

# **Wheelchair tennis skill development, court movement and physiological cost: effects of organised practice**

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# Wheelchair tennis: characteristics...

Adequate court mobility is required

- Poor movement
- Poor court positioning
- Timing and shot execution
- Errors and / or reduced rally duration

Dyrbus (2012).



# Wheelchair tennis: the racket as a constraint...



# Wheelchair tennis: the racket as a constraint...

## Negative impact on speed and acceleration

Goosey-Tolfrey and Moss (2005)



## Without a racket:

**More effective hand rim contact = more effective force production = higher speeds**

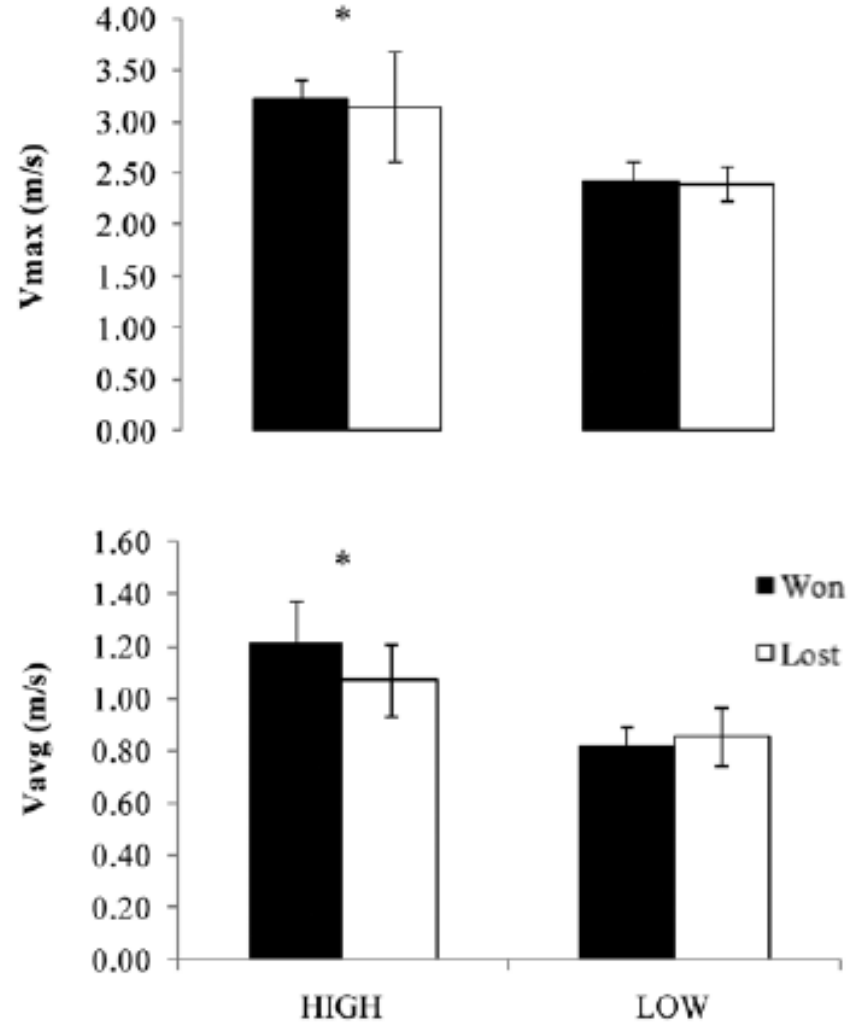
de Groot *et al.* (2016)

# Wheelchair tennis: characteristics...

Elite players are more capable of navigating the court surface...

Distance

Speed



**Figure 4** — Rank-by-result interaction of tennis match-play speed ( $V_{max}$ ,  $V_{avg}$ ). \*Significant main effect for rank ( $P < .05$ ).

