BWF SPORTS SCIENCE PROJECT

SPEED AND ACCURACY IN THE BADMINTON JUMP SMASH

Mark King
MY BACKGROUND

• Sports Biomechanist
• National level badminton player
• Elite performance research
  • gymnastics, athletics, tennis, kayaking, springboard diving, cricket
• Badminton
SPORTS BIOMECHANICS

• mechanical understanding and explanation of movement in sport

• identify the factors that are important
  • performance
  • injuries
PHILOSOPHY

• some factors are critical for elite performance

• other factors are less important and will be governed by coaching, individual variation etc
METHODS IN SPORTS BIOMECHANICS

- experimental studies
  - cricket

- theoretical studies
  - tumbling
1. what characterises the fastest bowlers?
EXPERIMENTAL - MODERN MOTION ANALYSIS
PERFORMANCE
BOWLING ACTION
THE FASTEST BOWLERS
THE FASTEST BOWLERS
– quicker run-up
THE FASTEST BOWLERS

– quicker run-up
– delay the bowling arm

slower  faster
THE FASTEST BOWLERS

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– more trunk flexion (between FFC and BR)
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– straighter front knee (at BR)
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<table>
<thead>
<tr>
<th>Predicted Speed (mph)</th>
<th>Actual Speed (mph)</th>
</tr>
</thead>
<tbody>
<tr>
<td>70</td>
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</tr>
<tr>
<td>80</td>
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<tr>
<td>90</td>
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74% of the variance explained
SHAPE AT BALL RELEASE

slower  faster
SHAPE AT BALL RELEASE

slower faster
FAST BOWLING
DOUBLE LAYOUT SOMERSAULT
THEORETICAL - TUMBLING

performance

simulation
OPTIMISATION - TUMBLING
TRIPLE LAYOUT SOMERSAULT
OVERHEAD – THROWING / STRIKING

- cricket fast bowl
- baseball pitch
- tennis serve
- badminton smash

- optimum performance
  - speed, angle
  - accuracy
FASTEST CRICKET BOWL - 160 km/h
FASTEST BASEBALL PITCH - 169 km/h
FASTEST TENNIS SERVE - 264 km/h
FASTEST BADMINTON SMASH – 426 km/h
## IPL - FASTEST SMASHES

<table>
<thead>
<tr>
<th>male</th>
<th>speed km/h</th>
<th>female</th>
<th>speed km/h</th>
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<td>Bodin Isara</td>
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<td>Gabrielle Adcock</td>
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<td>Carolina Marin</td>
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<td>Sameer Verma</td>
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<td>Nitchaon Jindapon</td>
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<tr>
<td>Jan O Jorgensen</td>
<td>401</td>
<td>Cheung Ngan Yi</td>
<td>324</td>
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QUESTIONS

• why can some smash much faster than others?
  • strength
  • technique
  • grip

• what is the limit for an individual?
• what does optimum look like?
• can we coach someone to smash faster?
BADMINTON SMASH - OPTIMUM?
1st BWF SMASH PROJECT

• accurate method for determining shuttle trajectory and speed
• impact location on the racket

• to identify the key aspects of technique which characterise the fastest jump smash
• accuracy in the smash
1\textsuperscript{st} DATA COLLECTION

- 18 experienced players
- motion analysis (400 Hz)
- maximal jump smashes
1st DATA COLLECTION
IDENTIFICATION OF CRUCIAL INSTANTS
IDENTIFICATION OF CRUCIAL INSTANTS

- maximum knee flexion
IDENTIFICATION OF CRUCIAL INSTANTS

- racket lowest point
IDENTIFICATION OF CRUCIAL INSTANTS

• shuttle contact
FITTING SHUTTLE TRAJECTORY

distance (m)

0 0.2 0.4 0.6 0.8 1

0 0.02 0.04 0.06 0.08 0.1

time (s)
FITTING SHUTTLE TRAJECTORY

distance (m)

-1 -0.6 -0.2 0 0.2 0.6 1

0 0.02 0.04 0.06 0.08 0.1

time (s)
FITTING SHUTTLE TRAJECTORY

distance (m)

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time (s)
Fitting Shuttle Trajectory

- Distance (m)
- Time (s)
- Shuttle velocity
- Impact location
RACKET IMPACT LOCATION
DATA PROCESSING

• shuttle velocity
• racket impact location

• fastest smash for each player
  • knee, wrist, elbow, and trunk angles at crucial instants

• stepwise linear regression
RESULTS
small elbow angle during backswing

predicted speed (mph)

actual speed (mph)

52% variation explained
ELBOW ANGLE

rear view
side view
front view
elbow angle & appropriate wrist angle at impact

predicted speed (mph)

actual speed (mph)

70% variation explained
elbow, wrist and timing from preparation to impact

predicted speed (mph)

actual speed (mph)

84% variation explained
1st BWF SMASH PROJECT

• accurate method for determining shuttle trajectory and speed
• impact location on the racket

• to identify the key aspects of technique which characterise the fastest jump smashes
• accuracy in the smash
2nd DATA COLLECTION - LOUGHBOROUGH STUDENTS
<table>
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<th>subject</th>
<th>shuttle speed</th>
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<th>horizontal angle</th>
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<td>14 ± 1°</td>
<td>3 ± 7°</td>
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COMPARISON S5 & S6 – elbow angle

S5

S6
COMPARISON S5 & S6 – wrist angle

S5

S6

wrist angle (°)

wrist angle (°)

time before impact (s)

time before impact (s)
SHUTTLE - SHOULDER VARIATION AT IMPACT

S5

S6
SHUTTLE - IMPACT LOCATION ON RACKET

S5

S6
2nd BWF PROJECT – ELITE PRO PLAYERS

- normative elite smash data
- quantify differences / similarities
  - male / female
  - different countries
- key aspects of technique
  - speed, accuracy
BWF SMASH PROJECT

- All England Championships 2016
- Badminton England December 2016
- World Championships 2017
QUESTIONS

- why can some smash much faster than others?
  - strength
  - technique
  - grip

- what is the limit for an individual?
- what does optimum look like?
- how to coach young players to smash faster?
ALL ENGLAND CHAMPIONSHIPS 2016
FASTEST SMASH - 360 km/h
BADMINTON ENGLAND DEC’ 2016
BADMINTON ENGLAND DEC’ 2016
BADMINTON ENGLAND DEC’ 2016
BADMINTON WORLD CHAMPIONSHIPS 2017

OPTIMUM PERFORMANCE IN THE BADMINTON SMASH

23rd – 25th AUGUST

[Event Details]

Loughborough University
BADMINTON WORLD CHAMPIONSHIPS 2017
ALL SMASH DATA COMBINED

• 45 male and 35 female players
• initial analysis max speed:
  • male - 384 km/h
  • female - 317 km/h
HELP YOUNG PLAYERS TO REACH THEIR POTENTIAL
THANK YOU