance in the mind of parents.

Research must consider the effects of performance narratives on the behaviours of people who are most responsible for supporting children through competitive junior tennis – the parents. Performance narratives provide a story of dedication to sport performance, where, winning, results, achievements are pre-eminent and link closely to the story teller's identity (Douglas & Carless, 2012). Tennis is an expensive sport where early specialisation is common, and this presents challenges for parents due to sustained exposure to a competitive environment where win / loss ratios, points, and rankings are unavoidable phenomena.

Increasing education around the effect of performance narratives on parent attitudes, would improve the support for parents struggling to 'make sense' of a competitive environment that promotes rankings and tournament acceptance, whilst simultaneously encouraging parents to be patient and prioritise performance over winning. Furthermore, a deeper understanding of existing narratives in junior tennis will enable governing bodies, coach educators, coaches, and parents to communicate narratives which are appropriate for long-term, positive, emotional development of junior tennis players no matter what their aspirations in tennis are, for example, developmental narratives.

This paper looks at the experiences of 8 parents of elite junior tennis players and highlights challenges associated with the development versus winning paradigm in junior tennis.

METHOD

This study was an interpretative phenomenological analysis (IPA) of 8 parents of elite junior tennis players in the UK. The participants included 3 males and 5 females. Participants were parents of elite junior tennis players, and this was defined as competing at national level competition and above (Rees et al., 2016). Interviews were semi-structured, and the aim was to understand parental experiences of elite junior tennis competitions, for example "do you enjoy taking your child to competitions?" Interviews lasted between 45 minutes and 90 minutes and were audio recorded. Interview transcripts were transcribed verbatim, printed out, and analysed following the IPA procedure, namely: (1) reading and re-reading

transcripts, (2) initial noting, (3) developing emergent themes, (4) searching for connections across emergent themes, (5) looking for patterns across cases. (Smith, Flowers, & Larkin, 2009). The results section includes pseudonyms to ensure participants anonymity.

RESULTS

There are three main findings: (a) parents struggle with the development versus winning paradigm in junior tennis (b) "performance narratives" influence how parents evaluate player improvement (c) "performance narratives" influence parents' behaviours at competition.

PARENTS STRUGGLING WITH THE DEVELOPMENT VERSUS WINNING PARADIGM

A core value for parents along the junior tennis pathway is to promote their child's best interests. Parents try to adequately balance their involvement and promote their child's best interests by providing them with the opportunity to play the necessary hours to develop their tennis in a healthy environment (Knight, Berrow, & Harwood, 2017). However, parents question the real values inherent within junior tennis compared with their expected values. Amy said "Everyone, says it's about the process. But it isn't. It's about the winning. It doesn't feel like there is a long term outlook. It is about who wins now." Consistently, parents described issues in trying to understand the real values in junior tennis.

An unsolved question in broader junior sports conversations relates to the development versus winning paradigm. 'Trust the process' is a phrase often used within sports coaching, and it neatly summarises an attitude towards long term personal development and maximising human potential. The day-to-day reality of junior tennis challenged parents' belief in idealistic statements. Brian said, "how do you tell your child not to worry about the result and just play, when everything eventually comes down to their rating or ranking, and this will limit their opportunities to play tournaments?" There was a unanimous trend throughout the responses for parents to perceive tournament acceptance at the highest graded events as evidence they were giving their children with the best opportunity to develop in tennis. Mary said, "If you don't get into the highest graded tournaments, you don't get the best matches. You fall behind." It appeared difficult for parents to separate tournament acceptance from their perception of providing their children with the best opportunity to develop their tennis.

Continually the parents described internal conflict between wanting to prioritise long-term growth and a perceived pressure to achieve results for tournament acceptance. There was evidence of financial pressure influencing the responses. Colin said, "I understand that you can't put pressure on them (children), but you have to win matches, to get into the tournaments, to justify the investment. It's this vicious circle you can't get out of". Previous studies have shown that junior tennis players are hyper-aware of the financial sacrifices that parents make for their tennis participation which acts as a stressor during matches (Gowling, 2021). The parents described a financial pressure associated with junior tennis as an influence on how they assess the effectiveness of training. Nicky said, "Something has to give. We (family) understand there isn't a formula for success, but we don't have a limitless pot of money". A mix of confused messaging around the importance of results and financial pressures were a strongly

associated with the parents' discomfort with the development versus winning paradigm.

PERFORMANCE NARRATIVES INFLUENCE HOW PARENTS EVALUATE PLAYER IMPROVEMENT

The attitudes, beliefs, and values of parents have a powerful influence on the effectiveness of coach-athlete relationships. Without consistent communication from coaches and careful monitoring of shared goals, it is possible the flawed values can be internalised by parents along the journey, which may interfere with coaching messages. Performance narratives can steer parents off track from coach driven goals aimed at long term development. For example, Tony said, "You do lose perspective after a while. The whole environment seems to push you towards equating improvement with a better ranking." Sustaining their personal values such as provision of opportunity, lifelong learning, learning to cope with defeat, improvement through practice, enjoying what you do, taking pride in your performance, was challenging for the parents when they felt pressure to use results as measurement of improvement. Lucy said, "It feels quite toxic when you're at tournaments. I try to stay well away from the 'who has beaten who' conversations but even then, I find myself checking out results. You just want your kids to do well." Constant communication of development goals is required to help parents maintain the long-term perspective and focus on development above winning.

Coaches may find that development goals set at the beginning of a training block, are usurped by an innocent switch to short term prioritisation of results to gain entry to a higher graded event. Colin said, "xxx (child) had the goal of playing in a grade 1. We needed some more points to get there, so we had to do the miles. I felt daft doing it, but it was good for xxx's confidence to feel like he's part of the crowd." Parents feel an internal conflict between focussing on development goals (improvement) and outcome goals (results) causing them anxiety. Their anxiety related to what they should do for the benefit of their children, the goals set by their coach, and the mismatch with what they perceived the competition system to demand from them to provide opportunities for their children. Nicky said, "Her coach told her not to play but if she didn't play, she'd miss out on getting into xxx (competition). What do you do? She'd have been devastated to miss out". Support for parents must provide reassurance to commit to long-term, development goals over short term focus on gaining points.

PERFORMANCE NARRATIVES INFLUENCE PARENTS' BEHAVIOURS AT COMPETITION

The emotional climate and parent behaviours have a strong influence on children's experience tennis (Knight & Holt, 2014). There have been studies used to develop models of best practice for parent behaviours at competition born out of an understanding that negative parenting behaviours result in negative learning outcomes for children (Armour, 2013). It is not the aim of this paper to add to the list of dos and do nots of parenting in junior sport. This paper adds to a growing body of literature, which offers an illustration of performance narratives adding to the over-emphasis on results amongst parents.

Understanding performance narratives and how they permeate youth sport can give coaches the knowledge and confidence to educate parents who are struggling to make

sense of a competition system containing contradictory values and behaviours. Colin said, "It can be a toxic environment for everyone. Kids are desperate to win. Coaches are desperate for their players to win. We as parents, aren't immune either. There is a lot of questionable behaviour from everyone at tournaments." Sarah described a similar set of experiences, "When you see the environment and how people behave, you do question why you are doing it." Observations of a negative / tense environment around competitions were prevalent throughout the responses and Mary highlighted over emphasis on winning as the primary cause. Mary said, "I thought this was meant to be fun. My whole body is tense at tournaments. You have to walk away sometimes when you see other parents trying to put kids off, just so their child can win. It's pathetic." Research has shown that children are aware of the behaviours of spectators at competition, and they will formulate their own ideas about what is important to them based on how others behave (Knight & Holt, 2014). If children witness emotional and 'toxic' behaviours at competition from adults who become overly involved in matches, it could potentially confirm in their mind that winning is most the important thing.

The data in this study shows that there is a long way to go to ensure parents adhere to development narratives at competition. Colin said, "It's toxic. We all want our kids to win but some of the desperation in the parents' behaviour is quite shocking. You feel for the kids". Further studies are needed to highlight the gritty reality lived by parents at competitions and illustrate the effects of performance narratives on behaviour at competition.

DISCUSSION

The data in this study illustrates parents of junior tennis players struggling to balance contradictory narratives (e.g., development and performance narratives). Over reliance on winning to assess improvement makes it difficult to stay focussed on development goals, informs attitudes toward player improvement, and contributes to negative behaviours at competition. There are two main recommendations from this paper.

First, early specialisation and sustained participation in the competition system are strong influences on parents understanding of the values within junior tennis. Parents are conflicted by the development versus winning paradigm within junior sport and struggle to balance long-term player development with a perceived need to gain entry to the highest graded competitions. Consistent, face-to-face coach-parent communication is necessary to maintain a cohesive support network around junior tennis players and ensure adherence to developmental narratives which prioritise long-term player development over seeking short term approaches aimed at solely gaining wins / points.

Second, a desire to provide their children with the best opportunity to develop was associated with emphasis on gaining acceptance into the highest graded competitions. Parents described feeling pressure to prioritise results because playing in higher graded was closely associated with their understanding of player improvement. Increasing the frequency of parent education workshops would help to support parents who are trying to provide their children with the best opportunity to develop in tennis. Clubs and academies can host more parent education workshops that take a bold approach and include realistic depictions of

the gritty reality of the competition environment which (a) highlight negative behaviours associated with performance narratives, (b) illustrate the effect negative behaviours have on player development, (c) promote the benefits of long-term, developmental narratives.

CONCLUSION

The findings of this research contribute to an evolving, problematic epistemology of junior tennis coaching and confirms that the attitudes of parents of young tennis players are influenced by performance narratives. Parents struggle with the development versus winning paradigm in junior tennis and performance narratives influence how parents evaluate player improvement and their behaviour around competition. The findings recommend increased parent support through increasing face-to-face coach parent interactions and parent education workshops. Failure to address the influence of performance narratives in junior tennis and increase the frequency of parent support threatens the experiences of parents and their children in tennis. Further work must be done to monitor the influence of performance narratives in junior tennis, and to alleviate the misuse / misapplication of tournament systems that places too much emphasis on winning and rankings in the eyes of parents.

CONFLICT OF INTEREST AND FUNDING

The author declares that he does not have any conflict of interest and that he did not receive any funding to conduct the research.

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[RECOMMENDED ITF TENNIS ACADEMY CONTENT \(CLICK BELOW\)](#)





Proposal and evaluation of a practice session including a learning tennis wall

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ABSTRACT

Tennis is a challenging sport to learn. Novice children players (5-8 years old) need a certain amount of practice to reach both consistency and mastery in their strokes. In an attempt to support the coach and help the players to remain active, ©Artengo designed an equipment consisting of increasing the hitting volume during a practice session: The Tennis Wall. The objectives of the present study were i) to propose a practice session including the use of the Tennis Wall, ii) to evaluate the influence of adding the Tennis Wall on the hitting volume in a practice session with novice children tennis players. A practice session with the Tennis Wall allowed to hit about 3 times more balls for each young tennis player compared with a traditional practice session. Although the results of this study need to be confirmed with a larger sample of participants and more training sessions, they suggest that the Tennis Wall can be an interesting support to learn tennis due to the increased repetition of strikes which contributes to skill acquisition.