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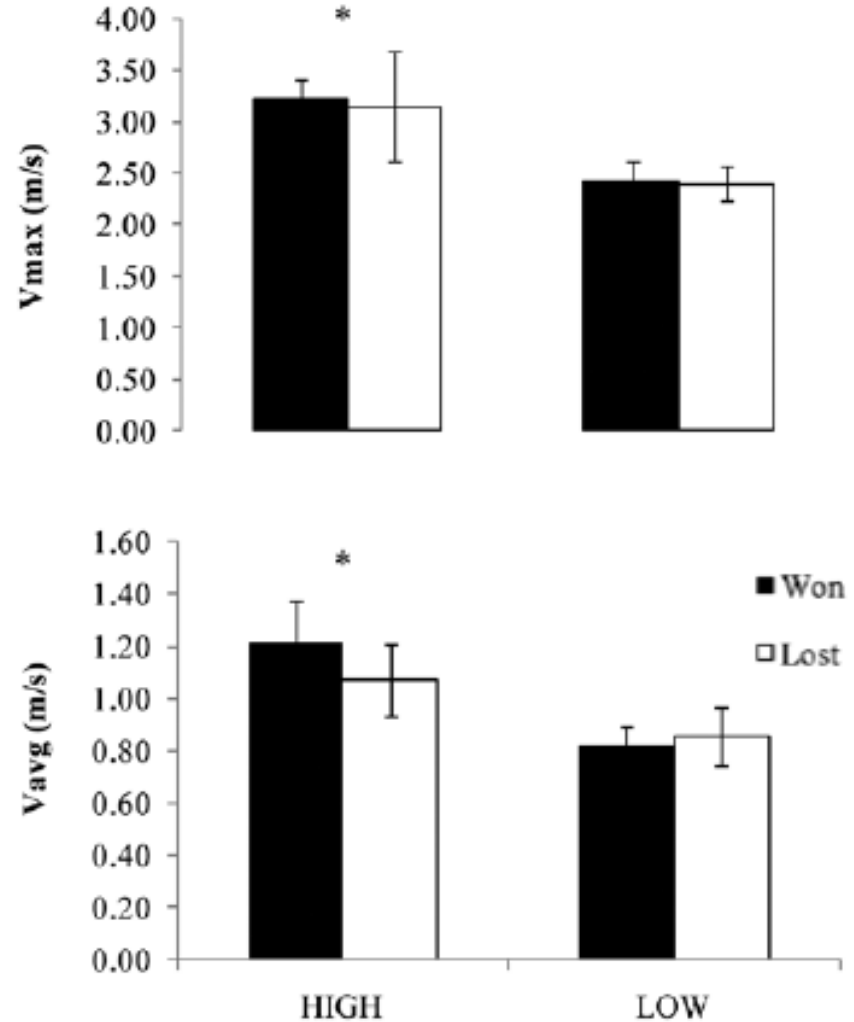
Distance

Speed

... increasing propulsion speed should enable enhanced court-movement and positioning

... more able to cope with the challenges of match-play

Sindall *et al.* (2013).



**Figure 4** — Rank-by-result interaction of tennis match-play speed ( $V_{max}$ ,  $V_{avg}$ ). \*Significant main effect for rank ( $P < .05$ ).

# Wheelchair tennis: characteristics...

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**Self efficacy (SE) is a function of skill level**

- **SE is higher in elite AB tennis players than low-skill counterparts**

Neil et al. (2006)



# Wheelchair tennis: characteristics...

## Self efficacy (SE) is a function of skill level

- SE is higher in elite AB tennis players than low-skill counterparts

Neil et al. (2006)

- Positive perceptions of anxiety control
- Positive performance outlook

Hanton et al. (2003)

# Wheelchair tennis: characteristics...

## Self efficacy (SE) is a function of skill level

- SE is higher in elite AB tennis players than **low-skill** counterparts

Neil et al. (2006)

