Individualisation of speed training

Elementary speed as a diagnostic instrument in the longterm development programm of jumping events in athletics

François Richter
richter.francois@goolemail.com
1. Theoretical Background
2. Questions
3. Research Methods
4. Results
5. Outlook
6. Literature
Speed is known as a theoretical construct

Speed helps to describe and predict complex performances

More than 40 different definitions

Theoretical Background

Based on: Bauersfeld, & Voss, (1992); Weineck, (2010); Hohman, A., Lames, M. & Letzelter, M. (2010); Schnabel, Harre, & Krug, (2011); Wenzel, (2013)

François Richter
Speed training should be performed

- at the beginning of a training session
- when possible after a day of rest
- at least with very long breaks inbetween the single repetitions
- only a few repetitions  (Strüder, Jonath, & Scholz, 2013, S.85)

Speed training takes place

- at the beginning of a training session
- under recovered conditions  (Weineck, 2010, S. 710)
- Explosive strength ability can be improved through short arbitrary maximum contractions (Güllich, 1996)
- Data improvement of the hand and pedal crank after a cycle ergometry (Thienes, 2001)
- Recognisable but noch significant data improvement of drop jump after a cycle ergometry (Krauß, 2009)
- Data improvement of tapping after endurance power training (Neumann, 2008)
- Data improvement of tapping, drop jump and counter movement jump after a cycle ergometry or a treadmill (Richter, 2009; Dreißigacker, 2009)
In context of sports performance, speed is an elementary performance condition (Bauersfeld, 1984).

Elementary speed is determined by innervation programs:
- Recorded in the nervous spinal system
- Independent process of the awareness (Voß, Witt & Werthner 2007, S. 27)
Theoretical Background

- Elementary performance condition
- Elementary performance condition
- Elementary performance condition

- Complex performance condition
- Complex performance condition

- Complex athletic performance

Voß & Werthner (1994)
Theoretical Background

- Goal of the elementary speed training is the change of existing programs:
  - Developement of shortterm time programs
  - Train shortterm time programs in simple and comprehensive movements
  - Feedback training:
    - Informations are send to the brain
    - Constant feedback with the CNS takes place → reprogramming
      → Cortical, subcortical and spinal levels have to closely interact

Voß et al. (2007), S.43-46

Taubø, Leukel & Gollhofer (2013)
Theoretical Background

Taube et al. (2013), p. 241
Which effects have different training interventions on the elementary speed (tapping and drop jump)?

a. Are tapping and drop jump an adequate diagnostic tool in the longterm development programm of jumping events in athletics?

b. Is elementary speed trainable?

c. Are time programs trainable?

**Goal → Development of a simple training tool with immediate feedback**
### Research Methods

<table>
<thead>
<tr>
<th>Test person</th>
<th>n=53 (31♀; 22♂), D- to A-squad of DLV and elite athletes from other nations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collection of data</td>
<td>October 2011 to March 2014</td>
</tr>
<tr>
<td>Time of measurement</td>
<td>Depends on test person</td>
</tr>
<tr>
<td>Documentation</td>
<td>Written training recording</td>
</tr>
<tr>
<td>Measurement system</td>
<td>Devided Haynl TDS-Contact mat</td>
</tr>
<tr>
<td>Cyclic speed</td>
<td>Tapping (Frequency, contact time, lifting time)</td>
</tr>
<tr>
<td>Acyclic speed</td>
<td>Drop Jump (efficiency, contact time, flight time)</td>
</tr>
</tbody>
</table>
Devided Haynl TDS-Contact mat
**Research Methods**

<table>
<thead>
<tr>
<th>Test</th>
<th>Sets</th>
<th>Repitition pause</th>
<th>Set pause</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Warm-up (running, coordination, stretching)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tapping</td>
<td>4 x 3 sec</td>
<td>20 sec</td>
<td>2 min</td>
</tr>
<tr>
<td>Drop Jump (40 cm drop height)</td>
<td>1 x 4</td>
<td>20 sec</td>
<td>2 min</td>
</tr>
</tbody>
</table>

**Training intervention**

<table>
<thead>
<tr>
<th>Test</th>
<th>Sets</th>
<th>Repitition pause</th>
<th>Set pause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tapping</td>
<td>4 x 3 sec</td>
<td>20 sec</td>
<td>2 min</td>
</tr>
<tr>
<td>Drop Jump (40 cm drop height)</td>
<td>1 x 4</td>
<td>20 sec</td>
<td>2 min</td>
</tr>
</tbody>
</table>

**Utilisation – running**
Definition Tapping

The test person stands on a contact mat and has to realise an individual optimized (not minimized) small leg movement. The movement has to be cyclic (mutual) and needs to be performed as fast as possible. The upper part of the body is stabilized. Arms are stretched out in front of the breast, fingers are intertwined. The test person can decide on the hip and knee joint position (individually optimized).