Key words: Skill acquisition, constraints based approach, pedagogical equipment, exercises

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INTRODUCTION

Tennis is a challenging sport to learn due to its multidimensional nature, requiring the acquisition of complex technical and tactical skills (Kolman et al., 2019; Reid et al., 2007). Current recommendation from the International Tennis Federation for tennis coaches is to favor children novice players to perform a large volume and variety of strokes during their practice sessions (www.tennisplayandstay.com). It was demonstrated that the improvement in performance during the early learning stage is produced by repetitive practice of the tennis shots (Menayo et al., 2010). Blocked-practice sessions with repetition were shown to be effective in improving the forehand performance of younger or less skilled players, particularly in the immediate term (Farrow & Maschette, 1997; Menayo et al., 2010). The results of these studies suggest that novice players need a certain amount of repetition to reach both consistency and mastery in the task before benefitting from less predictable and more game-like practice exercises (Reid et al., 2007).

Based on the constraints-led approach of learning, three elements (task, environment and individual) can be manipulated to help the acquisition of specific skills (Newell, 1986; Regan, 2021; Renshaw & Chow, 2018). It was shown that modifying the environment (i.e. court dimensions, net height, kind of balls, racket properties or presence of an opponent) had an influence on biomechanics, game tactics and success rate of young tennis players (Buszard et al., 2016; Fadier et al., 2022; Herbaut et al., 2023; Kachel et al., 2015; Limpens et al., 2018; Larson & Guggenheimer, 2013; Shafizadeh et al., 2019;

Timmerman et al., 2015). Specific task constraints can be used to allow the learner to focus on the emergence of specific information-movement couplings and to discover new solutions to solve a problem (Reid et al., 2007). In a guided-discovery lesson, the teacher provides a temporary structure (constraint) that assists or supports the child to successfully perform the skill (Newell & Rovegno, 2021).

One solution which supports the coach to change the environment and to teach the tennis technique to novice players is the use of a rebounder net, which is usually a heavy structure put on the tennis court. In an attempt to increase the hitting volume during the tennis practice sessions and to ease the use of this kind of solutions, ©Artengo designed an equipment called: The Tennis Wall (Figure 1). It consists of an inflatable structure with stretched and inclined canvas on which the player can send the ball and see it coming back to hit it again. The claimed advantages compared to a traditional wall is that it allows the player to perform strong strikes and still have the time to place correctly for the next strike thanks to the attenuation of the impact by the canvas and the inflated tube that allows the ball to come back and bounce quite high. It is also believed that the Wall creates an environment constraint which forces the players to hit the ball on the side of the body with a proper forward swing and frame orientation at ball contact to avoid sending the ball above it, promoting both an efficient forehand technique and a more aggressive gameplay (Reid et al., 2013).



Figure 1. Player repeating forehands against the Tennis Wall

The objectives of the present study were i) to propose a practice session including the use of the Tennis Wall, ii) to evaluate the influence of adding the Tennis Wall on the hitting volume in a practice session with novice children tennis players. It was hypothesized that training with the Wall increases the hitting volume, which should support the acquisition of forehand technical skills and improve performance.

METHODS AND PROCEDURE

Participants

Twenty-four participants were involved in this study. They were distributed in 4 groups of 6 players (2 groups of red level and 2 groups of orange level). The criteria of inclusion were being aged between 5 and 8 years old, being injury-free and having less than 2 years of tennis experience. Parents were informed about the experimental procedures and the right to withdraw their child from the study during or after the experiment. They gave written consent for their child's participation and the data collection.

Procedure & Task

Children participated in two practice sessions designed by a tennis coach, one week apart in a counterbalanced order. The specific skills to work in both practice sessions were the hitting plan (forward and lateral of the body) and the frame orientation of the racket at ball contact when performing forehands. The sessions were both composed of an observational situation (PRE-Test), 3 tennis-blocks (TB#1, TB#2 & TB#3) and a final evaluation (POST-Test) (Figure 2). The experimental session consisted of a training session with the Wall. The control session consisted of exactly the same training session but the block-practice against the Wall (TB#3) was replaced by a task of forehands with balls sent by each player himself, in autonomy, to the other side of the court. Balls used during the training session and court dimensions were adapted to players' level (Red balls and 11x5.5-meters court for Red-level players, Orange balls and 18x8.2-meters court for Orange-level players).

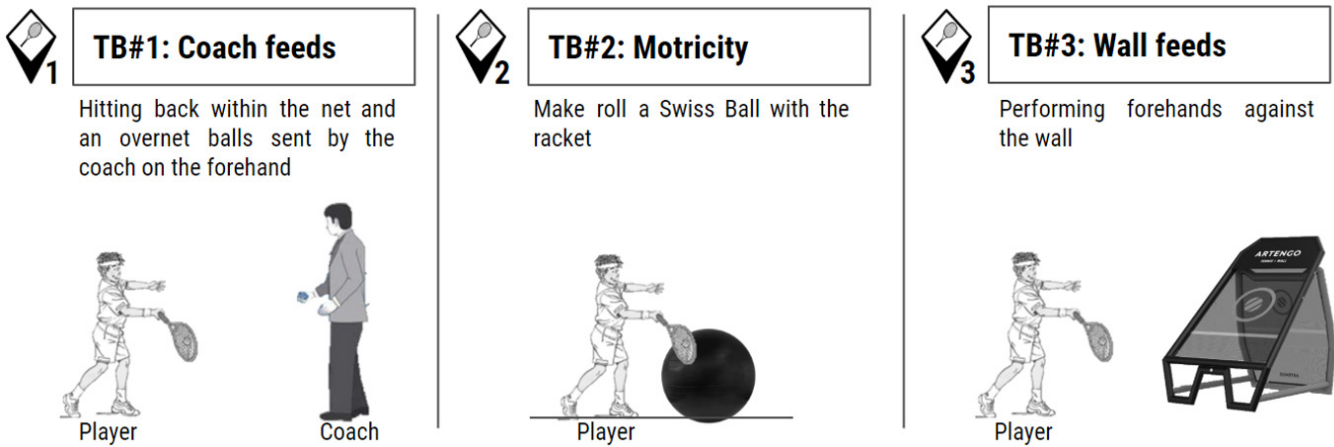


Figure 2. Tennis blocks (TB) used during the practice session with the Learning Wall.

PRE-Test (Observational situation)

- Objective: Observation of the difficulties encountered by the players and measurement of their initial performance.
- Duration: 6 minutes
- Description: The coach sends 10 balls to each player (ball color corresponding to player's level), who performs forehands with the aim to send them back to the other side of the court and within the net and an overnet placed 1 meter above the net.

Tennis Block #1: Coach feeds the ball

Same setup as the observational situation.

- Objective: Working on gesture quality.
- Duration: 12 minutes
- Description: The coach sends balls to each player, who performs forehands with the aim to send them back to the other side of the court and within the net and an overnet placed 1 meter above the net.
- Points of vigilance: Make sure that the player executes the right movements, with a proper hitting plan and with the intention to send the ball in the desired area

Tennis Block #2: Motricity

- Objective: Working on motricity and providing sensations.
- Duration: 12 minutes
- Description: The player rolls a gym ball (65 cm-diameter) forward with the racket, always keeping the gym ball forward and laterally of the body, and starting to push the gym ball from below.
- Points of vigilance: Make sure that the player keeps the contact on the gym ball with the racket from the beginning to the end of the gesture to accompany the gym ball progression.

Tennis Block #3: Wall feeds the ball

- Objective: Working on repetition to develop consistency.
- Duration: 12 minutes
- Description: The player hits forehands against the Wall, which sends the ball back to him repetitively. It is important to have a good acceleration during the forward swing and a correct frame orientation at ball contact.
- Points of vigilance: Make sure that the player keeps a sufficient distance with the Wall to favor correct placement and forward swing.

POST-Test (Final evaluation)

Same setup as the observational situation.

- Objective: Evaluate the performance evolution of the players.
- Duration: 6 minutes
- Description: The coach sends 10 balls to each player, who performs forehands with the aim to send them back to the other side of the court and within the net and an overnet placed 1 meter above the net.
- Points of vigilance: Make sure that the player executes the right movements, with a proper hitting plan and with the intention to send the ball in the desired area

Variables of interest & Data analysis

- Hitting volume: the total number of balls struck by each participant during the 1-hour practice session was recorded by the experimenters.
- Performance score progression: the score during the PRE-test (observational situation) and the POST-test (final evaluation) were measured. Out of the 10 balls fed by the coach, 1 point was granted when a ball was sent back on the other side of the court and passed within the net and the overnet. The performance score progression was computed as POST-test score minus PRE-test score.

All statistical analyses were done with XLSTAT (©Addinsoft Inc, NY, USA). Normality of data distribution was checked with a Shapiro-Wilk test. A 2x2 Repeated-measures ANOVA (repeated measure: Wall vs. No Wall, fixed factor: Red vs. Orange level) was conducted to evaluate the effectiveness of the Wall and the effect of game level on the 2 variables of interest. When a significant difference was found, t-tests with Bonferroni correction were applied. The significance threshold was set at $p < 0.05$.

RESULTS

Hitting volume

In terms of hitting volume, the repeated measures ANOVA revealed a significant main effect of players' level ($F_{1,25}=34.4$, $p < 0.001$), significant main effect of Wall condition ($F_{1,25}=68.2$, $p < 0.001$) and a significant interaction effect ($F_{1,25}=13.1$, $p < 0.001$). On average, the hitting volume increased by 289% for a practice session with the Wall compared to a practice session without the Wall ($p < 0.001$). The hitting volume increased more for Orange level players (+316%, $p < 0.001$) than for Red level players (+243%, $p = 0.025$) (Figure 3).

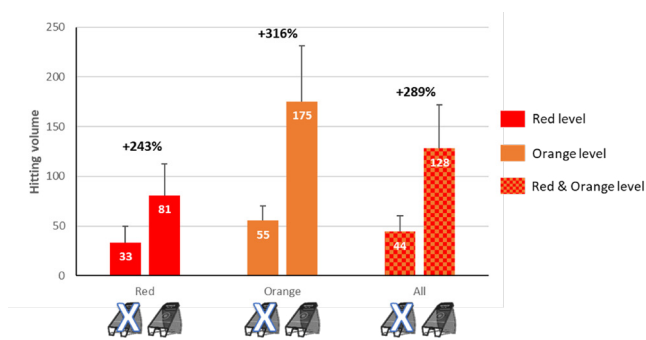


Figure 3. Hitting volume during the practice session without and with the wall (red: mean of the players with a red level, orange: mean of the players with an orange level, red/orange: mean of all the players).

