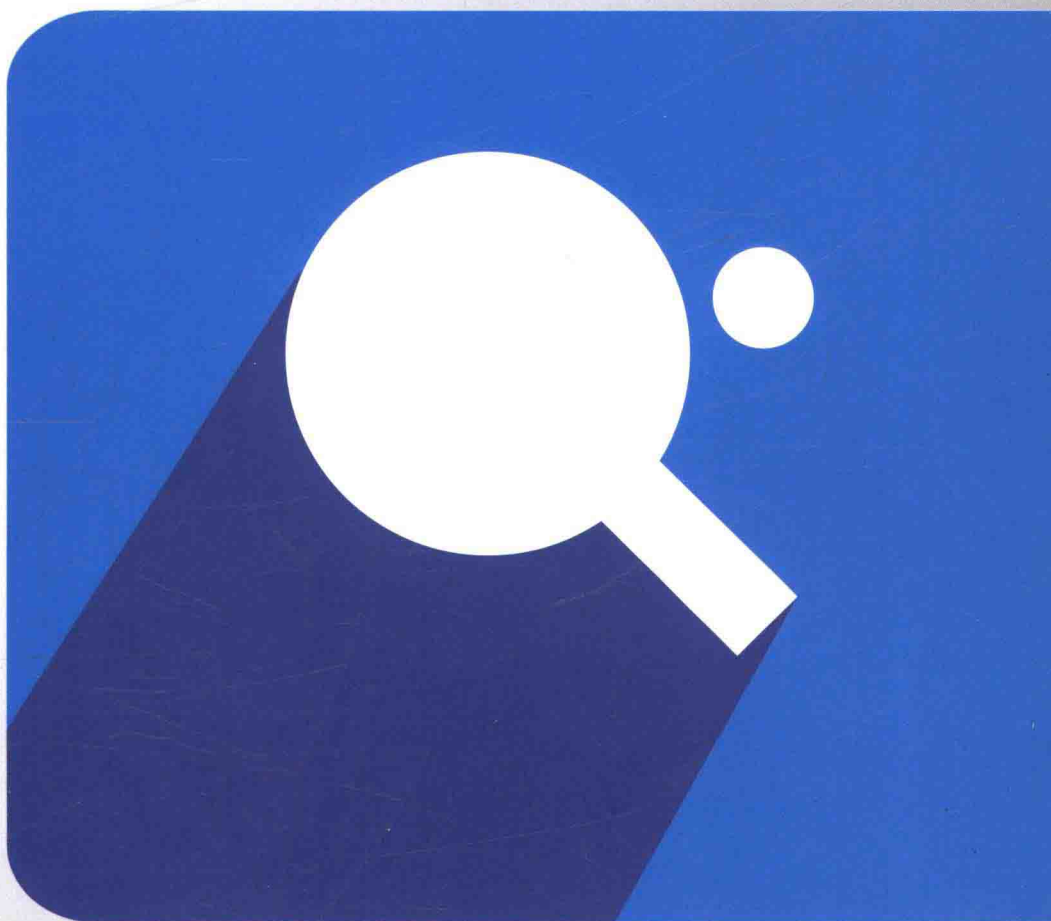


科学与持拍运动(五)

Science and Racket Sports V

Editors: Miran Kondrič, Xiaopeng Zhang, Dandan Xiao



苏州大学出版社
Soochow University Press



科学与持拍运动(五)

Science and Racket Sports V

ISBN 978-7-5672-2235-9



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定价: 50.00元

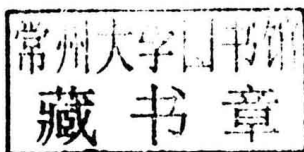
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图书在版编目(CIP)数据

科学与持拍运动. 五 = Science and Racket Sports V :
英文 / (斯洛文)米朗·康德里奇, 张晓蓬, 肖丹丹编
—苏州: 苏州大学出版社, 2017. 11
ISBN 978-7-5672-2235-9

I. ①科… II. ①米… ②张… ③肖… III. ①球类运
动-文集-英文 IV. ①G84-53

中国版本图书馆 CIP 数据核字(2017)第 232859 号

Science and Racket Sports (I, II, III, IV) have been published since 1995 under supervision of the World Commission of Sports Science (Science and Racket Sports steering group)