Performance parameter: Frequency
Video Tapping
Definition of Drop Jump

The test person jumps from a small gymnastic box (40cm height) without jumping up and with stretched knees. The movement comes with a single step forward, whereas the test person can choose the beginning leg. The landing on the contact mat is on the ball of the foot. While jumping up again the test person needs to stretch hip, knees and feet. The appropriate arm movement can be freely chosen (individually optimized).

Performance parameter: Efficiency

\[ EKA = \frac{\text{flight time}^2}{\text{contact time}} \]
Video Drop Jump
Training interventions

1. Sprint and plyometric strength training
2. Extensive strength training
3. Strength training – Change from extensive strength to maximum power training
4. Maximum strength training
5. Speed training
6. Sprints
7. Training of technical skills
Training effects on cyclic and acyclic speed

fig. 1 A-B: The mean (SD) of training days of athlete 07 is shown before training (white bars) and after training (black bars). The evaluation results from a t-test on a level of significance $p \leq 0.05$ (*) $p \leq 0.01$ (**) $p \leq 0.001$ (***)

Athlete 07 is a long jumper on international level (PB 8.29m).
Results

Effects of different training interventions on the drop jump efficiency

fig. 2 A-C: The mean (SD) of training days of athlete 07 is shown before training (white bars) and after training (black bars). The evaluation results from a t-test on a level of significance $p \leq 0.05$ (*) $p \leq 0.01$ (**) $p \leq 0.001$ (***) Athlete 07 is a long jumper on international level (PB 8,29m).
Results

Effects of different training interventions on the drop jump efficiency

fig. 3 A-D: The mean (SD) of training days of athlete 07 is shown before training (white bars) and after training (black bars). The evaluation results from a t-test on a level of significance $p \leq 0.05$ (*), $p \leq 0.01$ (**), $p \leq 0.001$ (***)

Athlete 07 is a long jumper on international level (PB 8.29m).
Speed training can also take place after extensive training interventions with lactate concentration

→ Training depends on the individual athlete

Tapping and drop jumps are diagnostic instruments regarding training controls

→ Definition of the athletes individual form
→ Consequences of the training interventions can be described
→ Consequences for the training composition
→ Individual control of the training
→ Injury prevention
Results

Change of efficiency in one micro-cycle

fig. 4: Every shown measurement represents the mean (SD) of drop jumps a day (n=4). Athlete 06 is a female high jumper on international junior level (PB: 1.88m).

after extensive strength training

athlete 06

complex performance diagnostic
Change of frequency in a macro-cycle. The shown frequency represents the second best try of athlete 07 before training (monday). One diagnostic at 08.08.2013 has been carried out on thursday. Athlete 07 is a long jumper on international level (PB 8.29m).

<table>
<thead>
<tr>
<th>Date</th>
<th>Comments</th>
<th>Frequency (Hz)</th>
<th>contact time (ms)</th>
<th>lifting time (ms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>14.11.2011</td>
<td>first test after 4 weeks of training</td>
<td>12,01</td>
<td>92</td>
<td>81</td>
</tr>
<tr>
<td>13.02.2012</td>
<td>two weeks before the german indoor championship in Karlsruhe</td>
<td>13,18</td>
<td>86</td>
<td>61</td>
</tr>
<tr>
<td>14.06.2012</td>
<td>one week before the german championship in Bochum</td>
<td>14,76</td>
<td>78</td>
<td>58</td>
</tr>
<tr>
<td>16.07.2012</td>
<td>five days before the european championship in Helsinki</td>
<td>15,30</td>
<td>77</td>
<td>47</td>
</tr>
<tr>
<td>20.08.2012</td>
<td>two weeks after the Olympic Games in London</td>
<td>15,63</td>
<td>68</td>
<td>60</td>
</tr>
<tr>
<td>12.11.2012</td>
<td>first test after 6 weeks basic military service and Hurricane Sandy in NY</td>
<td>15,85</td>
<td>70</td>
<td>59</td>
</tr>
<tr>
<td>14.01.2013</td>
<td>first test after two weeks sickness</td>
<td>15,90</td>
<td>71</td>
<td>56</td>
</tr>
<tr>
<td>04.03.2013</td>
<td>second week of training after sickness since January</td>
<td>15,59</td>
<td>73</td>
<td>53</td>
</tr>
<tr>
<td>02.07.2013</td>
<td>four days before the German Championship in Ulm</td>
<td>16,28</td>
<td>75</td>
<td>51</td>
</tr>
<tr>
<td>08.08.2013</td>
<td>last test before the WC in Moskau (Quali for the final on 14.08.2013)</td>
<td>13,10</td>
<td>91</td>
<td>46</td>
</tr>
</tbody>
</table>
Change of efficiency in one macro-cycle