Performance score progression

In terms of performance score progression, the repeated measures ANOVA showed no significant main effect of players' level ($F_{1,25}=1.1, p=0.305$), no significant main effect of Wall condition ($F_{1,25}=0.0, p=1.000$) and no significant interaction effect ($F_{1,25}=1.9, p=0.183$). The performance score between PRE-test and POST-test was not statistically significant but tended to improve both for a practice session without the Wall (+0.7 points, $p=0.054$) and with the Wall (+1.1 points, $p=0.054$) (Figure 4).

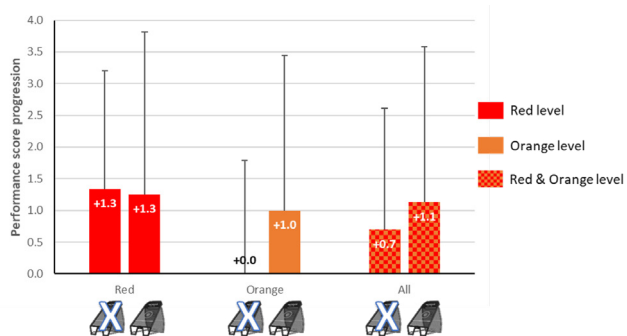


Figure 4. Performance score progression during the practice session without and with the Wall (red: mean of the players with a red level, orange: mean of the players with an orange level, red/orange: mean of all the players).

DISCUSSION

The objective of the present study was to evaluate the potential benefits for novice children tennis players to practice tennis in a training session including the use of a Tennis Wall compared to a traditional training session. The initial hypothesis that a training session with the Wall allowed increasing the hitting volume of novice children players was validated. It was observed both in red and orange level players but it seems that players with a higher level benefit even more from a practice session with the Wall, likely because they have a better capacity to make long rallies against it. Actually, increasing the number of strikes during tennis training sessions is crucial both to build the fundamental motor programs and to enhance the enjoyment of the players, which is key to keep them active and motivated to play tennis over the long-term (Anderson et al., 2009). It was shown that repeating tennis shots was effective in improving the forehand performance

of young novice tennis players (Farrow & Maschette, 1997; Menayo et al., 2010). Indeed, repeated task-specific practice generates structural and functional changes throughout the central nervous system, which is necessary to reach both consistency and mastery in the task (Leech et al., 2022; Reid et al., 2007). However, only the number of balls hit by the players was recorded but not the quality of each strike. Repeating a bad gesture multiple times could be counterproductive and may lead to learning bad habits, which can be challenging to unlearn later. It was recently evidenced in a longitudinal study that the use of a tennis racket containing visual and haptic cues helped to facilitate the acquisition of a proper technique (Herbaut et al., 2023). Further similar analyses on the Wall are needed in order to determine if using it regularly allows a larger improvement in the technique, specifically a better forward swing and a proper frame orientation at ball contact.

It made sense to observe an overall improvement trend in the performance of the players between the beginning and the end of the practice sessions. However, the absence of significant difference between a practice session with or without the Wall did not allow to conclude about the potential benefits of the Wall in terms of performance progression. As mastering complex movements such as tennis strokes requires time, it is definitely difficult to observe performance improvements in only one practice session (Reid et al., 2013). A several-weeks longitudinal study would be needed to observe more accurately the contribution of the Wall to support motor skill acquisition. Moreover, the fact that only one coach managed all the practice sessions was both a strength and a weakness of the study. It was needed to make the comparison reliable between a session with and without the Wall. Nevertheless, the outcomes in terms of hitting volume are also dependent on its teaching approach. It is likely that, with the help of the tennis coaches community, one could design new practice sessions in order to maximize the use of the Wall and optimize the learning process. It should result in even more multiplying the hitting volume during a practice and helping the acquisition of tennis-specific technical skills.

CONCLUSION

A practice session with the Tennis Wall allowed to hit about 3 times more balls for each young tennis player. Even though no better improvement in performance was observed after a practice session with the Wall compared with a practice session without the Wall, it can be assumed that the increased repetition of forehands contributes to the acquisition of a proper technical skill.

This study provides the first elements to demonstrate the interest of the Tennis Wall as a support to learn tennis, especially by the increase of repetition of the gesture (quantitative analysis). A long-term qualitative study consisting of an evaluation of the technique of each participant made by the coach during several weeks would be necessary to assess the relevance of this equipment to ease the learning of tennis technique.

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CONFLICTS OF INTEREST

AH, AV, GD and MF are employees of Decathlon which commercializes the Artengo Tennis Wall evaluated in this study.

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RECOMMENDED ITF TENNIS ACADEMY CONTENT (CLICK BELOW)





Non-gender stereotyped motor development in the discovery stage of tennis: A narrative review

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ABSTRACT

We present motor development as the central element of the integral development of children in the pre-school stage, which is also transferable to primary education. Movement and motor acquisition facilitate new learning, such as that which takes place in the social sphere. Thus, through motor skills, boys and girls increase their interactions with others, which gives them more opportunities to establish positive gender relations with their classmates. The purpose of this review article is to provide knowledge and recommendations so that teachers who teach mini-tennis classes in schools or clubs have educational resources that allow them to teach with equity in a context of greater gender equality. The teachers will note two relevant facts: first, that human beings begin to show gender differences when choosing a game very early, around the age of two; second, they will understand that rackets in themselves, like balls and colours, do not have gender. Throughout the text, we will present some examples of gender stereotypes that will help to better understand this problem that limits the development of boys and girls, and that is part of our society.

Key words: Developmental cascades, early ages, mini-tennis, gender equity and equality values.

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INTRODUCTION

From the earliest ages, the natural energy that children possess drives them to move, to play with different toys and to participate in all kinds of playful, physical and sporting activities such as those that are put into practice in mini-tennis classes in educational centres, clubs and tennis schools. In this initial stage of discovery and "motor literacy", exploration and experimentation are promoted, the first games, circuits and stations are organised (without and with racquet) in which various motor skills are developed (walking, running, jumping, throwing, catching, driving, pushing, bouncing, hitting, etc.); and coordination, balance, physical abilities, and social and emotional skills are also improved (Campos-Rius and Rocca, 2021). Movements and motor experiences are essential tools of motor development that allow children to perceive their opportunities for action, to know their bodies, to acquire new skills, to understand the meaning of the context and to achieve an integral development in all areas: motor, physical, emotional, social, linguistic and cognitive; it is from this perspective that Adolph and Hoch (2019) defend motor practice as a fundamental pathway of motor development, since motor actions are the resource that enables new learning in the various domains studied by developmental psychology: "motor skill acquisition can instigate cascades of development that are so far-flung from motor behavior and so far removed in time that, on the surface, they hardly seem connected at all" (p. 155).

This means that children not only learn new motor skills, but that these newly acquired milestones "are a means" that facilitates the acquisition of other skills that are part of the

pupils' overall development. This is a central idea of our article: the motor domain influences and incites developmental cascades. Therefore, these new motor learning processes benefit other areas of boys and girls; thus, the consequences of these influences go far beyond the exclusively motor aspect, they stimulate various psychological functions and, above all, the acquisition of social skills, attitudes, behaviours and values such as equity and gender equality.

Education authorities are concerned about gender stereotypes and behaviours among boys and girls in schools. In the recent Royal Decree 95/2022, several key terms are intentionally used to explicitly encourage Early Childhood Education teachers to adopt a didactic approach based on equity: equality (15 times), discrimination (13 times) and stereotypes (8 times); as an example, in the curriculum area of "Growing up in harmony", basic knowledge "D" highlights "respect for gender equality and the rejection of any kind of discrimination" (p. 14581). The issue of gender equality is not only of concern to education authorities, but also to sports leaders, managers and various professionals who observe significant inequalities in sport. For this reason, the International Tennis Federation (ITF) has launched the gender equality strategy "Advantage All" in 2019. In addition, the ITF Academy online platform offers the e-learning course "ITF Advantage All Gender Equality Strategy-Introduction" and the video "The psychological effect of stereotypes on girls and women in tennis". The ITF Gender Equality Commission hopes that tennis will be an example for other sports, a more egalitarian sport at all levels, without discrimination for any reason or circumstance, without favouritism, with more opportunities, with more gender balance, and that the equity

measures implemented will promote the empowerment of the most vulnerable groups, such as girls and women who play tennis.

The main objective of this article is to provide knowledge and guidance to teachers who teach mini-tennis classes in pre-school and primary schools and tennis clubs, as well as to other professionals involved in the motor and integral development of pre-school children, and transferable to later ages. We highlight the fact that early motor experiences will impact the future developmental potential of boys and girls, and that learning about gender equality starts very early in the life cycle.

RESEARCH METHOD

This review has articulated three main themes (motor development, gender perspective and the discovery stage of tennis) in order to find useful knowledge and applications for teachers. In order to do so, four main stages were followed (see Table 1): 1st Identification stage A: bibliographic searches in English and Spanish were carried out in two electronic databases using various keywords; 2nd Identification stage B: manual searches were carried out by studying the reference list of some relevant documents and in addition specific websites were consulted; 3rd Eligibility stage: the most appropriate documents for this study were selected, in total: 14 articles, 3 books and/or book chapters, 1 project and 1 educational regulation; and 4th In-depth review phase: the content of the 19 selected documents was read and the essential information for the main sections of this article was extracted.

Table 1

Summary of the investigation procedure.

Succession of the stages used in the review
1st Identification Phase A: electronic searches in Web of Science and Google Scholar.
2nd Identification Phase B: manual searches through reference lists and website queries.
3rd Eligibility phase: selection of suitable documents.
4th In-depth review phase: full-text reading of the selected documents and extraction of key information.

MOTOR AND SOCIAL DEVELOPMENT GO HAND IN HAND

As we saw earlier in the introduction, motor development stimulates and accompanies the socialisation process. Motor and social skills are progressively acquired during interactions with others. These links between the motor and social spheres occur naturally through play, looks, smiles, gestures, sounds, words, etc. When children acquire a new motor skill, a whole range of possibilities opens up. An example of this process is when they stop crawling and start walking independently. This is a more interesting skill because they can now move from one point to another more easily, their field of vision increases and they free their hands to manipulate more objects, all of which will lead to increased interaction and play with others. Consequently, as children improve their motor skills, they also progress in their socialisation processes by increasing their interactions with significant people: peers, caregivers, educators and family members (mothers, fathers, siblings,

etc.). In this initial stage of discovering tennis, through a wide range of group games and mini-tennis activities, children will increase the frequency of their relationships with their peers and will have more opportunities to develop their social skills.