Science and Racket Sports V first published in 2017 by Soochow University Press

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Papers presented at the 14th ITTF Sports Science Congress and the 5th World Congress of Science and Racket Sports, 23–25 May, 2015, held at Soochow University, Suzhou, China

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书 名: 科学与持拍运动(五)
Science and Racket Sports V

编 者: 米朗·康德里奇(Miran Kondrič) 张晓蓬(Zhang Xiaopeng)
肖丹丹(Xiao Dandan)

责任编辑: 金莉莉

装帧设计: 刘 俊

出版发行: 苏州大学出版社(Soochow University Press)

社 址: 苏州市十梓街1号 邮编: 215006

印 装: 宜兴市盛世文化印刷有限公司

网 址: www.sudapress.com

邮购热线: 0512-67480030

销售热线: 0512-65225020

开 本: 700mm × 1000mm 1/16 印张: 18.75 字数: 337 千

版 次: 2017 年 11 月第 1 版

印 次: 2017 年 11 月第 1 次印刷

书 号: ISBN 978-7-5672-2235-9

定 价: 50.00 元

凡购本社图书发现印装错误, 请与本社联系调换。服务热线: 0512-65225020

PREFACE

It is a great honour and pleasure for the editors to issue *Science of Racket Sports V* produced as a conclusion to the 14th International Table Tennis Sports Science Congress and 5th World Congress of Science and Racket Sports. This book contains selected papers from both congresses.

All four major racket sports belong to the most popular sports in the world. Players range from youth, recreational players to the world-class elite players. Correspondingly, scientific studies on racket sports are increasing. Research has been conducted in every field of interest including areas such as physical training, physiology, psychology, medicine, dietetics, physics, and engineering. It is envisaged that this book will contain papers that will eventually be regarded as a major sources of knowledge and material for the advancement of racket sports science. We express our thanks to the International Table Tennis Federation, the Chinese Table Tennis Association, Soochow University, the Organising Committee of the World Table Tennis Championships, the Badminton World Federation, and the World Commission of Sports Science for hosting the 14th International Table Tennis Sports Science Congress and 5th World Congress of Science and Racket Sports. We would like to thank all the reviewers for their insightful comments on the papers, as these comments led us to an improvement of the book. The Congresses were organized by members of Soochow University, Chinese Table Tennis Association and members of ITTF Sports Science and Medical Committee with the support of International

Table Tennis Federation. We are truly grateful to all those people who helped to organize these congresses.

We hope that this and future publications will contribute to the major goal of the racket sports international federations, that is, to bridge the gap between sports scientists and practitioners in teaching, coaching, training and rehabilitation.

Miran Kondrič, Editor-in-Chief, PhD

Xiaopeng Zhang, PhD

Dandan Xiao, PhD

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A Comparison of the Table Tennis Capabilities of China and Its Opponents at the 2014 World Team Championships

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Abstract: The Chinese research activities in the field of tactical performance analysis in table tennis are traditionally based on a diagnostic method using indices to evaluate skills in three different stages of the rally. In the light of the 2014 world championships, an analysis of strong and weak points of the best men's and women's teams was conducted by using the three-phase diagnosis. The achievements set by the Chinese national teams in the course of their struggle for the medals were compared to the skills of their direct opponents. Compared to their adversaries, the Chinese males and females demonstrated clearly superior capabilities in all three respects analysed. The only case in which non-Chinese players achieved on average acceptable ratings was the performance of the antagonists of the Chinese men's team during the open exchange of shots after stroke number four. In men's world-class table tennis the serve and receive play is presumably still of very importance for the recorded results: It is shown that the competition success of China's men might be essentially based on their highly efficient serve and third ball play. For the non-Chinese males, the core instrument for scoring seems to be their return of the service plus their second shot in the role of the receiver. In women's world-class table tennis the tactical key points can be found rather beyond serve and third ball: According to the results, the central challenge for China's ladies is to score points through their receive and their next stroke as a receiver, while the opposing females should focus more on the training of the so-called stalemate phase of the rally.