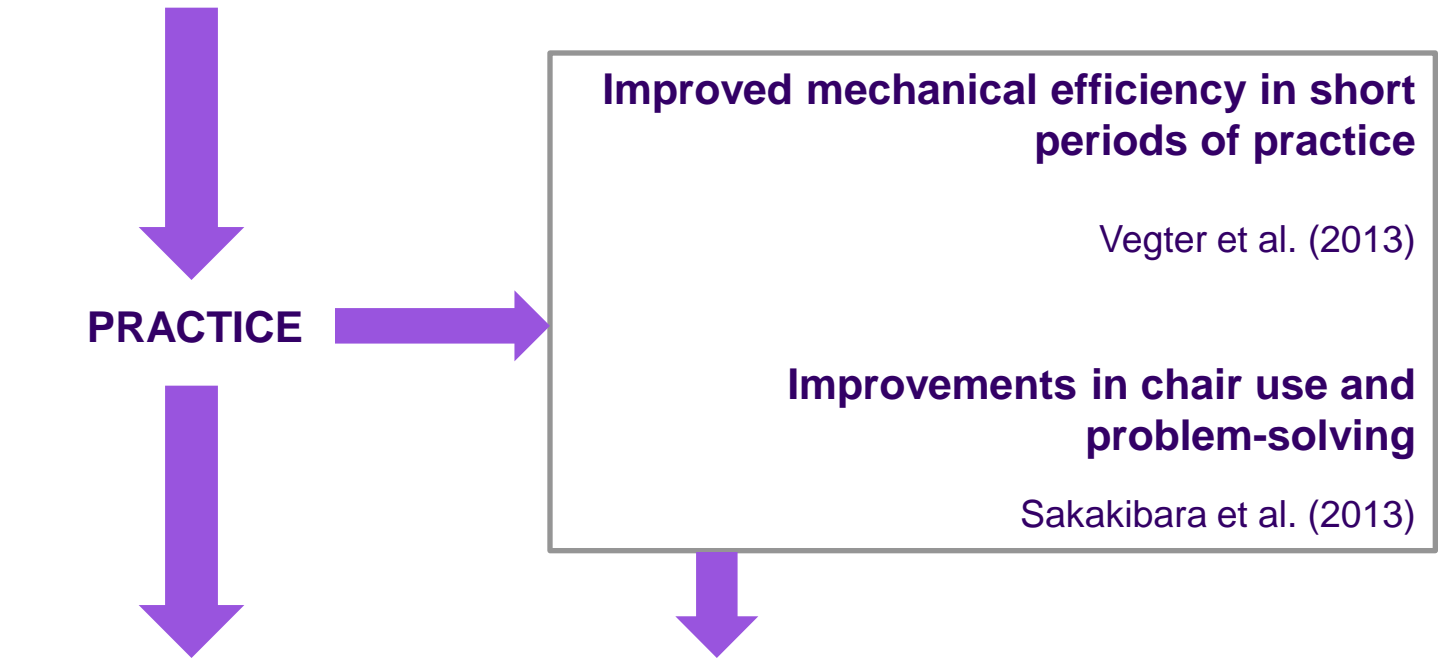
- Decreased perceptions of anxiety control
- Problems with focus and concentration
- Debilitating performance effects

Hanton et al. (2003)

# Wheelchair tennis: characteristics...

Low skill groups

Novel approaches for increasing SE are merited



- Specific to tennis
- Considers the effects of racket holding
- Can court-movement and self efficacy be increased using R / NR practice?

## **Purpose of the study**

**Determine possible differences in court-movement, physiological cost and self-efficacy in match-play following practice and racket-holding.**

