Hold design supports learning and transfer of climbing fluency

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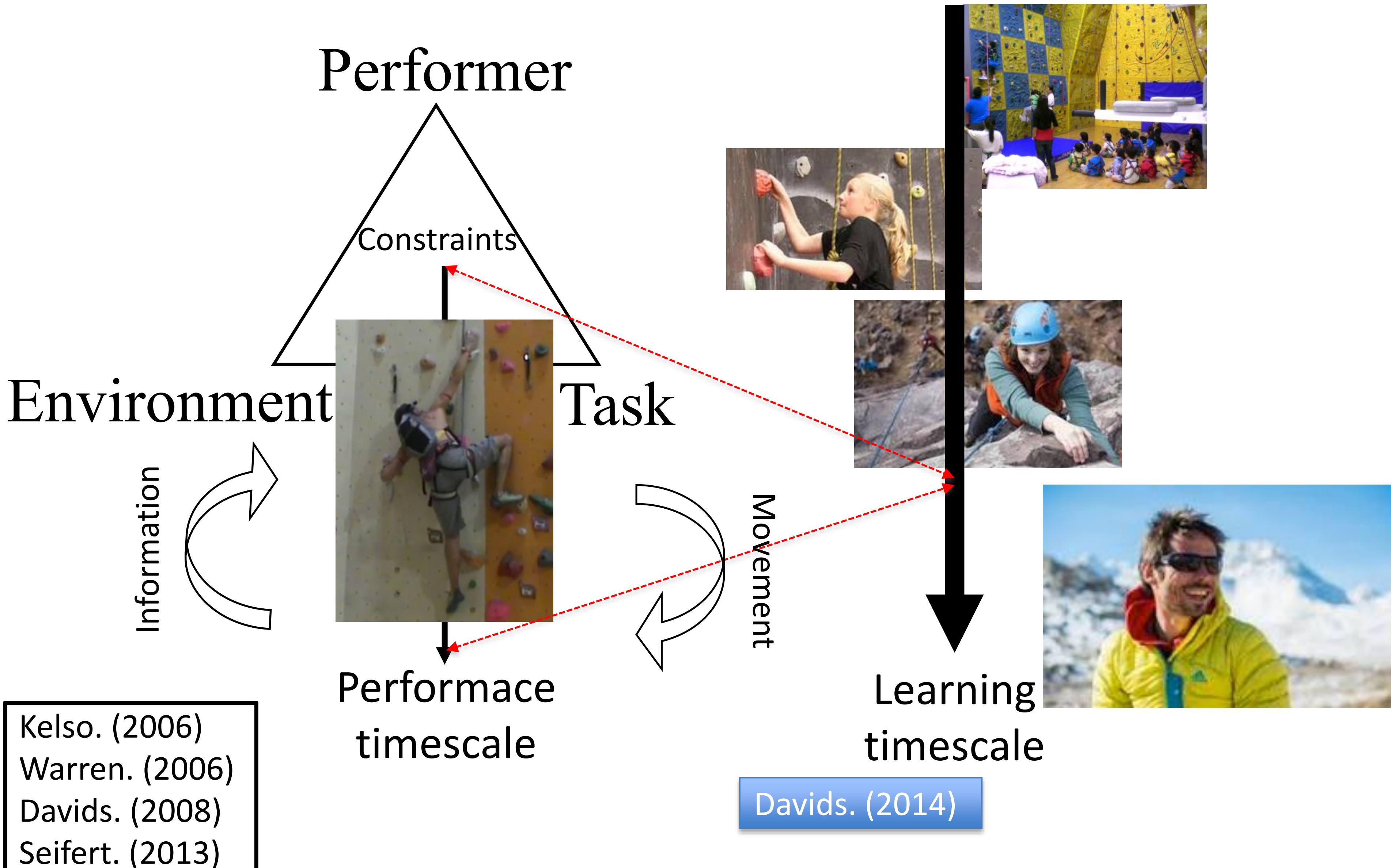
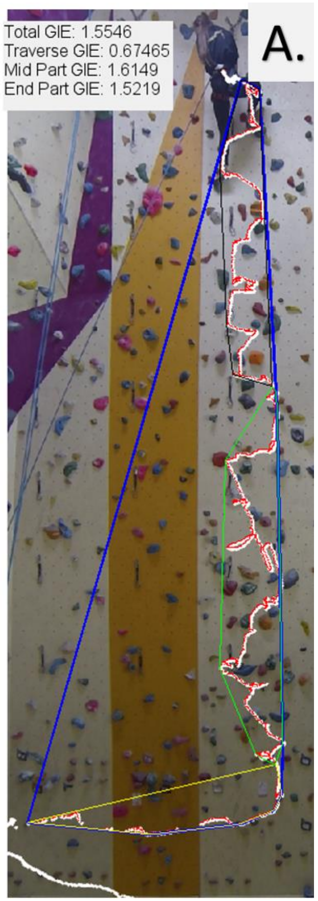
Climbing constraints