Key words: tactical performance analysis, three-phase evaluation, strength and weakness analysis, improvement potential

1 Introduction

In China, the systematic analysis of table tennis matches has a remarkable tradition. The beginning can be traced back to the first half of the 1960s (Wu, 1963). Thus, this research tradition is about as old as the supremacy of Chinese table tennis at the world-class level. As early as 1961, 1963 and 1965, except for one case, all gold medals of the three world championship tournaments were won either by players from Japan or China. This head-to-head race resulted from an enormous stepping up of training efforts. In 1959, the table tennis player Rong Guotuan, as the very first Chinese athlete, became a world champion, and besides, the International Table Tennis Federation (ITTF) awarded the next world championships to the city of Beijing. As a consequence, this racket sport gained centre stage in the Middle Kingdom (James, 2008). In the course of the Cultural Revolution the Chinese players stayed away from the world scene for half a decade, but following their comeback in 1971 they were right on the spot at the top of the sporting world and ever since then dominated international table tennis, apart from occasional exceptions (Table 1).

**Table 1 Distribution of gold medals in regard to the supreme disciplines
 of the world table tennis championships from 1971 to 2014**

Event	China	All other Nations
Men's Team	16	6
Women's Team	18	4
Men's Singles	13	9
Women's Singles	19	3

Around the year 1987, a working group to study table tennis matches was established at the National Research Institute of Sports Science (NRISS) in Beijing. Since then, research work has been closely linked to practical experience in the field of competition and training. Research work is thought to support directly the national table tennis squads during their preparation for contests (Zhang, 2006). Another big step at the interface between theory and practice happened only a few years ago: In February 2010, a department which

is specialized on the academic concerns of table tennis was founded at China's oldest sports university; the "China Table Tennis College" (CTTC) is nowadays a part of the Shanghai University of Sport (SUS) (Zhao, 2011).

The Chinese research activities in the field of tactical performance analysis in table tennis are traditionally based on a diagnostic method using indices to evaluate skills in three different stages of the rally. This instrument has been called "three-phase method of performance diagnosis" (Zhang, 2006), "three-stage skill analysis" (Hsu, 2010) and "three phase evaluation theory" (Zhang et al., 2014). The methodology of analysis has been refined over recent decades. According to Zhang et al. (2014), one can distinguish two contemporary approaches. On the one hand, there is a sort of fundamental research relying on artificial neuronal networks, data mining, Markov chains and the rough set theory (Pfeiffer, Zhang & Hohmann, 2010). On the other hand, there are applied empirical approaches including various indexes. Some of these parameters had already been used in the 1980s (Wu et al., 1989). Some other indicators were developed more recently. Due to the fact that the formulae concerning these indices are quite understandable, these statistical instruments can be applied even by coaches and players themselves.

2 Research Topic

In the light of the 2014 world championships a tactical profile of the strengths and weaknesses of the world's best table tennis teams was drawn up, using the three-phase diagnosis. Considering the encounters of the knockout rounds (2nd stage), the achievements set by the teams from China were compared to the outcomes of their direct adversaries. In addition, the results were subjected to a comparison between the sexes, among the members of the two Chinese teams as well as between the male and female players of the opposing squads. On the background that the method chosen allows statements to what extent a certain skill quality is linked with the logged tournament performance, this investigation finally gave hope for the detection of improvement potentials.

3 Research Methods

3.1 Three-phase evaluation

The three-phase diagnosis is understood as a method of match analysis whereby the statistician evaluates how successful a table tennis player has been in three situations or roles (“phases”) within the rally. In all three cases, the number of points scored as well as the number of faults is of interest. Therefore, the first situation is related to the athlete in his role of the server; the question is how many points and failures have been produced with the first and second ball contact (serve + third ball of a rally; “attack after service”). The second situation is linked to the task of receiving the opponent’s serve. Here, the number of points and errors caused by the receiver’s first and second shot is of importance (receive + fourth stroke of a rally; “attack after receiving service”). The third kind of situation is the so-called stalemate phase after stroke number four in a rally. Again, points scored and points lost are recorded. Taking into account these figures and using the following formulae, two indexes are calculated (Cai et al., 2002; Hsu, 2010; Zhang et al., 2014; Zhang, 2006): the scoring rate (SR) and the usage rate (UR).

The Scoring Rate (SR) =

$$\frac{(\text{Number of points won in a phase})}{[(\text{Number of points won} + \text{number of points lost}) \text{ in a phase}]} \times 100$$

The Usage Rate (UR) =

$$\frac{[(\text{Number of points won} + \text{number of points lost}) \text{ in a phase}]}{[(\text{Number of points won} + \text{number of points lost}) \text{ in a match}]} \times 100$$

The scoring rate provides information on how successful an athlete was in a particular stage of the rallies. The usage rate makes clear to what extent a certain situation of the rally was the venue where points were scored and lost. The usage rate is helpful to answer the question how frequently a player won and lost points in a specific phase. In Table 2, an evaluation scheme can be seen which, as a tally sheet, is useful to write down the statistics (Zhang & Hu, 2013).