At the same time, in this social context of teaching and learning, the set of play activities developed in each session will be the means for the education of values such as respect, companionship, equity and gender equality. By equity we understand the means, measures and resources to achieve equality between boys and girls. Not all children grow up in equal socio-cultural and economic conditions, and we know that these conditions of inequality can limit their all-round development (Haywood and Getchell, 2020); therefore, some children will need special support in order to have similar developmental possibilities as others. We also understand gender equality as the aim, the goal to be achieved in childhood, that we are treated equally in our society, with respect and fair treatment, and that we have the same possibilities to develop.

COLOURS, BALLS AND RACKETS HAVE NO GENDER!

A key issue to consider for the education of our children is to assimilate the fact that colours, clothes, toys, sports materials and facilities, play spaces, games, sports, professions and household chores are "genderless"; however, gender attribution and, consequently, stereotypes are so ingrained in our society that it is sometimes difficult to see that they are right in front of our eyes (Collard and Meurant, 2023). Adapting the examples of these authors, you can ask yourself if you have had the following cases in your mini-tennis classes: have you ever seen a pupil playing dressed in pink or dressed up as a fairy, or have you seen an unfeminine and extremely competitive pupil playing very well at sports or dressed up as Spider-Man, these fictitious cases that might cause concern for some parents encourage us to reflect.

Gender identity is constructed from childhood and is a complex multifactorial process that is not static; it can undergo changes during the life cycle because a set of biological, social, cultural and psychological variables are interrelated (Rocha, 2009). At the same time as the process of gender identification is taking place, gender typing (stereotyping) is developing. The latter is mainly influenced by socio-cultural factors: from an early age, boys and girls acquire typified behaviours and learn to differentiate colours, toys, games, activities, etc. by gender. In this way, boys and girls acquire gender stereotypes which are representations, ideas or labels "different for males and females": they may attribute gender role stereotypes to games, tasks or activities (e.g. boys play at being firemen and girls at being nurses), or gender stereotypes of behaviour (e.g. girls are sensitive and boys aggressive).

In psychology, this process of categorisation has been studied by analysing gender differences in choosing or preferring toys to play with; for example, at the age of two years, girls and boys differentiate themselves by preferring to play with a certain type of toy; if this differentiation occurs, we would be proving that a gender stereotype does exist. Boys' and girls' choices are influenced by "multiple factors" such as the messages they receive from adults, mothers, fathers, teachers or caregivers (Boe and Woods, 2018), or by other variables such as the colour and type of toy (Fulcher and Hayes, 2018), or are caused by toy companies' advertising strategies that target a particular gender; thus, children, mothers and fathers see highly gender-stereotyped images, words and messages

on television, the internet, social media, or on the toy box itself.

In this regard, Weisgram and Dinella (2018, p. 4) raise two relevant questions: "what makes a toy masculine or feminine?", and what would happen if the industry advertised and marketed the same toy in a neutral way for boys and girls, "omitting explicit and implicit labels". Undoubtedly, these factors condition boys' and girls' choices by generating stereotypical toys and dichotomous play activities that are either masculine or feminine (i.e., boys play with motorbikes and cars; girls play with babies and dolls). These characteristics related to gender typing are learned in a sociocultural environment that is specific to each child and, therefore, children's behaviours and preferences are studied from a binary or traditional gender perspective, masculine versus feminine, with no other options in between, neutral or mixed (Dinella and Weisgram, 2018).

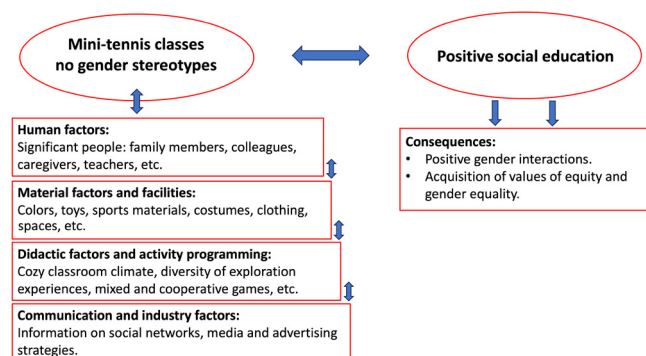
In research, it is quite difficult to ascertain precisely at what age infants, toddlers and very young children show gender differences in their play preferences; one of the important limitations is due to language acquisition. Despite the methodological problems inherent in the nature of these studies, some researchers argue that gender differences "appear" from 18 to 21 months, but that these differences "are constant" as they approach 24 months of age (cf. Zosuls and Ruble, 2018).

Educational programmes and interventions are priority instruments to improve gender equality in children and adolescents. In Physical Education classes, stereotyped behaviours have been observed mainly in boys, although if the intervention is appropriate, improvements in equal behaviours are observed in both genders (Pelegrín et al., 2012). In Early Childhood Education schools, gender-stereotyped play spaces can be identified, such as the cooking corner or the construction corner; Collard and Meurant (2023) suggest that these spaces be modified by educators, for example, a corner with a restaurant where all the staff "working" is very diverse (boys and girls) would be more inclusive compared to the more traditional cooking corner.

Inappropriate behaviour, inequality and gender stereotypes are also frequently observed in the shared spaces of schools and tennis clubs. Recently, Zapatero-Ayuso et al. (2022) conducted a study in the playground of a primary school in the Community of Madrid. The results after the co-educational intervention indicated certain gender differences. Girls complained of disrespect from boys, they demanded more "passive" spaces for rest and the need for alternative games to sports, and they requested materials such as swings and benches. The boys, for their part, had problems with respecting the turns on the multi-sports courts and expressed dissatisfaction with the reduction of sports areas, especially the one for football.

Researchers such as Riemer and Visio (2003) have observed a trend of change in the sporting choices of boys, girls and adolescents, which provides some hope for the reduction of gender stereotypes, but more research is needed to provide new data on this evolution. These patterns of change are a reflection of a society transforming over time as demonstrated by analyses of boys' and girls' drawings in very different years or time periods, 1977 versus 2015 (see Lamm et al., 2019).

As a result of this literature review, Figure 1 shows how various factors influence the implementation of an ideal educational approach: "Mini-tennis lessons without gender stereotypes". On the other hand, on the right, readers can see that mini-tennis lessons are an ideal way to promote a healthy socialisation process in which there is room for positive relationships between pupils and an inclusive education that



incorporates the values of equity and equality from a gender perspective.

Figure 1. Diagram depicting multiple factors that determine a mini-tennis education proposal based on equity and equality.

GUIDELINES FOR TEACHERS

This article is intended as a contribution to society in general, however, the main advice is aimed directly at teachers who teach mini-tennis in schools and tennis clubs.

You are the role model for your students, maintain a positive classroom climate

You are unaware or often unaware of the immense influence you exert on your students, without realising it, they will imitate your attitudes and behaviours, which will leave a permanent imprint in their minds (Haywood and Getchell, 2020; Jiménez, 2021). There are inconspicuous micro-events of gender stereotypes that can be detected in non-verbal and verbal expressions used by adults and teachers, some words such as "pretty, macho or champion" would be inappropriate (Collard and Meurant, 2023). Therefore, we suggest that you use neutral expressions in order not to condition your students, always think about preserving a positive classroom climate free of gender discrimination and discrimination of any kind. You will be the model that your students will implicitly imitate, examples:

- If you are a man, it is a good idea to participate in games and play activities that are often considered feminine, such as dances or jumping games with and without rope or rubber bands, adapted to the motor competence of your pupils.
- On the contrary, if you are a woman, try to show behaviours and values "normally" associated with masculinity, such as being very competitive, being aggressive in a good way and having ambition to win; your students will perceive that you can feel good showing behaviours associated with masculinity and, above all, they will be able to learn the positive aspect of these values.

In this way, your students will observe both facets: "the masculine and the feminine", being more equitable for their integral development; thus achieving the objective that they participate in confidence, without fear and in an atmosphere of respect and companionship.

Programme playful, varied, mixed and cooperative activities without gender stereotypes

The greater the diversity of games, the more likely your students will be to acquire the innumerable benefits that each activity offers; try to ensure that most of the games are mixed and cooperative, thus increasing social interactions between boys and girls and their interest in participating, and with creativity, gradually introduce gender-sensitive elements into the games (see Fuentes-García and Carmona, 2021). Your programming should not only have motor and tennis objectives, but also, ideally, in several sessions you should specify objectives (or competences) that promote values related to gender equity and equality. Teachers have a fundamental role to play in designing mixed-gender activities, taking into account the fact that girls are usually less encouraged and stimulated to develop motor skills and practice sports activities (Collard and Meurant, 2023); also, girls often feel "less capable"; therefore, teachers should plan measures or adaptations that promote equity, as well as avoid the habitual practice of gender-stereotyped activities and sports (Beasley, 2013).

Uses gender-neutral materials, toys, clothing, colours and play spaces

Educate your students without gender, the different elements you use will be the tools to take a step towards equality. Use a variety of colours, and if you use materials that are associated with a particular gender this will be an excellent opportunity to teach your students tolerance and respect. If a negative comment is made towards someone, or a child does not want to use a particular material, this is an opportunity to observe this behaviour and educate the pupils, examples:

- Suggest to your school or tennis club to buy paddles, rackets, bibs or design "gender neutral" clothing.
- Watch your pupils when pink is used in mini-tennis classes, it is possible that a pupil may say a derogatory comment to a classmate, or reject the pink material; remind them that there are great tennis players such as Alcaraz or Nadal who wear pink or similar colours in some matches.
- Make the most of the class that coincides with the carnival party so that everyone can dress up as they like. A few years ago, in a tennis club in the Community of Madrid, a teacher dressed up as Snow White and it was fantastic, there was no problem at all.

Involve families and managers

Raise awareness among parents and managers through workshops, projects or seminars involving people from the school or tennis club.

Design together with your students, collaboratively, a poster and/or "decalogue of good behaviours" that communicates messages directly related to gender equity and equality, and that involves the whole school or tennis club.

Also, it is key to emphasise that in the case of detecting inappropriate behaviour of a student, do not overlook it, and respectfully inform his or her family; take advantage of this possibility, your work is not limited to teaching only hitting skills.

Claims women's and men's triumphs in tennis

As a PE teacher, manager or club coach, recognise the achievements of male and female tennis players. If you ask people in a talk in 2023: who has won the most Grand Slams, you will be surprised to find that most people will not know that there are women tennis players who have won more Grand Slams than men. As has been suggested, some people are unaware of women's success because of the limited media coverage of these merits. Let us not be agents of this unequal transmission and let us be critical of this situation. It can be positive for your students to find sporting references of the same gender to strengthen their sporting practice in the long term; at the same time we contribute to spreading a fair and equal vision of sporting success in tennis.