# Methodology

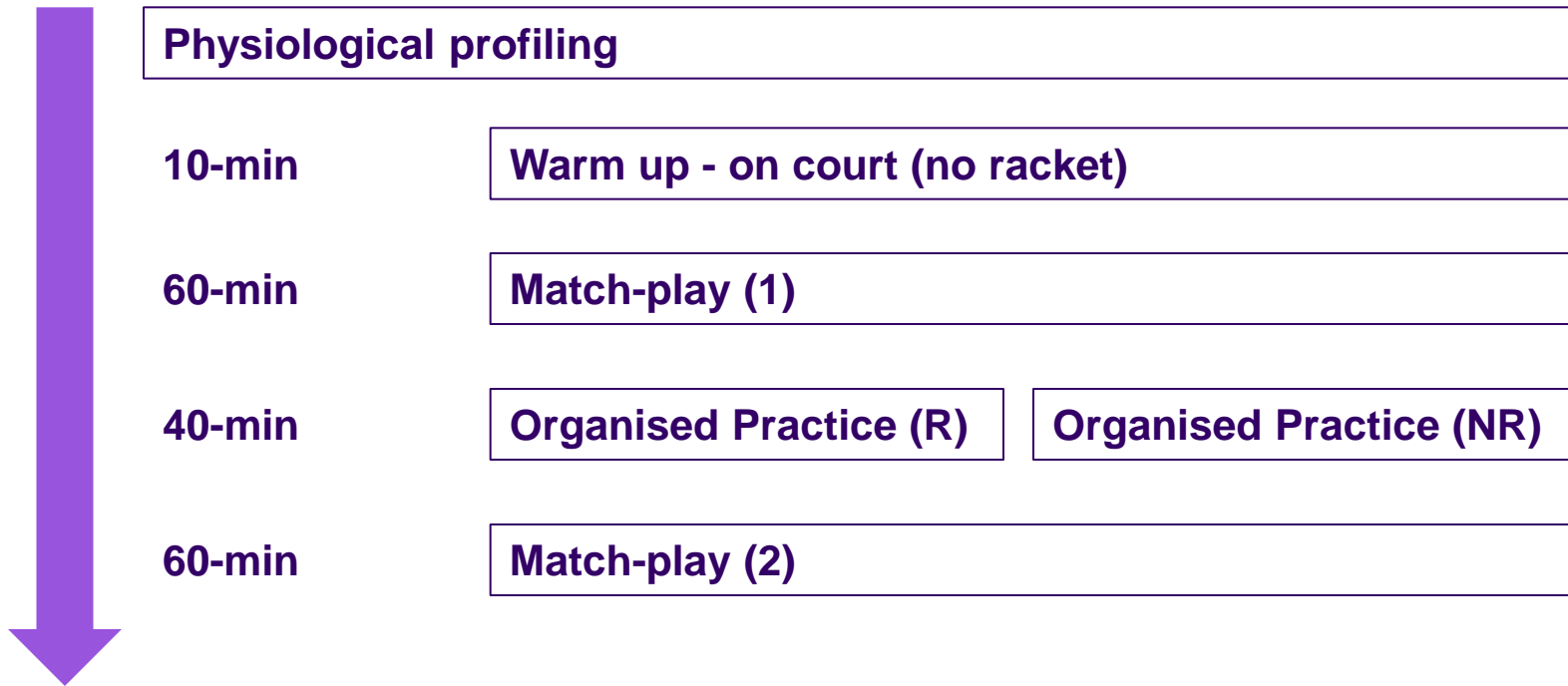
## Participants

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- **n = 16 (M = 12, F = 4) able-bodied participants**
- **No prior wheelchair propulsion experience**
- **No prior wheelchair tennis playing experience**
- **Allocated match-play opponent**
- **Random assignment to racket (R) or no racket (NR) practice**