Table 2 Exemplary distribution of points won and points lost as well as the scoring rates and usage rates calculated (game result 11-9)

	Serve	Third Stroke	Receive	Fourth Stroke	After Fourth Stroke
Scores Won	I	I I I	I I I		I I I I
Scores Lost		I	I I	I I I I I	I
Scoring Rate/SR (%)	$(4/5) \times 100 = 80.0$		$(3/10) \times 100 = 30.0$		$(4/5) \times 100 = 80.0$
Usage Rate/UR (%)	$(5/20) \times 100 = 25.0$		$(10/20) \times 100 = 50.0$		$(5/20) \times 100 = 25.0$

Furthermore, the researchers from China suggest a system of norms or standard values which have been re-evaluated over the past decades. By using the scoring rates, it is possible to give grades or marks regarding the skills shown throughout the stages (Zhang, 2006; Zhang & Hu, 2013). Besides, a standard given in terms of the usage rate in a certain phase of the rally can be understood as a recommendation for being successful in competition or as a characteristic of a match which typically turns out well (Zhang, 2006). Until the last decade, the descriptive performance analysis in China seemed to be primarily based on soring rates and usage rates (Cai et al., 2002; Zhang, 2006). More recently, two other specific values were implemented in order to assess table tennis tactics: “technique effectiveness” (TE) and “competition performance” (CP). The scoring rate and usage rate are integrated into the new parameter “technique effectiveness” according to the following formula (Zhang & Hu, 2013; Zhang et al., 2014):

$$TE = A + B \times TE_0 + C \times TE_0^2$$

where

$$A = - \left(1 + \frac{\sqrt{2}}{2} \right)$$

$$B = (1.5 + \sqrt{2})$$

$$C = -\frac{\sqrt{2}}{2}$$

$$TE_0 = \left(1 + \frac{UR}{100} \right)^{\frac{5R}{100} - 0.5}$$

In respect of the parameter technique effectiveness, there are also standards to assess the various skills (Tables 3 and 4).

Table 3 Evaluation criteria for TE of elite male table tennis players
(Zhang et al., 2014; $n = 121$)

	Excellent	Good	General	Poor
Serve + Third Ball ($TE_{1,3}$)	≥ 0.565	$0.564 - 0.543$	$0.542 - 0.520$	< 0.520
Receive + Fourth Ball ($TE_{2,4}$)	≥ 0.533	$0.532 - 0.506$	$0.505 - 0.477$	< 0.477
After Fourth Stroke ($TE_{>4}$)	≥ 0.477	$0.476 - 0.454$	$0.453 - 0.423$	< 0.423

Table 4 Evaluation criteria for TE of elite female table tennis players
(Zhang et al., 2014; $n = 123$)

	Excellent	Good	General	Poor
Serve + Third Ball ($TE_{1,3}$)	≥ 0.567	$0.566 - 0.549$	$0.548 - 0.526$	< 0.526
Receive + Fourth Ball ($TE_{2,4}$)	≥ 0.517	$0.516 - 0.493$	$0.492 - 0.465$	< 0.465
After Fourth Stroke ($TE_{>4}$)	≥ 0.483	$0.482 - 0.456$	$0.455 - 0.431$	< 0.431

As an indicator, technique effectiveness serves the purpose of identifying improvement potentials in regard to the way an athlete plays. Beyond the evaluation criteria, there is the statistical method to relate a performance shown in a certain stage of the rallies to the performance recorded in the particular matches. This is done with the help of the Pearson product-moment correlation coefficient. The strength of the relationship indicates how relevant this specific phase of a rally is for competition and training. On this background, the official match result is reappraised and expressed by the parameter “competition performance” (CP). One pivotal question in this context is how close or how clear the final results of the diverse games have been. As laid down by Zhang et al. (2014), the formula to calculate competition performance is:

$$CP = 22 - \sqrt{\sum_{i=1}^n (x_i - 11)^2 / m}$$

where

x_i = Point difference at the end of each game

n = Number of games in each match

3.2 Data collection and data analysis

In the course of the 2014 world championships, all encounters of both Chinese table tennis teams in the knockout stage were observed. Matches which included players who preferred the defensive style (“choppers”) were omitted