

Theoretical and practical research on skill transfer between table tennis and tennis

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Abstract: Combining the technical frameworks and motor skill traits of table tennis and tennis alongside ongoing curriculum reforms, this paper thoroughly explores skill transfer between the two sports, supported by objective student assessment data and questionnaire findings. It analyzes the similarities, differences and mutual transfer of their motor skills, elaborates on the laws of mutual skill transfer and connections between teaching materials of the two sports. This study proposes rational curriculum design and teaching schedule arrangement, advocates optimizing the presentation of teaching materials in teaching, improving students' initiative in learning via skill transfer, and cultivating students' ability to consciously apply the laws and methods of motor skill transfer, so as to provide valuable references for the practical teaching of table tennis and tennis.

Key words: Table Tennis, Tennis, Skill Transfer, Discussion

1. Introduction

Relevant studies have confirmed that transfer is a common phenomenon in sports. Since sports emphasize speed, endurance, strength, technique and other physical factors, similarities exist among different sports disciplines. Proper mastery of skill transfer and cultivation of relevant capabilities allow athletes to deliver outstanding performance in competitions, boost their self-confidence, and enable them to adopt flexible and varied tactics to win matches. Skill transfer also plays a vital role in ordinary competitions: it helps athletes improve their physical fitness as well as technical and tactical proficiency based on mastered fundamental movements. At present, the theory of skill transfer has been widely applied in competitive sports such as basketball, aerobics and track and field. However, insufficient in-depth research has been conducted on whether skill transfer exists between table tennis and tennis, as well as which aspects generate positive and negative transfer. On the basis of questionnaire research and a thorough review of Chinese and overseas literature, this study clarifies the framework of skill transfer and conducts an in-depth analysis of the inter-sport skill transfer theory applicable to table tennis and tennis.

The research subjects of this study are students majoring in Physical Education with table tennis and tennis specializations from sports universities. They possess in-depth understanding and personal experience of both sports, which are integrated with the motor skills of table tennis and tennis to further enrich the theory of skill transfer. There are commonalities between the relevant skills of table tennis and tennis athletes. Such commonalities can be applied in competitive matches and exert a significant impact on athletes' tactical thinking as well as their spatial and temporal perception, facilitating positive skill transfer and mitigating the adverse effects of negative transfer on athletes. In addition, this study also identifies cases where skills of the two sports exert no mutual influence on each other.

2. Transfer theory in table tennis and tennis teaching

2.1. Skill transfer of footwork techniques

Footwork plays a pivotal role in learning table tennis and tennis, whose footwork shares similarities while retaining unique characteristics (see Table 1).

Table 1 Main footwork in table tennis and tennis

Sport	Adopted footwork
Table Tennis	Stride, single step, jump step, side shuffle, cross step
Tennis	Slide step, split step, cross step, stride, running step, side shuffle, quick tiny steps

Table tennis is played within a limited court space. Athletes need solid technical movements and delicate ball sense to deliver outstanding match performances. In contrast, tennis features a spacious court with a large range of movement, placing high demands on footwork. Poor foot positioning prevents players from coordinating arm and wrist strength to deliver powerful, advantageous shots, so getting into the correct position is the fundamental first step in tennis. Many players can sustain long rallies during training yet fail to do so in competitions, largely due to inadequate footwork. Footwork is critical in tennis as it determines whether players can hit threatening shots. Over 70 percent of tennis errors stem from flawed movement rather than flawed technique. While stationary hitting yields high shot accuracy, tennis requires constant active running, which means athletes must master proficient positioning and meet stringent footwork standards.