Skill in climbing: Complexity approach



Skill in climbing: A rapid adaptation to the constraints on performance



Geomtric index of entropy = log2(2Distance/convex hull)/log2

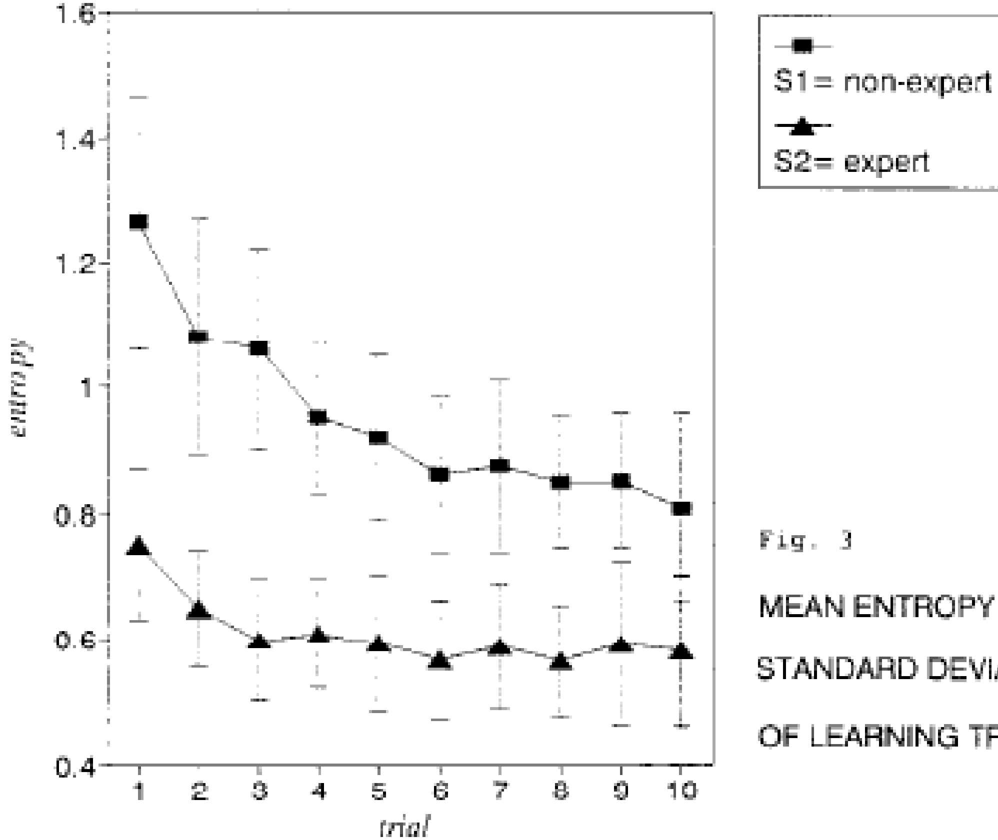


Fig. 3

MEAN ENTROPY AND STANDARD DEVIATION OF LEARNING TRAJECTORIES

Cordier. (1994)

Cordier. (1993)
Cordier. (1994)
Cordier. (1996)