Get your message across to the sporting goods and toy industry

If you dream of a more egalitarian society, don't just sit on your hands, find a way to make your voice heard. The "overly stereotypical" advertising your students receive is one of the factors affecting their development.

Evaluate your teaching

It is important that you take some time to think, evaluate and make decisions about your own teaching, using simple self-assessment questions such as these:

- Do I prepare concrete equity measures, adaptations or actions to bring pupils growing up in a less advantaged socio-cultural and economic environment closer to the development opportunities available to others?
- Do I create a welcoming classroom climate for my students to interact in a positive way?
- Do I programme mini-tennis activities and games that contribute to a more equal education of boys and girls from a gender perspective?
- Do I use mini-tennis materials, games and spaces that stimulate children's development?
- Do I take into account families and others who might influence the motor and holistic development of my learners?

CONCLUSIONS

The motor actions, games and strokes that boys and girls experience in mini-tennis classes not only stimulate motor development, but also motor skills are the way to promote new acquisitions in other areas of development, therefore, it is essential that teachers pay special attention to the design of sessions and activities. In this programming, objectives (or competences) guided by the principle of equity must be specified so that gender equality can be achieved or, in a more utopian way, so that mini-tennis classes can be taught free of gender stereotypes. As previously explained, we know that the differences in play preferences shown by boys and girls begin to develop very early, and can be detected when they are close

to two years old. As a consequence, it is of vital importance not to waste time and to start gender-sensitive education as early as possible from pre-school age. But we also know that children's gender-neutral minds are bombarded daily by stereotype-laden messages from peers, adults, the media, social networks and industry. The consequences of these messages modify ideas, beliefs and influence the formation of boys' and girls' personalities, limiting or significantly affecting development; they could affect the perception of competence, the expression of emotions, the choice of future studies and the roles played at home, among others. For these reasons, gender equality education should start at the pre-school stage, and then needs to be reinforced in the following educational stages.

CONFLICT OF INTEREST AND FUNDING

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[RECOMMENDED ITF TENNIS ACADEMY CONTENT \(CLICK BELOW\)](#)





How important is the coach-created motivational climate on player longevity?

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ABSTRACT

Coaches are considered the architects of sustained participation and performance in sport, often responsible for implementing the structure and content of training and competition over short- and long-term periods. Further, coaches can also influence the design and nature of social interactions and experiences. Appleton et al. (2016) refers to such coaching environments, created intentionally or unintentionally, as 'coach-created motivational climates,' given their impact on player motivation (or lack of). This article initially describes the research that supports empowering coach-created motivational climates, an evidence-based approach to developing and sustaining player motivation. An empowering climate is characterised by coach behaviours of high task involvement, autonomy and social support and low ego control. The article then highlights how tennis coaches can implement and review empowering coaching principles, promoting positive health development and player longevity.

Key words: Coach-athlete relationships, athlete development, long-term motivation, sustained participation.

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INTRODUCTION

Previous research has identified several coach-driven factors that are important to sustained participation and performance, including the coach-created motivational climate (Appleton et al., 2016). The motivational climate created by the coach can influence the quality of training and competition in short and long-term contexts, as well as the potential to facilitate positive health development including the accrual of physical, psychological, and social benefits (Duda & Appleton, 2016). More specifically, what the coach says and does, and how they structure the environment, can influence an athlete's interpretation and responses to training and competition (Duda, 2001).

Duda (2013) presented a dualistic framework of the motivational climate, known as a coach-created Empowering or Disempowering climate. Duda (2013) defines the coach-created motivational climates, as either: optimising athlete development and participation (i.e., empowering) or dysfunctional psychological and social responses/outcomes (i.e., suboptimal or disempowering). An empowering climate is characterised by coaching behaviours of high task-involvement, autonomy-support, and social support (Appleton et al., 2016; Mageau & Vallerand, 2003; Reinboth & Duda, 2004), with low ego control. More specifically, task-involving refers to coaches implementing, encouraging, and reinforcing values related to personal task effort and a work ethic toward individual skill improvement and self-betterment. The coach may implement skill activities aligned with task-involving values or may encourage these values during activities where individuals are focused on skill mastery and problem solving. Autonomy-supportive coaching



is evident when the coach takes the athletes' perspective into account. The coach encourages athlete choice and voice (i.e., during problem-solving or learning), as well as acknowledging athlete emotions or feelings (Mageau & Vallerand, 2003). Socially supportive coaching refers to a genuine interest in athlete welfare. The coach demonstrates care and concern for athlete well-being and provides social encouragement and support during learning/training activities. A socially supportive coach respects his or her athletes and does not demand respect in return (Reinboth et al., 2004).

To differentiate between the motivational climates, disempowering climates are commonly characterised by features of ego-involving (e.g., result focussed) and controlling (e.g., authoritarian) instruction, social interaction designs, and behaviours (Duda, 2013; Duda & Appleton, 2016).

Ego-involving coaching often refers to different treatment based on an athlete's (perceived) capability or competency differences. In this climate, the coach may create an excessively competitive rivalry between all participants (e.g., athletes, support staff, other coaches, parents, significant others) with the focus on outperforming others (Newton et al., 2000), and create inequity in participation and social engagement opportunities. Finally, the controlling dimension refers to how a coach will dictate all participant behaviours, social interaction, and performance within training and competition settings. Controlling behaviour includes pressuring, coercing, intimidation, and threatening behaviours during interactions. Such coaches may more likely use extrinsic rewards/reinforcements to manipulate participant behaviour (Bartholomew et al., 2010). Previous research on former club to national-level Australian swimmers (aged 8 -18 years) identified the association between sport discontinuation and a coach-created disempowering climate when compared to continuing swimmers (Moulds et al., 2023).

As coach-created climates convey information and meaning for participating individuals and those in close social proximity (e.g., support staff, other coaches, parents, significant others), logic suggests that promoting and implementing favourable empowering coaching characteristics could be beneficial to sustained performance and longevity in tennis.

EVIDENCE BASED COACH-CREATED MOTIVATIONAL CLIMATES

Previous coach education intervention studies include the Promoting Adolescent Physical Activity (PAPA) project (Duda et al., 2013; Duda, 2013) and isolated studies in North American youth sport contexts. The PAPA project examined soccer as a platform to endorse youth mental, emotional, and physical health. Within the project, interventions aimed to increase the knowledge and awareness of 'grassroots' coaches to foster youth (males and females, aged 10-14 years) experiences, motivations, and enjoyment (The PAPA project, 2023). For instance, working with French and Norwegian youth soccer coaches (N = 18) at the grassroots level, a six-hour pre-season intervention qualitatively examined the implementation of empowering motivational climate principles in coaching instruction and behaviours. In support, findings from a recent intervention pilot study conducted with Australian swimming coaches (N = 19) provided preliminary evidence suggesting coach motivational climates can be positively modified via a short-course coach education intervention. Incorporating empowering characteristics, while concomitantly reducing disempowering associated characteristics could benefit youth swimmer experiences and sport longevity (Moulds et al., 2023).

Similarly, in a United States community-based youth basketball program involving 37 coaches (n = 4 females, n = 33 males; $M_{age} = 45.0$, $SD = 6.17$) and N = 216 junior players (n = 99 females, n = 117 males; $M_{age} = 11.50$, $SD = 1.63$), Smith et al. (2007) examined the influence of a motivational climate intervention upon athlete anxiety over a 12-week basketball season. Statistical analyses identified athletes in the intervention group perceived their coaches as being more mastery-involving on the MCSYS, when compared to athletes in the control group. Analyses of time differences (time point 2 - time point 1) revealed that athletes in the control condition had increased anxiety levels according to the Sport Anxiety Scale-2 (SAS-2; Smith et al., 2006).

WHY CONSIDER THE MOTIVATIONAL CLIMATE AND TENNIS PLAYER LONGEVITY?

Previous findings considering age-related factors of the top 100 ranked men and women over the last few decades have reported a shift towards older ages and longer playing careers. Ages of top 100 male tennis players examined from 1984 - 2013 (Gallo-Salazar, 2015) increased significantly from ($M_{age} = 24.6$, $SD = 3.9$ to $M_{age} = 27.6$, $SD = 3.2$ yr; $P < 0.01$). In female tennis players, data examined from 1998 - 2013 also suggested an increased age ($M_{age} = 23.5$, $SD = 3.5$ to $M_{age} = 24.8$, $SD = 4.2$ yr; $P < 0.01$). When comparing males and females, a top 100 ranking was reached earlier in females than males ($M_{age} = 21.6$, $SD = 3.4$ vs $M_{age} = 22.8$, $SD = 3.1$ yr; $P < 0.05$) and peak performance was also attained significantly earlier in females than males ($M_{age} = 23.6$, $SD = 3.5$ vs $M_{age} = 24.8$, $SD = 2.9$ yr; $P < 0.01$). Men remained in the top 100 for a slightly longer period than women ($M_{age} = 4.1$, $SD = 3.1$ and $M_{age} = 4.6$, $SD = 3.8$ yr; $P < 0.01$). Analysing thirty years of longitudinal data, Li et al., (2018) implied the developmental time course and career trajectory of top-level players in professional tennis took approximately two decades. Top 10 players spent approximately 10 years from the age they first began playing tennis ($M_{age} =$ males 5.5, $SD = 1.6$ yr, females $M_{age} = 5.6$, $SD = 1.9$ yr) to reaching an international junior level and another 10 years to reach their best career senior ranking. Age-related trends have remained similar over time. In 2022 the age of the top 100 ranked men was ($M_{age} = 27.3$ $SD = 4.5$ yr) and women ($M_{age} = 27.2$ $SD = 4.8$ yr). Therefore, if it takes approximately 20 years for players to reach peak performance, the role of the coach and other stakeholders in close social proximity with the athlete (e.g., support staff, other coaches, parents, and significant others) is paramount.

COACH-CREATED EMPOWERING CLIMATES TO ENHANCE PLAYER LONGEVITY

Given their frequent interactions with athletes, coaches should consider how coach-created motivational climates can impact vital factors (i.e., technical, tactical, physical) for positive long-term psychosocial development. Whilst acknowledging complexity in coach-created motivational climates, there are guiding principles that can be used to help motivate athletes using known indicators of motivation such as attention, energy, effort, and enjoyment. Examples of empowering and disempowering coaching behaviours for tennis are provided in Figure 1. By considering and satisfying empowering climate dimensions, coaches can positively contribute to the long-term tennis experience and influence healthy and sustained performance outcomes. Armed with the knowledge of evidence-based research and self-awareness, combined with the expectation that coaches are only steering/influencing and not definitively determining motivation, coaches and (support staff, parents) may be able to navigate the complexity that is inherent in motivational climates, enhancing empowering climates and avoid suboptimal, disempowering climates.