The straddle step, shuffle step and cross step in table tennis adopt the same muscle groups for force generation as those in tennis. Meanwhile, the selection of footwork and adjustment of movement rhythm are highly similar between the two sports. As two racket ball games, athletes adjust the coordination between themselves and the ball by exerting force, which generates positive skill transfer. Positive transfer is merely one type of skill transfer. The two sports share numerous connections and common features with insignificant differences in their constituent elements and structures. After learning the techniques of one sport, learners can realize skill transfer based on existing experience and apply such techniques to new learning tasks, which is defined as specific transfer of motor skills. In addition, the footwork adopted in the two sports and their learning contexts are analogous, giving rise to near transfer of motor skills.

It can thus be seen that there exists skill transfer in the footwork of table tennis and tennis, and many of their footwork techniques are interlinked, satisfying the prerequisites for skill transfer.

2.2. Skill transfer of forehand hitting techniques

Forehand drive in tennis and forehand attack in table tennis are both common offensive techniques. It is not difficult to find that there are no obvious differences between the two movements in the pre-hitting preparation phase (see Table 2).

Table 2 Analysis of muscle force in table tennis forehand attack and tennis forehand drive

Sport	Main force-generating parts and force sequence	Main force muscles	Body weight transfer
Tennis	Legs→ waist→ shoulder→ upper arm	Triceps brachii	middle→ rear foot→ front foot
Table Tennis	Legs→ waist→ Elbow→ forearm→ wrist→ fingers	Biceps, wrist joint	middle→ rear foot→ front foot

Table 3 Structural analysis of backhand chopping (volley) strokes

Sport	movement phase			
table tennis	ready stance	backswing	hitting motion	follow-through
	Stand with feet apart,	Twist your upper	When hitting the ball, swing	Recover quickly

	right foot forward, knees slightly bent	body slightly to the left, shift your weight to your left foot, and draw the racket back beside your left shoulder.	your forearm forward and down to the right driven by the upper arm, with the racket face tilted backward. Rotate your wrist following the force direction of the forearm. Brush the lower-middle part of the ball during its descending phase, and shift your weight to your right foot.	after hitting the ball to get ready for the next stroke.
tennis	When the ball heads toward your backhand side, lightly grip both sides of the racket throat and quickly switch from forehand grip to backhand grip with your right hand.	Rotate your torso and draw the racket back quickly, keeping the racket away from your body. Raise the racket head higher than your wrist with the racket face tilted slightly backward.	Step your right foot forward to the left, release your left hand holding the racket throat, and swing the racket forward and downward with your right hand. Strike the ball level with your waist in front of the left side of your right foot. Keep your wrist firm and drive the racket forward and downward as you swing.	Swing the racket upward and forward following the ball's trajectory. Complete a full follow-through and finish the stroke high. Then face the net and return to your ready stance.

Table 4 Biomechanical comparative analysis of chop technical requirements in table tennis and tennis

Sport	Main force-generating parts and force sequencing	Auxiliary force muscles	Hitting method
table tennis	upper arm→ forearm, wrist	forearm, wrist muscle group	brush
tennis	upper arm→ forearm\wrist	forearm, wrist muscle group	slice shot

According to the above comparison, both the table tennis forehand attack and tennis forehand drive rely on muscle exertion at the start, yet they end up with different body postures after the hitting motion. The forehand attack in table tennis emphasizes coordinated movements of the forearm and wrist, while the tennis forehand drive mainly generates power from the upper arm. In addition, their swing trajectories differ. During training, learners frequently adopt tennis hitting postures when playing table tennis, or vice versa. Such occurrences are quite common and stem from negative transfer formed during the learning of the two sports.

Analysis shows that table tennis forehand attack and tennis forehand drive feature nearly identical ready stances: feet shoulder-width apart, knees slightly bent, torso slightly forward, and lowered body center of gravity. The minor distinction lies in the slowing down point of forward torso lean. Table tennis is confined to a small playing area, and the player's reach covers the entire table, keeping the center of gravity between the two feet. Tennis requires extensive active movement across a large court, so the center of gravity shifts with the trajectory of the ball. Both sports follow the same force transmission sequence: power originates from the knees, drives torso and hip rotation, activates the upper body, and culminates in coordinated force from the upper arm, forearm and wrist to complete the hit. The muscle groups engaged throughout the full movement are identical. Each movement of the two sports generates positive transfer for subsequent movements. Meanwhile, differences in backswing between table tennis and tennis result in negative transfer of motor skills.

