Hold design supports learning and transfer of climbing fluency

2nd International rock climbing conference, Pontresina, 16th Sep 2014

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Reises
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Climbing constraints
Skill in climbing: Complexity approach

Performer

Constraints

Environment

Task

Information

Performace timescale

Movement

Learning timescale

Kelso. (2006)
Davids. (2008)
Seifert. (2013)

Davids. (2014)
Skill in climbing: A rapid adaptation to the constraints on performance

Geomtric index of entropy = \( \log_2(2 \text{Distance/convex hull})/\log_2 \)

Cordier. (1994)

Cordier. (1993)
Cordier. (1994)
Cordier. (1996)
Experience influences the ability of individuals to detect and use affordances for fluent traversal.

Unexperienced climbers (<10hs) climbing an ice fall

Experienced indoor climbers (~3yrs) climbing an ice fall

No experience on ice-falls

Seifert. (2013)
Skill differences in climbing: Different movement patterns available built up through experience

Seifert. (2013)
Interventions related to affordances in climbing

Different techniques can improve fluency

Nature of the constraints determine whether they are used

<table>
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<th>Differences Between Groups* in Climbing Duration (sec.) and Geometric Entropy of the Route’s Middle Section</th>
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*Arm Crossing, Dual Grasping, Control. a,b: Significant performance differences between groups for each measure and climb are indicated by different superscripts (p < .05).
Variability during practice promotes retention and transfer through a more extensive exploration of affordances

**Mechanisms**

- New and better solutions
- Requires adaptation
- Context specific

Schollhorn. (2009)  
Chow. (2013)  
Shea. (1979)
Induce exploration of affordances

Hristovksi. (2011)
Pinder. (2011)
Chow. (2011)
Kelso. (2012)
Research question: *Role of technique variation in learning design for practicing climbing skills*

- Does possibility of practice of different climbing actions improve learning and transfer of skill?

2 Global patterns of climbing can be discriminated
- Face-wall
- Side-wall

Seifert. (2013)
Design

A.

Transfer route
Design

Horizontal  Vertical  Both

- Set to 5c
- 10.3m height
- 20 handholds
Apparatus

Raw

Distortion

Paralax

SA-tracking
Learning will only be induced in the double edged route

Climbing fluency will transfer to new condition of the same difficulty and hold usability, but with different hold locations

**Analysis: Geometric index of entropy**

Geometric index of entropy = $\log_2(2\text{Distance/convex hull})$

- Geometric Entropy (H):
  - $H_1(\text{blue}) = \ln(2\times PL_1/c)$
  - $H_2(\text{orange}) = \ln(2\times PL_2/c)$

- Since $PL_1 > PL_2$
- $H_1 > H_2$
- For the same height $HTot$

Sibella. (2007)
Schollhorn. (2009)
Chow. (2013)
Results: RM-ANOVA

Main effects:
- Condition
- Condition x trial

Planned contrasts confirmed a trial by condition effect driven by the double edged route
Results

Double edged route was only route that showed a learning effect.

Climbing fluency remained good under transfer.
Discussion: learning effect

• The effect of choice at each hold drove learning effect and not the practice of different movement patterns, the route difficulty or route novelty.
• The uncertainty represented in the route facilitated the transfer of climbing fluency to a novel route
  – Transfer effects appear to be driven by learning to adapt movement patterns, as opposed the practice of those movement patterns in isolation
Discussion: Practical applications

• Once movement patterns have been stabilised, representing uncertainty is an important design factor for inducing learning and facilitating transfer