fig. 5: Every shown measurement represents the mean (SD) of drop jumps a month (n=no fixed measurement per month, from 3 to 12 measurements).
Athlete 07 is a long jumper on international level (PB 8,29m).
Results

Change of contact time in one macro-cycle

fig. 6: Every shown measurement represents the mean (SD) of drop jump contact time a month (n=no fixed measurement per month, from 3 to 12 measurements). Athlete 07 is a long jumper on international level (PB 8,29m).
Results – Summary

- Performance diagnostic

  → Diagnosis of current and continuing condition (Wick, 2013)

  → Use of results for training methods (Wick, 2013)

- Simple and economic diagnostic tool

- Standardised

- Can quickly be used
Results

Relationship between contact and flight time (Drop Jump)

![Graphs showing the correlation between contact and flight time for athletes 06 and 26.](image)

**fig. 7:** Correlation of contact and flight time.
Flight time of 600 ms = appr. 44 cm jumping height
Athlete 06 is a female high jumper on international junior level (PB: 1,88m). Athlete 26 is a former female high jumper on international level. (PB: 1,91m)
Results

Relationship between contact and flight time (Drop Jump)

fig. 8: Correlation of contact and flight time.
Flight time of 700 ms = appr. 60 cm jumping height
Athlete 01 (PB: 2,28m) and athlete 14 (PB: 2,25m) are male high jumpers on international level.
- Instrument to recognize and develop talents

- The current results have shown, that the best contact time for a long flight time is between 130ms and 150ms (short term time program)

- Faster contact times are possible → Question is, whether this is reasonable?

- Differences between women and men (flight time)
Results

Relationship between contact and flight time (Drop Jump)

fig. 9: Correlation of contact and flight time.
Flight time of 600 ms = appr. 44 cm jumping height
Athlete 06 is a female high jumper on international junior level (PB: 1,88 m).
Tapping and Drop Jump are training tools for the elementary speed

- Feedback training (Voß et al. 2007, S.45)
- Increase of the cognitive ability
- Increase of communication quality between trainer and athlete
- Elementary speed performances are trainable
  - Reduction of contact time and extension of flight time (drop jump)
  - Reduction of contact and lifting time (tapping)
- Time programs are trainable
Results – Summary

- **Technical training**
  - High efficiency in drop jump can (amongst others) be achieved through a correct execution of the movement → stretching hip, knee and feet
  - A high tapping frequency can (amongst others) be achieved through stiffness in the ankle joints
  - A relation to complex performances during competition can be established
Results – Summary

- Training tools
- Simple and economic diagnostic tool
- Standardised
- Can quickly be used
- Recognition of complex performances

➢ Development of a simple diagnostic training tool with immediate feedback
Outlook

- Instrument to recognize talents in young athletes
- Monitoring the development of performances from childhood to adulthood
- Goal and efficiency oriented speed training in sensitive phases
- Training with “simple“ exercises to improve speed in sensitive phases
- Transfer in other disciplines


Literature

Literature

Thank you for your attention!

François Richter
Individualisation of speed training

Elementary speed as a diagnostic instrument in the longterm development programm of jumping events in athletics

François Richter
richter.francois@googlemail.com
Additions

different levels of processing in the brain
  ➔ reprogramming
  ➔ saving programmes
  ➔ programm takes place

change of transfer between neurons of the anterior horn (CNS) and parts of the peripheral nervous system (PNS)

lower inhibition in the CNS

more activation of alpha-motoneurons

more sensitivity in the muscles

change of neuromuscular activity in order to provide an appropriate tendo-muscular stiffness

Taube et al. (2013)

Pole Vault Symposium - Cologne, 15.03.2014
François Richter