COACHING STRATEGIES FOR IMPLEMENTATION - MOTIVATIONAL CLIMATE REFLECTION

An immediate strategy to consider is empowering motivational climate training and awareness for coaches. As athletes' mental health issues are becoming increasingly apparent, key stakeholders (coaches, support staff, parents) must aim to create positive (empowering) environments

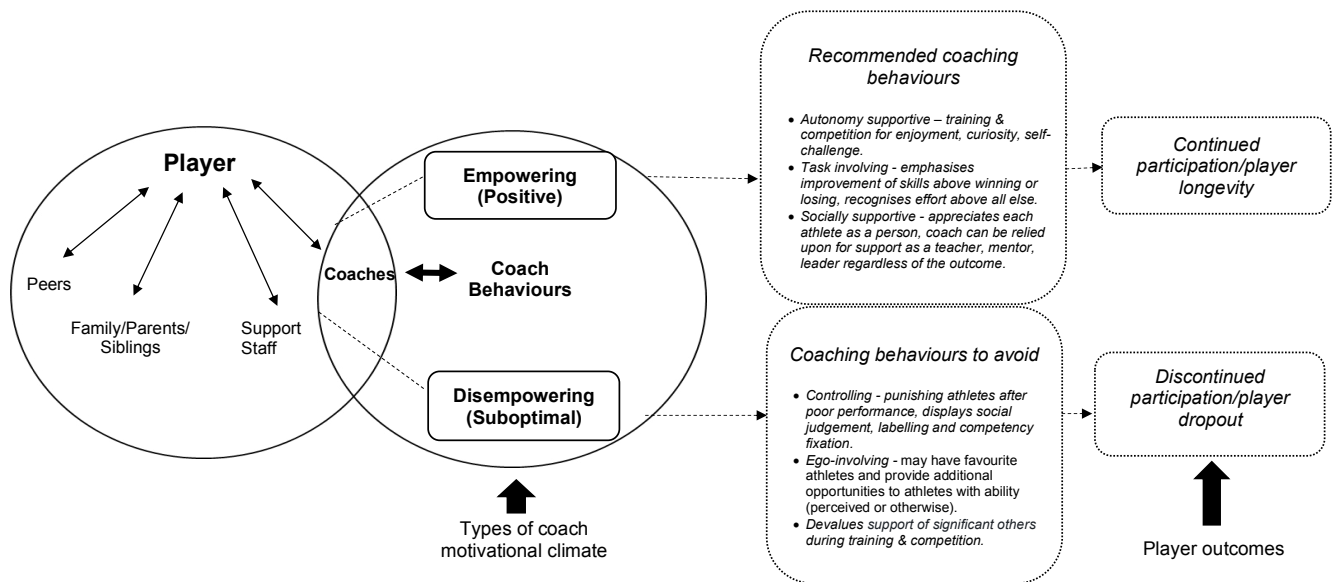


Figure 1. Visual summary of how interactions and coaching climate behaviours may associate with discontinuation and long-term development outcomes of empowering and disempowering coaching behaviours for tennis.

for athletes. In addition, coach education training could be valuable for reducing dropout rates and increasing the likelihood of attaining functional longer-term developmental and performance benefits from sustained participation (Moulds et al., 2023). Individual coaches should aim to increase self-awareness through constant self-reflection and evaluation of coaching climate behaviours. Multiple assessments (e.g., with athletes, support staff, colleagues, national sporting organisations, other sporting organisations) and conducting periodic reviews could enhance player longevity. The importance of interactions with other coaches, group education and coach mentoring may also help pinpoint when and where changes/alternative factors within a coaching climate may need to occur. Several types of reflection can take place at various times of the coaching process, the following recommendations could help to assess the motivational climate and inform coaching practice:

- Retrospective reflection-on-action (Gilbert and Trudel, 2001) assessing empowering/disempowering coaching principles 'after the fact'. Notes, reflective journaling, informal discussions/interviews with others, to reflect on motivational climates from a training and competitive context.
- Reflection-in-action (Schön, 1983) assessing empowering/disempowering coaching principles during training or competition with a colleague/mentor/critical friend to examine aspects of delivery in terms of the coach-created motivational climate, and to formulate goals for improvement.
- Reflection-on-action (Gilbert and Trudel, 2001) assessing empowering/disempowering coaching principles immediately after a coaching session or days later, but before the next coaching session. Video analysis can be an effective strategy to assist the coach in making sense of their coaching climate to improve future action.

Coaches will differ in terms of when the most appropriate and effective time for motivational climate reflection is. Coaches should also consider the value of including other stakeholders (e.g., athletes, support staff, mentors, colleagues, and parents) in the process.

CONCLUSION

Key recommendations from this article are for coaches to specifically implement coaching behaviours, aligned to an empowering motivational climate for player longevity. Coaches' relational skills, the implicit message meaning (empowering and disempowering) from instructional behaviours can shape athlete behavioural responses (e.g., anxiety levels) and outcomes (e.g., sport dropout or longevity). A coach-created motivational climate combining autonomy-supportive, task-involving, and socially supportive relational exchanges between individuals (e.g., athletes, coaches, support staff, parents, and significant others) may increase the likelihood of athletes attaining positive outcomes from longer-term participation and ultimately performance. Avoiding suboptimal climates in the form of controlling coach behaviours, such as pressurising, coercing and intimidation, and using extrinsic rewards/reinforcements to reward behaviour should be of utmost importance. Developing a robust motivational climate reflective practice throughout the coaching process can benefit coaches in many ways. As well as session planning, coaches can use reflection strategies to help further develop self-awareness and emotional regulation.

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Tennis development at the ground level: Coaches' perceptions of how incentive structures impact the development systems national tennis associations implement

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ABSTRACT

National Tennis Associations operate within the confines of a market-driven environment. An environment creating incentive structures forcing NTAs to be cognizant of revenue generation, which may impact how tennis development systems are designed and implemented, affecting how tennis products and services are delivered at the micro-level. Therefore, the study sought to examine coaches' perspectives of how tennis delivery at the ground level is shaped by the incentive structures created by NTAs' implementation of tennis development systems. Findings from eight interviews with experienced coaches demonstrate how coaches feel compelled to compromise some of their ideals in their delivery of tennis services, feel the pressure of competitive youth tennis can be overwhelming for players, and believe a team-oriented tournament structure can alleviate some of the concerns arising from extant incentive structures. Findings show the need to consider how tennis's existence in a market-driven economy shapes how tennis is managed and delivered, and provide an initial foundation for future research.

Key words: Coaches, incentive structures, National Tennis Associations, tennis development

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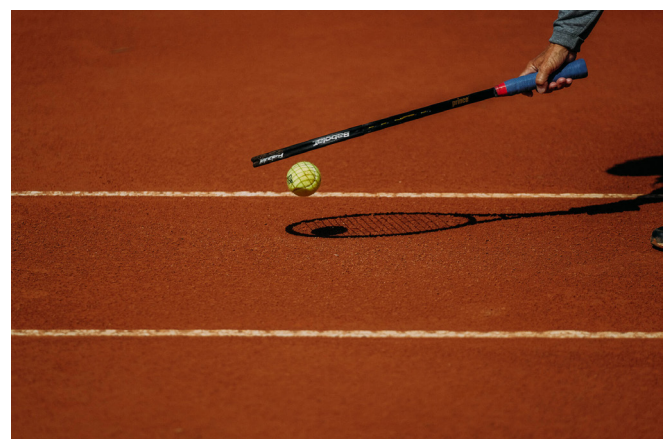
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INTRODUCTION & LITERATURE REVIEW

National Tennis Associations (NTAs) govern the sport of tennis within their nation. In developed tennis nations, NTAs' primary objectives are to increase participation rates and develop elite athletes capable of winning major tennis tournaments (Green, 2007). Large portions of NTAs' budgets are dedicated to the pursuit of these objectives. Budgets which are funded by NTAs' central government and through NTAs' own revenue streams. Therefore, the more revenue NTAs can generate the more they can invest in increasing participation rates and athlete development, thus increasing their likelihood of experiencing desirable outcomes. NTAs then, are incentivized to prioritize revenue generation.

To prioritize revenue generation, NTAs adopt comparable business models to for-profit corporations. Like for-profit corporations NTAs are at the mercy of market forces. Whereby, revenue generation depends on their ability to offer in-demand products and services. In many ways then, NTAs practices mirror those of for-profit corporations. This is noteworthy, yet the environment, and therefore, incentive structures steering the governance of sport development systems are often ignored. In part, because the ethos of sport are assumed by most to supersede business ideals.



In a recent overview of the model of youth sports in the U.S., Bowers and Ozyurtcu (2018) explain how private sport organizations are focused on providing goods and services their consumers demand in their market-driven environment, leading to suboptimal sport delivery. Although Bowers and Ozyurtcu's (2018) article is U.S. centric, hypercompetitive private youth sport development practices in the U.S. are considered universal (Coakley, 2021). Ideally, sport delivery

is driven by supply-side factors (i.e., experts' knowledge and proven best practice), rather than by consumers (i.e., parents). Although scholars have highlighted the perils of sport development systems beholden to market forces, to date, little research has examined how market-driven incentive structures steer NTAs and sport delivery at the ground level. In one of the few studies accounting for the influence of external factors on sport delivery in tennis, Horne and colleagues (2022) found coaches engaged in "attraction" management, whereby coaches would tell parents what they thought they wanted to hear to appease the individual purchasing their coaching services. Conflicts of interest are known to arise in sport organizations grappling with business ideals (Sherry et al., 2007), and sport development systems will likely always preside in a market-driven space, to address concerns with suboptimal sport delivery it is necessary to examine how sport delivery is being impacted by policymaking decisions beholden to market forces.

Coaches are arguably the tennis stakeholders who feel and experience the incentive structure conflict facing NTAs and other tennis organizations the most as coaches are responsible for delivering tennis at the ground level. The systems and policies implemented by NTAs are delivered by coaches. For instance, coaches and directors of tennis deliver youth tennis tournaments sanctioned and structured by their NTA. Coaches are also trained through coaching education programs designed and implemented by NTAs. Further, coaches manage the facilities where efforts to maximize participation rates and develop elite athletes (i.e., college and/or professional players) who their NTA may identify as talented.

Coaches then are best placed to describe how NTA development systems created in a market-driven industry shape tennis at the ground level. To this end, the purpose of the current study was to examine coaches' perspectives of how tennis delivery at the ground level is shaped by the incentive structures created by NTAs' implementation of tennis development systems. This is important as tennis is, and will continue to be a sport pursued in private settings and governed by NTAs who must prioritize, if not heavily focused on, revenue generation. However, rarely is the reality of NTAs position in market-driven settings accounted for. By addressing this gap in our understanding, it is possible to highlight root causes of suboptimal sport delivery, thus informing viable solutions to such problems.