2.3. Skill transfer of backhand techniques

Whether it is table tennis or tennis, chopping and volleying, the main net shot techniques, share striking distinctive characteristics in hitting methods. Players first lean forward and shift their center of gravity toward the net with smaller hitting motions than swinging shots and forehand drives; force is mainly generated by the arms and wrists while body strength is only used for footwork rather than striking and merely serves as support. Nevertheless, subtle differences exist between the two techniques.

The key to the movement structure of table tennis chop is intercepting fast incoming balls during the ball's rising phase by transferring the force from the opponent's hit to the ball; players move the racket downward with barely any force from arms and wrists to complete the chopping motion mainly through blocking, and the triceps brachii acts as the primary force-generating muscle for this chop. Tennis volley mainly involves moving forward to the net to intercept the ball with a forward leaning posture, and players strike the ball into the valid area of the opponent's court near the net by using the elbow joint and forearm.

It can be seen from the above analysis through the analysis of the movement structure of backhand techniques in table tennis and tennis that the backhand chop of table tennis and tennis basically share the same hitting position, racket face angle and swing path, with numerous identical elements and strong transferability, while there is a prominent difference in wrist application: table tennis requires flexible wrists to cope with various incoming balls from opponents, whereas tennis demands rigid wrists to firmly grip the racket and deliver powerful shots. People tend to focus more on their differences while overlooking their common characteristics.

2.4. Skill transfer between tennis overhead smash and table tennis high ball smash

Table tennis smash and tennis overhead smash are both the most powerful scoring shots for athletes in competitions, and they share similarities in return speed and spatial hitting position. When executing a table tennis high ball smash, players generally stand with feet shoulder-width apart and the right foot slightly behind and to the right of the left foot, tense their arms to store power and place the center of gravity on the right foot. During the hitting motion, the upper arm swings downward in a circular arc with a forward-tilted racket face; the forearm and wrist jointly exert force and press down to strike the ball at head and shoulder height. After contact, the upper arm swings to the left side of the body due to reaction force, the torso rotates left accordingly, and the center of gravity remains on the right foot. For the tennis overhead smash, when the opponent lifts a high ball, players watch the incoming ball, turn sideways and fully stretch the hitting arm, and adjust footwork rapidly according to the ball's trajectory while holding the racket above the head, shifting the center of gravity between the two feet and bending backward slightly to accumulate power. When hitting, the non-dominant hand lifts upward aligned with the incoming ball, and the player moves into the optimal hitting position; the wrist and forearm of the hitting arm form an internally rotated posture to strike the ball at eye level or slightly above the eyes. The upper arm drives the forearm to complete the hitting movement with auxiliary power from the waist and leg muscles, and the fully extended arm creates a large swing amplitude to boost hitting force and generate faster ball speed.

By comparison, the two techniques are basically identical in backswing, hitting surface and hitting point, and both adopt the whipping movement of upper limbs, yet slight differences exist in body center of gravity. Compared with tennis overhead smash, table tennis high ball smash relies more on wrist force. Tennis and table tennis are both racket sports, which generally store power starting from lower limbs, and then transfer force through knees, hips, torso, upper arms, forearms and wrists to complete the hitting movement with nearly identical muscle groups; meanwhile, they bear striking similarities in footwork, racket grip and gravity shift, thus presenting high transferability. According to the transfer theory, prior learning exerts positive effects on subsequent learning, which is defined as forward transfer in terms of learning sequence; mastering table tennis high ball smash first helps athletes secure better hitting points and greatly enhance hitting aggressiveness when learning tennis overhead smash, and tennis overhead smash is more difficult than table tennis high ball smash, reflecting vertical transfer. In addition, learning table tennis high ball smash becomes easier if athletes have already mastered tennis overhead smash, which manifests reverse transfer.