# Methodology

## Testing procedure



# Methodology

## Testing procedure – **Physiological profiling**

### *Graded Exercise Test*

- **4 to 6 bouts submaximal exercise**  
3-min @ 15 to 20W increments

5-min Rest

### *Peak Exercise Test*

- **Bouts of exercise to volitional exhaustion**  
1-min @ 15 to 20W increments

**Measures: HR, expired air for oxygen uptake, blood lactate and differentiated RPE**



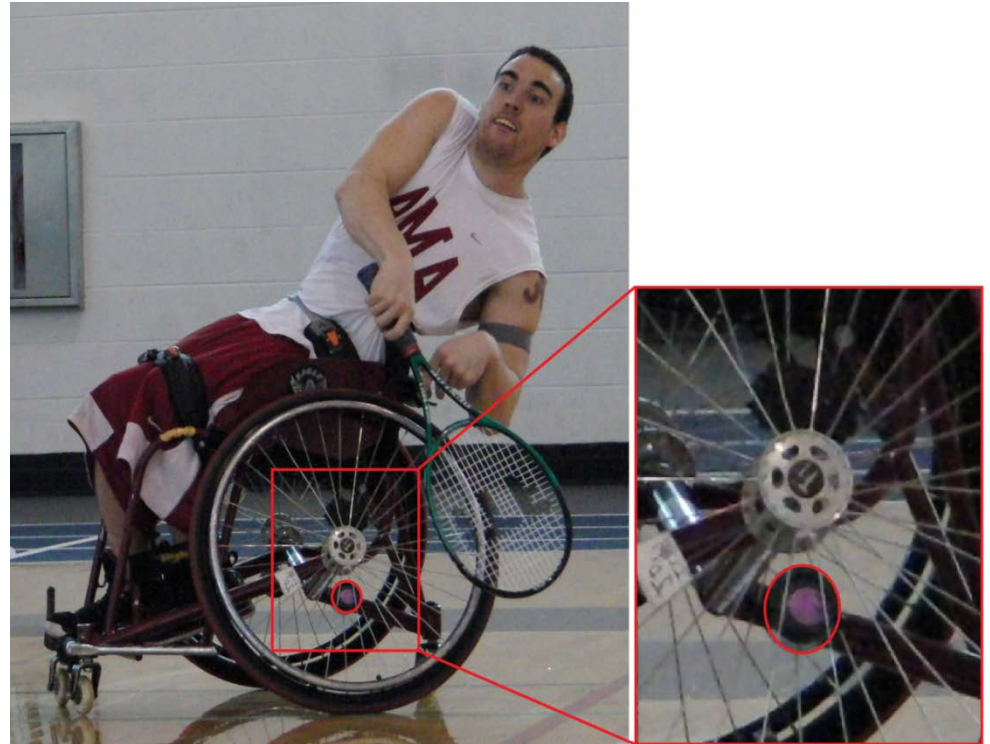
# Methodology

## Testing procedure – Match-play bouts (1) & (2)

- Likely recreational conditions
- Continuous, competitive play
- Green LCB

### Measures:

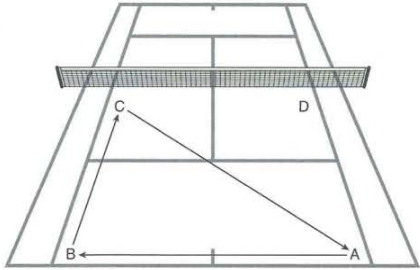
- Court movement variables
- Physiological variables
- Self efficacy



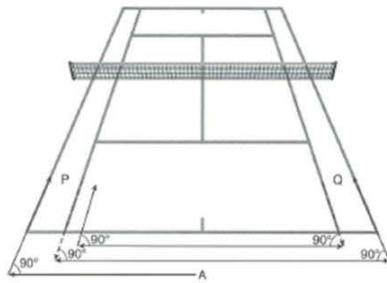


# Methodology

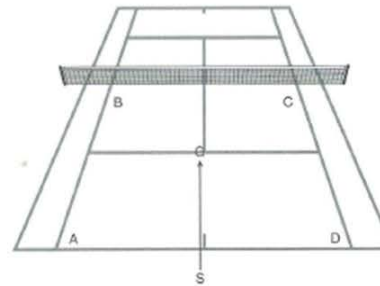
## Testing procedure – Organised practice



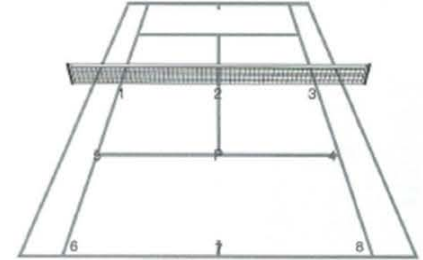
**1=Down-the-mountain.** *Bout 1:* Gentle push from A to B. Increase speed gradually from B to C. Turn at C, sprint to A (2 mins 45 secs). *Bout 2:* Start at B. Gentle push to A. Increase speed to D. Sprint to B (2 mins 45 secs).



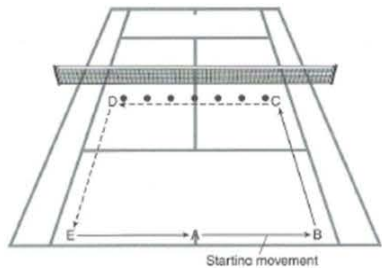
**2=Park-the-car.** *Bouts 1 & 2:* Start at A. Sprint behind the baseline. Turn 90 degrees and stop at P (brake sharply). Reverse out of marked area beyond the baseline, turn 90 degrees, and sprint along the baseline before turning 90 degrees and parking in Q. Reverse out of Q, turn 90 degrees and sprint back along baseline to P.



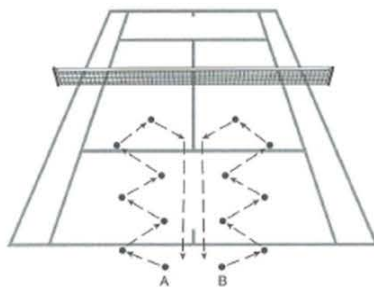
**3=Through-the-gate.** *Bouts 1 & 2:* Start at S. Push through G, then through any marker (A, B, C or D). Back to G, then to any other marker, but not one directly in a straight line (ie. a push to A cannot be followed by a push to C). Finish at S.