CONCEPTUAL FRAMEWORK

To examine coaches' perspectives of how tennis delivery at the ground level is shaped by the incentive structures created by NTAs' implementation of tennis development systems, the study was guided by a multi-level framework (Kozlowski & Klein, 2000). Multi-level frameworks provide a holistic depiction of systems, allowing researchers to examine how environmental factors shape and influence organizations management and governance (i.e., NTAs), and how management and governance then shape actors at the ground level (i.e., coaches). Studies that consider the influence of systems and studies adopting a multi-level framework to examine sport organizations have shown issues at the micro-level (i.e., ground level) are often linked to root causes at the organizational or environmental levels (Dixon & Bruening, 2007; Horne & Brown, 2019). Guided by the extant literature and multi-level framework, the study sought to answer the following research question: how do coaches believe tennis

development at the micro-level is impacted by incentive structures created by NTAs' implementation of tennis development systems?

METHOD

Data Collection and Analysis

Semi-structured interviews lasting roughly an hour were conducted with eight coaches who met the inclusion criteria. To be eligible for participation in the study, coaches must have been coaching for at least five years, and regularly work with competitive youth tennis players. Purposive and snowball sampling techniques were adopted to recruit eligible participants. Interviews were recorded and transcribed verbatim and pseudonyms were used to ensure participant confidentiality.

As the study was underpinned by the ontological and epistemological assumptions of interpretivism (reality is subjective) and constructivism (knowledge is constructed according to individuals' perception of their reality, questions were designed to be participant driven (Patton, 2014). As an interpretivist approach was adopted, the researcher adopted an inductive coding strategy. First, open coding was conducted to summarize segments of data, with descriptive categories established with the intent to remain close to the text. Themes were then derived from the descriptive categories. Efforts to ensure reliability and validity in the data analysis process were guided by an evolving list of quality indicators (Tracy, 2010). Data was analyzed by the researcher, with interpretations discussed with a critical friend to reduce researcher bias (Sparkes & Smith, 2014). No software was used for the qualitative analysis of the content of the responses.

FINDINGS AND DISCUSSION

Three broad themes were identified from the data: 'Compromising Between Coaching Objectives and Parents' Demands', 'The Pressures of Competitive Youth Tennis', 'Adapting Existing Practices to Make the Journey Better'. As participants shared their experiences of the major system-level factors influencing athlete development, they also drew from their extensive experiences to proffer potential solutions. What follows is a presentation of the three broad themes, each culminating in coaches' recommendations for addressing the issues they raise.

Compromising between coaching objectives and parents' demands

As coaches shared their experiences of managing their role within youth tennis's market-driven environment, participants described feeling compelled to compromise some of their own ideals to appease their clientele's demands. For instance, coaches described how "there are a lot of compromises to be made given that we are trying to run a successful business. It's something I struggle with every single day in my job" (Toni, Director of Tennis in the U.S.). In delineating the compromises coaches experience, John, a long-time tennis academy director and international traveling coach from the U.K. expounded:

The parents are in charge. They pay me and I provide advice from the knowledge I've developed over 25 years. Even with my experience, it is hard not to think 'well this parent is paying my wages, so I'll do what they tell me to do.'

As John explains, with his wages largely dependent on parents seeing value in the coaching service he delivers, he can feel pressure to compromise his coaching by acquiescing to parents' demands even though he is a highly experienced and qualified coaching professional who knows how to deliver appropriate coaching. But, given the service nature of private, market-driven youth tennis John must consider his consumers' preferences. This can be problematic, as coaches' and parents' preferences for youth sport programming are misaligned (Horne et al., 2023). John's sentiments towards his perceived pressure to compromise were echoed by Sam, an established manager of a reputable tennis program in the United States, who explains the dilemma of juggling clients' satisfaction and program objectives:

Parents can be a little short sighted. Like, 'my kid isn't winning.' It's really tough because the parent, what does the parent want? The best for their children. So, it's trying to juggle making sure the client is satisfied so that you can keep them coming back for more and more lessons. And then, obviously, keeping them within what you want to from a programming perspective.

When pressed to provide an example of when such instances arose, Sam shared: "We've had parents pull their kids out, but you have to let them go otherwise it's going to be a whole new train wreck a few months down the road. You can't just bend to what parents want." Participants also expressed their concern with how the compulsion to compromise to parents' demands is likely exacerbated for young coaches early in their career. Especially given how coaches with 25 years of experience still find themselves susceptible to compromise (i.e., John). As Carolyn, an experienced coach with international coaching experience and a leader in coach education suggested: "I'm sure the dynamic changes according to experience, doesn't it? Whether you're a young coach starting off and trying to make your way in the world. It's not easy for young coaches still building their reputation to say no."

Solutions

Carolyn elaborated on her previous statement by explaining potential coping mechanisms young coaches can adopt to reduce the compulsion to compromise, "My mantra would be honesty and professionalism matter more than anything." Carolyn also stated that coach education could help provide a solution, or at least generate greater awareness for coaches in training of the environment they're inheriting, and the short-term difficulties they may face as new coaches:

I do think coach education could help, not that young coaches will necessarily believe you, but by at least having the conversation. 'This is going to be hard to start with, but you have to be honest with yourself and your clients.'

James also presented a potential solution, by sharing a strategy he has adopted as a coach with over 20 years of experience and having worked with multiple ITF World Tennis Tour Juniors players and their parents: "To be successful within this system, I treat my coaching like a business. I set it up that way when I first work with a new player. I approach it very professionally in terms of what I can offer." By managing his coaching in a business-like manner, James felt capable of sticking to his coaching ideals and better positioned to resist pressure to conform to clients' demands.

Expert coaches clearly grapple with delivering the coaching informed by their own knowledge and expertise, and in appeasing the demands of their clients in an environment beholden to market forces. This finding is important, as it suggests coaching may be compromised by coaches' perceived need to deliver attractive coaching services to clientele in the market-driven setting. Findings also provide insight as to the root cause of well-documented tensions between tennis parents and coaches (e.g., Gould et al., 2006). Some of the frustrations coaches experience with parents, and vice versa may be caused in part by their market-driven environment. Tennis programs/clubs are businesses incentivized to maximize revenue. Losing clients has financial repercussions for coaches and their employers. Coaches need to be cognizant of their livelihood and that of their employers, thus elevating parents' power in private youth sport settings. Yet, current tennis coach education overlooks this, and fails to train coaches in how to develop a coaching business as an independent contractor or club manager/owner. Further, it has been suggested coach education programs often fail to adequately inform coaches of how to develop positive relationships with parents (Newman et al., 2016).

Findings do align with Horne et al. (2022), who found contingencies at both the personal and environmental levels contributed to parent-coach relationship dynamics that are failing youth athletes. Findings, therefore, highlight and reinforce the need for tennis policymakers to consider how the context of a market-driven setting pervades and impedes youth tennis development.

The pressures of competitive youth tennis

Coaches also expressed their frustration with the dominant performance ethic present in youth tennis development systems. A performance ethic that is not unique to tennis, but rather a feature of youth sport development systems in the western world, if not globally (Coakley, 2021).

Dropout as a consequence of NTA talent identification programs

Coaches' particular grievances with the performance drive relate to why they believe many youth tennis players dropout of the sport at increasingly young ages. As Jennifer, the director of a prominent tennis program in the Southwestern United States shared, "kids today are giving up at 10, 11, or 12 because they think they're not good enough. And that's so sad." Jennifer was not the only coach interviewed to blame the loss of junior players on the pressures of performance tennis. In fact, several coaches went one step further by pinpointing the widespread use of talent identification schemes. As did John, who explained, "I've had players told by the NTA's talent ID they'd never be any good, then go on to have a top collegiate career with a full-scholarship. Luckily, they stayed the course and weren't put off by the NTA. Diane also tied the pressures she has seen as a long-time director of junior tennis development programs to talent identification:

"We used to be a performance accredited club and get money from our NTA but we stopped doing it because I didn't want to give money to seven- and eight-year-olds. The system sets them up for when they're seven or eight and tells them how good they are. There are so many examples of when the NTA tells players they are rubbish at the age of 8/9 and now they're national tennis players. So, that kind of system and pressure is terrible."

The expense and lack of unstructured play of youth tennis

Coaches also demonstrated how the pressure within performance youth tennis manifests itself in forms not directly related to talent identification programs. Sam tied the pressures he'd witnessed in youth tennis development to the outcome-oriented outlook of youth tennis, he believed derived from tennis's expensive nature, "There is too much pressure on the kids and their parents. Tennis is a very very expensive sport compared to most other sports so it is easy to get caught up in short-term results." As Sam saw it, given the expense of supporting a child in youth tennis it is unrealistic to expect all parents to look beyond short-term outcomes. Sam's sentiments align with what we know to be true of many youth sport parents. By investing upwards of \$20,000 a year into their children's sport and athletic development, parents often expect to see a return on their investment (Hyman, 2012). While Sam appeared somewhat accepting, or understanding of a desire for short-term success, Manu was clearly more concerned with the pervasive short-term lens he has seen too often adopted in youth tennis, "Everything is short-term results focused today. And sport is horrible in that way. Tennis especially. The system in tennis really exaggerates all that pressure."

In delving into factors driving the results-oriented world of youth tennis, coaches pinpointed the intensely structured system of youth tournaments. As Greg, a former college tennis player now the director/head coach of a prominent youth tennis program in the U.K. put simply:

The system tells children and parents to play tournaments. You can't advance if you're not competing regularly. And you can't get into the top tournaments unless you're rating or ranking is good enough. And you can only get a good ranking or rating if you're playing tournaments.

As Greg delineates, the tournament system itself drives and incentivizes greater commitment to the system. But tournaments are not cheap. Tournament travel is one of the most expensive components of youth and athlete development and participation (Hyman, 2012). However, tournaments can be a revenue generator. Youth tennis tournaments can accommodate hundreds of athletes. Which is why, as Manu detailed, part of the reason why tournaments remain a critical cog in the youth tennis system machine, "The numbers make the money in the industry." As a result, some coaches felt the youth tennis system was becoming increasingly structured, "Everything is structured. You don't see a lot of these kids out of class playing as much as you used to" (Diane).

In relation to play, Toni explained how tournaments have contributed to dropout in her experience:

We've all seen the statistics of kids that play a handful of tournaments and then we never see them again. I mean, tennis is a lonely game especially for young kids also playing soccer or other team sports. In tennis they're out there alone. And everyone has to be quiet unlike any team sport. You're not allowed, for the most part, to cheer people on. It's a lonely game, it's tough for kids.

