- selected aspects -

Biomechanics of the Pole Vault
I. Introduction

II. Helsinki: first results

III. Jump and Plant Complex (JPC): theoretical considerations new findings

KÖLN  BONN  LEVERKUSEN  OLYMPIASTÜTZPUNKT

Falk Schade
scientific goal: understand movement

movement = interaction
project „pole vault“

goal:
understand interaction between athlete and pole
↓
improve pole vault knowledge (improve pole vault performance)
↓
a) what are elite vaulters doing
b) experimental studies

Falk Schade
Pole Vault

- first results -

F. Schade/G.-P. Brüggemann/J. Isolehto/P. Komi
phase 1: energy gain = criterion 1

phase 2: energy gain = criterion 2

criterion 1 + criterion 2 = total energy gain

theoretical considerations:

Falk Schade
how is the energy transferred into the pole?

a) compressive force  
b) bending moment

depends on:  
- JPC action  
- rock back action
differentiation of first pole phase
- criterion 1 -

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role of arm motion in countermovement jump
- a phenomenon -

jump height countermovement jump:
- arms only: 3 cm
- legs only: 35 cm
- legs+arms: 45 cm
model muscle-tendon-unit (micro level)
the work of contractile elements

- the force-length-relationship determines maximum force generation

- contraction velocity determines the muscle's maximum power (force-velocity-relationship)
interaction between muscle and tendon

Arampatzis et al. 2001

The diagram shows the shortening velocity of GM and GL over time, with different markers for MSE, CE, and SEE.
interaction between muscle and tendon

interaction increases the force production of the contractile element
interaction between muscle and tendon

interaction increases the force production of the contractile element

Falk Schade
role of arm motion in countermovement jump
- a phenomenon -

the reason:

- energy transfer
- reflexes
- energy storage
- force-velocity relationship

→ principle valid for each muscle-tendon-unit (even the arms?)
differentiation of first pole phase
- criterion 1 -
energy balance of JPC - TD to TO -

transformation 1: lower extremities

transformation 2: arm/trunk connection - pole

Falk Schade
kangaroos would never jump with their arms

Falk Schade
pole planting is like jumping on our arms

we have to train our arms for something
they are not made for

Falk Schade
generate knowledge – transfer knowledge

Kölner Modell (Schade 2003)