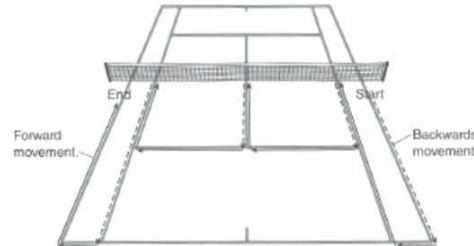
**4=Agility.** *Bouts 1 and 2:* Begin at P facing the net. Coach shouts positions (1 to 8). Player must react, turn and sprint to the number marker, returning to P at speed.



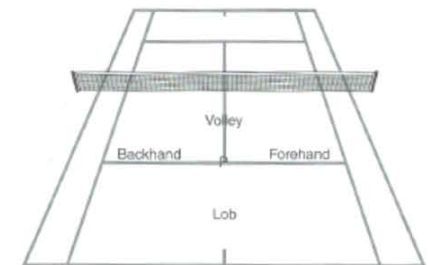
**5=Sprint-slalom-reverse.** *Bout 1:* Start at A. Sprint to B. Turn and sprint to C. Slalom through markers to D. Reverse the chair back to E. Turn and sprint to A. *Bout 2:* Repeat in the opposite direction.



**6=Two-push-slalom.** *Bout 1:* Start at A. Sprint to B (only two pushes permitted between cones). *Bout 2:* Repeat, starting at B.



**7=Half-court-map.** *Bout 1:* Begin at the Start position facing the net. Tennis court markings outline the course to be taken. *Bout 2:* Repeat starting at the End position.



**8=Box-command.** *Bouts 1 & 2:* Begin at P, facing the coach. Coach shouts shot type (volley, backhand, forehand, lob). Player turns towards the command and makes one powerful push to leave P. On leaving P, player brakes to stop dead, and reverses back to P. Player should now remain facing the same way as the direction he / she reversed from. Player is ready for the next command.

# Methodology

## Data analysis

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### 1. Combined effect of organised practice and racket strategy on match-play:

- Separate 2 x 2 (*practice by racket*) mixed measures ANOVAs
- $\eta^2p$  for effect size

### 2. Effect of racket holding during practice:

- Independent t-tests
- Cohen's *d* for effect size

# Results

## 1. Combined effect of practice and racket strategy on match-play

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No significant *practice* by *racket* interaction effects

Main effects for *practice* were significant

Main effects for *racket* were not significant

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# Results

## 1. Combined effect of practice and racket strategy on match-play

	PRE		POST		<i>P</i>	$\eta^2_{\text{partial}}$	
Overall distance (m·min <sup>-1</sup> )	34.5	▼ (6.9)	37.5	▼ (6.9)	0.042 *	0.263	Large
Forwards distance (m·min <sup>-1</sup> )	20.5	▼ (6.9)	24.2	▼ (6.9)	0.012 *	0.370	Large
Reverse distance (m·min <sup>-1</sup> )	0.7	▼ (0.4)	0.7	▼ (0.4)	0.409	0.049	Small
Forwards-to-reverse distance (m·mi	13.3	▼ (1.7)	12.6	▼ (1.4)	0.053	0.242	Large
Peak speed (m·s <sup>-1</sup> )	2.22	▼ (0.31)	2.51	▼ (0.35)	0.004 *	0.455	Large
Average speed (m·s <sup>-1</sup> )	0.58	▼ (0.12)	0.63	▼ (0.11)	0.036 *	0.277	Large
Mean peak HR (b·min <sup>-1</sup> )	124	▼ (15)	125	▼ (16)	0.839	0.003	
Mean minimum HR (b·min <sup>-1</sup> )	73	▼ (15)	74	▼ (13)	0.158	0.137	Medium
Mean average HR (b·min <sup>-1</sup> )	96	▼ (17)	96	▼ (17)	0.597	0.021	Small
%HR <sub>L</sub>	51.5	▼ (7.6)	51.8	▼ (7.6)	0.586	0.022	Small
VO <sub>2T</sub> (L·min <sup>-1</sup> )	0.75	▼ (0.36)	0.76	▼ (0.37)	0.620	0.018	Small
%VO <sub>2T</sub>	28.6	▼ (9.1)	29.0	▼ (9.5)	0.537	0.028	Small
Self efficacy scale score	3.3	▼ (0.9)	4.1	▼ (0.9)	0.001 *	0.533	Large