Solutions

In presenting potential solutions to the concerns of high pressure, expenses, and structure of youth tennis, six of the nine participants expressed a desire to see a shift to more team tennis formats in youth tennis. And of those six

coaches, a handful claimed to have independently designed and introduced team tennis competition for players within their programs. As Greg described, "I create teams of players that go on the journey together, because if you've got teams of players going together then parents can share rides. By taking groups you can share the cost." James compared tennis with the atmosphere of many team sports, in justifying why he'd like to see greater opportunity for team competition in tennis, "In the beginning especially, the kids enjoy it more. You go to soccer, and you've got 11 friends and 11 parents, and it just creates a bit more of an atmosphere, it's a bit nicer." As a former college player turned coach, Jennifer explained, "I think it's more fun as well, I really do think team tennis is more fun. My American college experience is probably my best tennis experience, playing in teams."

In addition to reducing costs and creating an atmosphere they saw as being more 'fun,' coaches believed a team format to be associated with other benefits. John believed, "It is one way for me to talk to more parents. By creating teams and traveling together. With team tennis you can be with more parents and more children, so I think it's really important to do that." Diane also explained how team tennis could reduce the inequity of athletes access to coaching at tournaments, and replicate the experience of college tennis which is a more realistic goal for youth tennis players than the professional game:

The team atmosphere is one area where you could address the issue of having everybody access to coaching. So, I think that's something that in tennis has to be done. Tennis is inherently so, so competitive. Of the kids that we work with, their ultimate goal is going to be to play college tennis. We just need to foster that. And then being proponents of a team. It doesn't necessarily have to be traveling but just within groups, within facilities. So, that's what I think is missing from our sport that could help it grow.

As both Diane and John mentioned, it could allow coaches to spend more time with parents and athletes in competitive spaces. As this point was raised in two of the earliest interviews conducted, the point of coaches access to competitive spaces was added to the interview protocol for participants yet to be interviewed. Sam responded to this point by stating, "I often get questions from newish parents like, 'Well why isn't there a coach at the tournament?' Well maybe the coach has another clinic at that time. Some parents understand, not that it is necessarily a good thing." As with most of the coaches, Jennifer had a similar response to Sam:

I think the competition system also makes it tough because I have a lot of kids of different levels, and on the weekends, I'm teaching them. So, I have kids who are playing tournaments, but I'm also teaching. I can't be at every tournament. And that's different because in other sports, the coach is at the game, right? I think that that's tough about tennis.

Implications

Tennis's place in the private, market-driven setting is unlikely to change. Therefore, studies identifying where and how tennis governance and delivery are shaped by market forces are important. Findings from the current study are indicative of a need for greater transparency between all tennis stakeholders in precisely how market forces impact tennis at all system levels. Through higher levels of communication and engagement within tennis development systems, stakeholders can establish a better understanding of how tennis is impacted by a need for most tennis organizations to

be market driven, increasing the likelihood of creating viable remedies for addressing identified concerns.

Looking specifically at practical solutions to issues the study's findings illumine, National Tennis Associations should consider developing more opportunities for competitive youth players to participate in team-oriented competitions. Such competition formats exist (e.g., USTA Adult League and LTA National Club League), therefore, allowing NTAs to model new or expand upon current youth team-oriented competition from existing templates. This can alleviate some of the pressure tournament competition creates, improve coach attendance, and lessen the financial burden associated with competitive youth tennis. NTAs should also expand upon extant parent-coach relationship training in their coach education systems. Specifically, training should inform young/less experienced coaches on the dynamics of the tennis service industry, and how this can contribute to coaches feeling compelled to compromise some of their ideals.

Policymakers could instruct coaches to adopt a business professional approach to their coaching, in a fashion similar to the approach coach James has adopted through his experiences. Establishment of a business-like approach, however, requires the design and implementation of a clear contracting process. Contractual agreements between parents and coaches, if they exist at all are often ad hoc and lack agreed upon timelines and expectations. This could create greater misalignment (Horne et al., 2023), and result in greater frustration for each stakeholder. By implementing these practical implications, NTAs can address coaches' concerns with current tournament and coach education systems.

Limitations and Future Research

As with most studies, findings are impacted by the study's limitations. First, only U.K and U.S. based coaches were included in the study. Therefore, coaches interpretations of sport development systems may not reflect those of coaches from other nations. Second, the study was conducted by one researcher. Although a critical friend did assist in the data analysis process, qualitative data analysis conducted by two researchers is considered preferable for reducing researcher bias.

Although participants did have international experience, as some had coached in multiple countries, future research should include a more representative sample of tennis coaches. As an exploratory study, future research is needed to further examine the means by which NTA created development systems in the private sector influence tennis delivery at the ground level.

CONCLUSION

In conclusion, the study provides a meaningful contribution to our understanding of how incentive structures shaped by a market-driven industry influence tennis delivery. The study also provides important practical solutions to address some of the micro-level issues tennis coaches experience without the need for systemic change. The study provides a foundation for future studies to pinpoint and explain how sport delivery is impacted by the private sector within which it presides.

CONFLICT OF INTEREST

The author declares that he has no conflict of interests in the production of this article.

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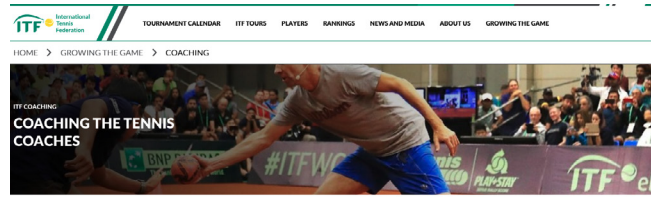
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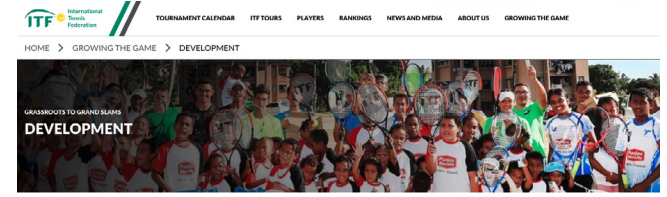


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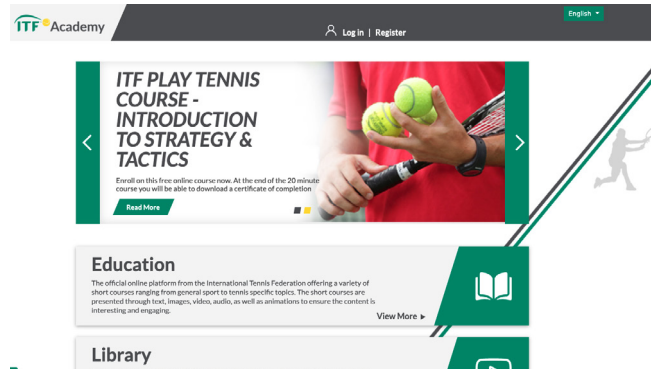


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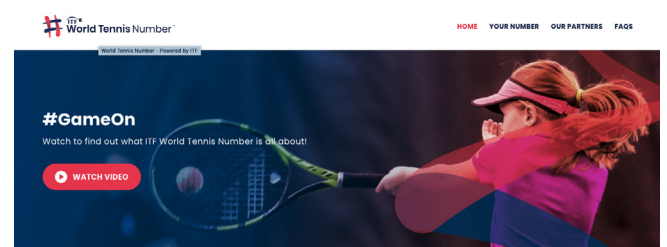
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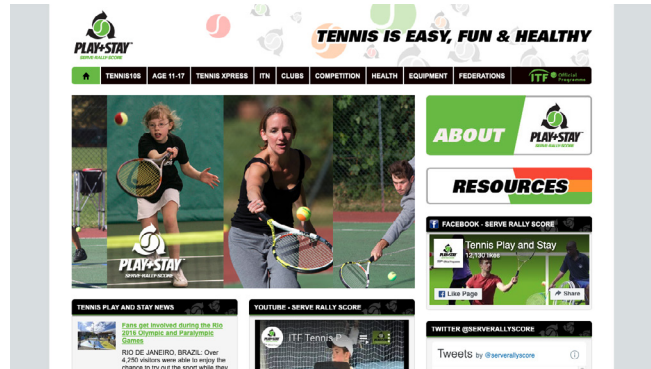
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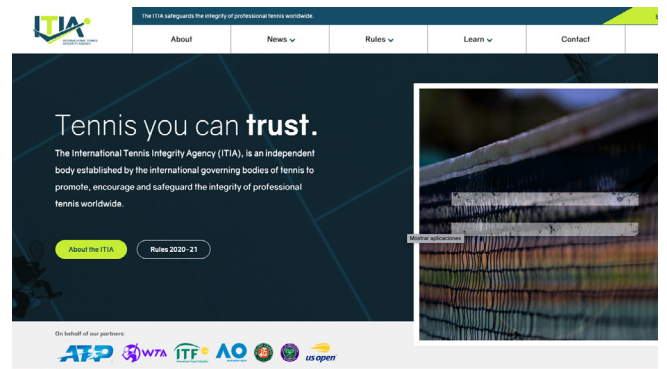


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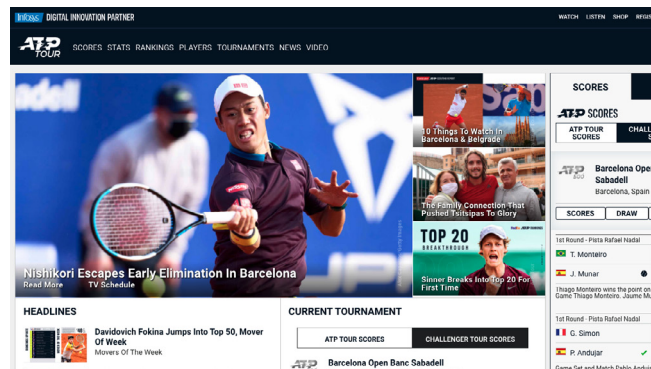


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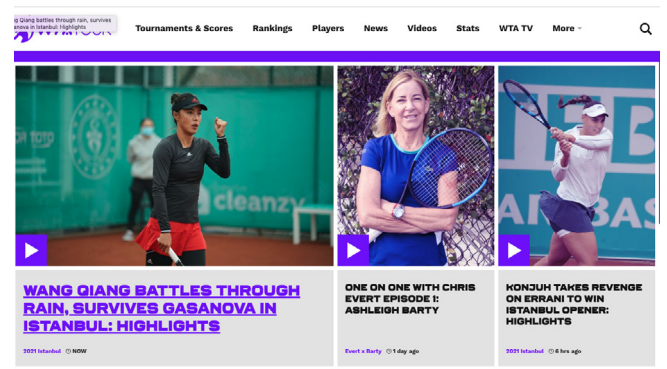
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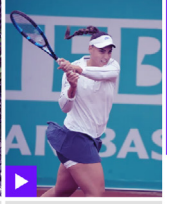
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