3. Application of skill transfer in table tennis and tennis teaching

3.1. Select teaching materials reasonably and present the optimal teaching sequence

Textbooks should be compiled from easy to difficult and simplified according to practical teaching demands, enabling students to master complex motor skills through straightforward learning. Meanwhile, teachers should continuously explore teaching content, optimize and revise textbooks to improve their serialization and programmability, integrate knowledge points thoroughly and avoid repetitive learning.

When introducing new knowledge, teachers can use transfer to connect relevant contents and reduce potential learning interference. For instance, emphasizing the basic concepts and principles of table tennis and tennis in physical education classes can effectively facilitate knowledge transfer among students. In selecting textbook content, the integration of theory and practice should be prioritized to visualize and concretize skill transfer amid continuous practice accumulation and enrich abstract theoretical concepts. During teaching, teachers shall combine typical cases to elaborate distinct viewpoints and underlying principles. It is evident that textbook compilation plays a vital role. Teachers should integrate transfer theory into textbooks and strengthen it as a fundamental component of table tennis and tennis teaching materials.

3.2. Reasonably organize teaching and training content

Reasonable compilation of textbook content can promote students' understanding and mastery of knowledge and provide the most intuitive theoretical basis for their study of table tennis and tennis. It can not only deepen the overall teaching system at the macro level but also be reflected in micro classroom teaching. When compiling textbook content, educators need to establish a comprehensive understanding of the whole and components of teaching from both macro and micro perspectives and build an integrated learning model covering the two sports. Besides, transfer theory should be deliberately integrated into teaching. Physical education should adopt a step-by-step teaching approach to assemble fragmented knowledge into a complete knowledge system for students, facilitating their sound physical and mental development. At present, textbooks for table tennis and tennis all contain introductions to relevant sports theories, concepts and techniques, as well as content concerning tactics, competition refereeing and event organization, with much overlap in their layout.

3.3. Methods for teachers to improve teaching and training standards

Regardless of whether the sports are the same or not, there will be slight differences in techniques. It is necessary to cultivate students' ability to discover, analyze and then solve problems. In addition, attention should be paid to the expansiveness of learning, and students should develop a questioning thinking that can draw inferences from one instance. On the premise of understanding the knowledge framework, students can summarize and generalize knowledge, and independently explore the common points in the knowledge system, which helps to explain the relevant content of transfer theory to students. Teachers should adopt a comparative method in class to explain the common problems existing in students' knowledge systems and clarify the similarities and differences between them. In the teaching of motor skills, teachers should assist students in mastering correct skills, so that students can have solid basic skills and thereby be able to draw inferences from one case to another, and subtly understand the relevant knowledge of transfer theory. In the teaching process, it is necessary to reasonably arrange teaching time and adopt a combination of theory and practice to stimulate students' interest in learning, strengthen their autonomous learning, and enable them to continuously discover new knowledge in the learning process, so as to achieve breakthroughs in abilities, further highlight the learning effect and make the mastery of skills more proficient.

Besides, physical fitness is the fundamental condition for improving athletic performance. There is strong transferability among different physical qualities. Teachers should provide active guidance to help students identify transferable elements in various fitness training for better training outcomes. The theory of skill transfer shall be rationally applied to teach similar knowledge points so that students can achieve all-round improvements in physical fitness, theoretical knowledge and technical proficiency.

4. Conclusion

In conclusion, the theory of motor skill transfer is highly practical in table tennis and tennis teaching. Teachers should grasp the core of this theory to help students avoid repetitive learning when mastering similar knowledge points, conduct in-depth research on motor skill transfer theory, promote the generation of positive transfer among students, reduce the adverse impact of negative transfer, and thus achieve better results in physical education teaching.

5. References

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