# Results

## 1. Combined effect of practice and racket strategy on match-play

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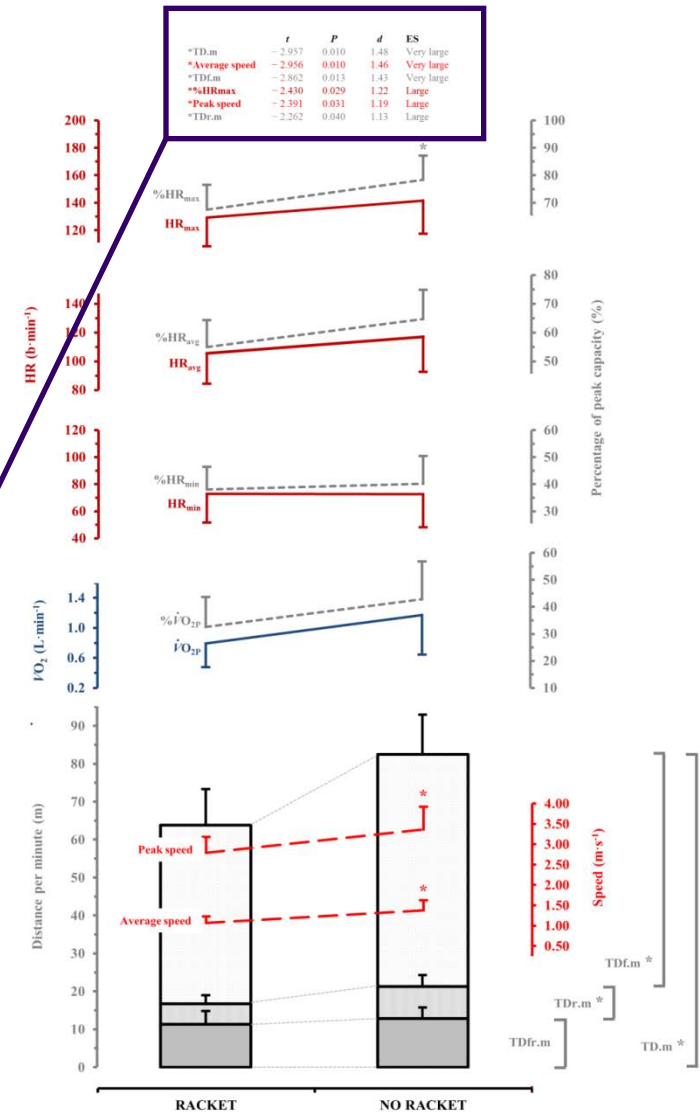
# Results

## 2. Effect of racket holding during practice

### Court-movement and physiological variables

	<i>t</i>	<i>P</i>	<i>d</i>	ES
Total distance	- 2.957	0.010	1.48	Very large
<b>Average speed</b>	<b>- 2.956</b>	<b>0.010</b>	<b>1.46</b>	<b>Very large</b>
Forwards distance	- 2.862	0.013	1.43	Very large
%HR <sub>L</sub>	- 2.430	0.029	1.22	Large
<b>Peak speed</b>	<b>- 2.391</b>	<b>0.031</b>	<b>1.19</b>	<b>Large</b>
Reverse distance	- 2.262	0.040	1.13	Large

Higher values attained during NR practice



# Results

## 2. Effect of racket holding during practice

### Energy expenditure (EE)

		Practice Type		<i>t</i>	<i>P</i>	<i>d</i>
		R	NR			
<i>EE</i>						
<i>Total</i>	kcal	95 (38) [64 - 126]	141 (63) [88 - 194]			
<i>Relative</i>	kcal·min <sup>-1</sup>	4.0 (1.6) [2.7 - 5.3]	5.9 (2.6) [3.7 - 8.1]	-1.770	0.098	0.88
<i>Duration</i>						
<i>Activity</i>	min	24				
<i>Target for EE of 300 to 350 kcal</i>	min	75.8 - 88.4	51.2 - 59.7			

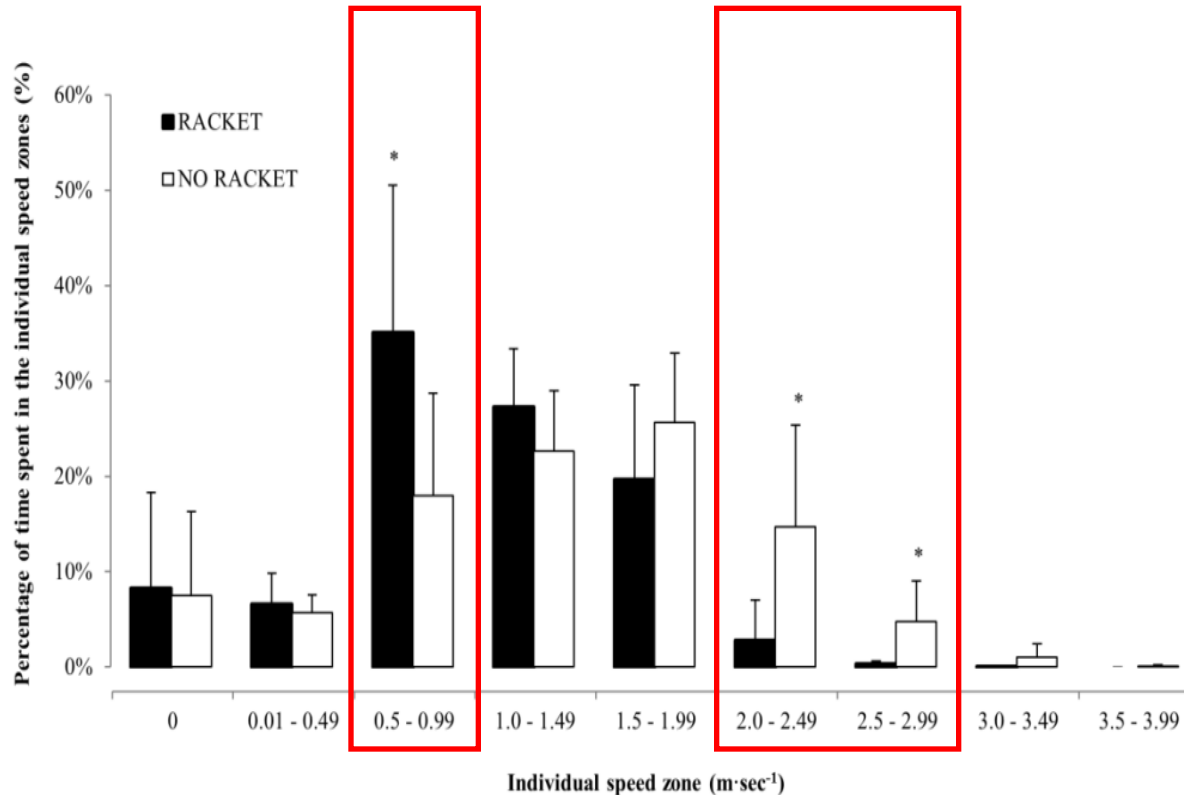
### Higher values attained during NR practice

Target duration: 76 to 88 min (R) vs. 51 to 60 min (NR)



# Results

## 2. Effect of racket holding during practice



Time spent in individual speed zones

# Discussion

- Increased court movement, but no change in physiological variables



Practice-induced changes in chair skills increasing mechanical efficiency...

... offset likely physiological consequences of increased movement activity

- Racket strategy not a factor...
  - ... either mode of practice has desired effects on court-movement
- Ball to racket contact



Characteristics of R and NR practice

NR - EE & health outcomes

The racket as a constraint

# Acknowledgements

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**John P. Lenton<sup>1</sup>, Barry S. Mason<sup>1</sup>, Keith Tolfrey<sup>1</sup>, Rory A. Cooper<sup>2</sup>,  
Kathleen A. Martin Ginis<sup>3</sup> and Victoria L. Goosey-Tolfrey<sup>1</sup>**

<sup>1</sup>The Peter Harrison Centre for Disability Sport, School of Sport, Exercise, and Health Sciences; Loughborough University; Loughborough; UK

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<sup>3</sup>University of British Columbia, ICORD; Canada.