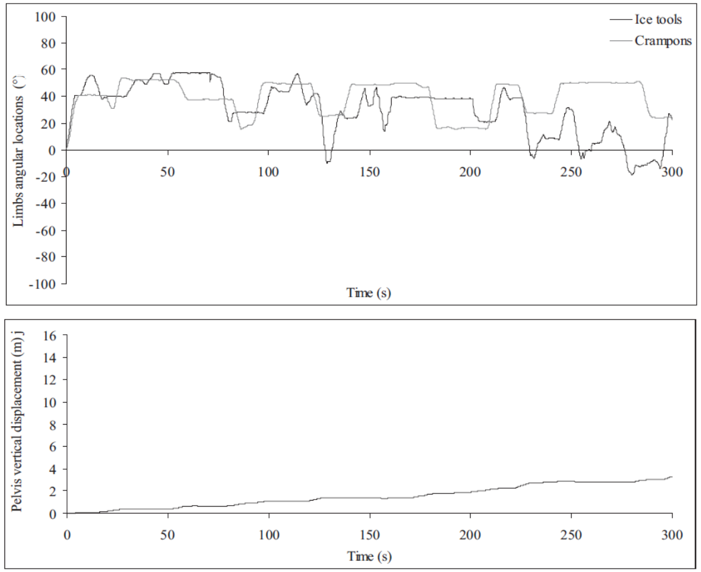
Transfer of skill in climbing

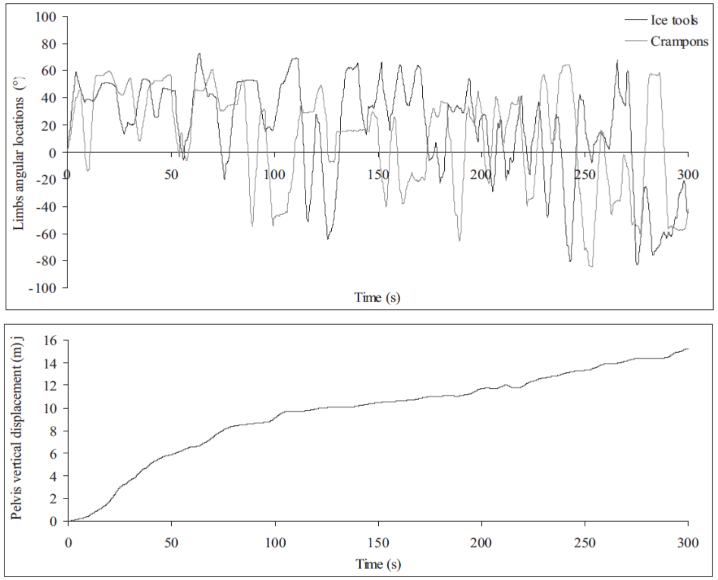
Experience influences the ability of individuals to detect and use affordances for fluent traversal

Unexperienced climbers (<10hs) climbing an ice fall

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

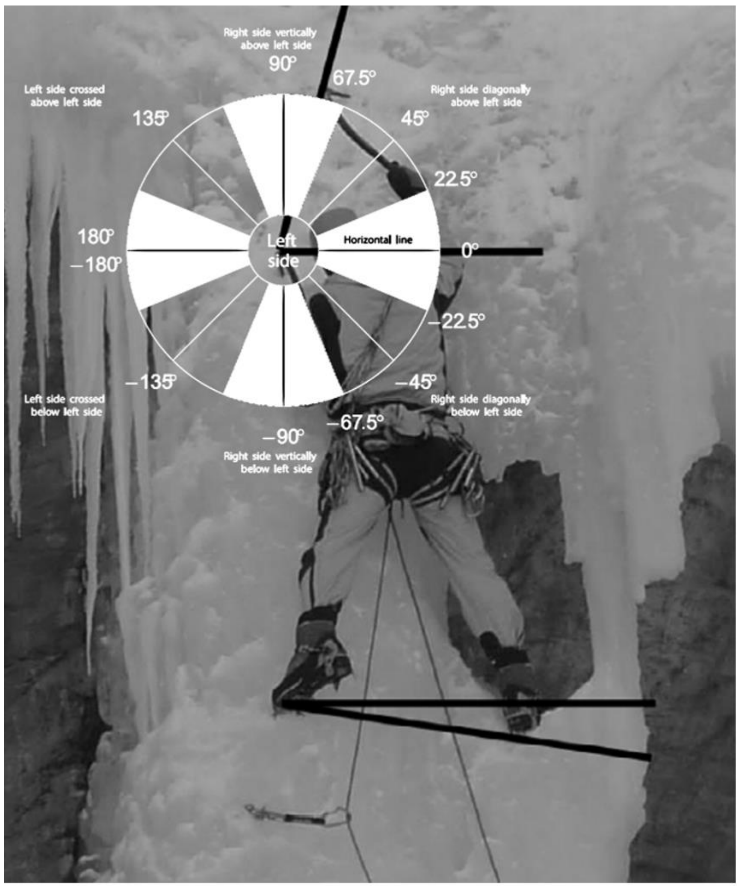
No experience on ice-falls

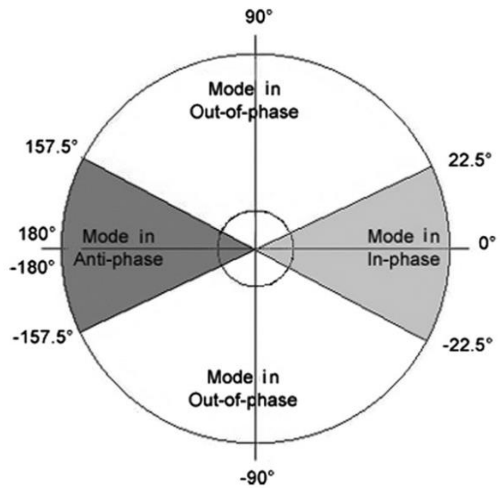


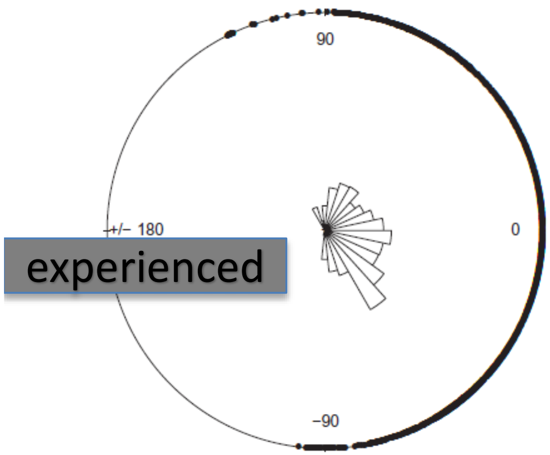


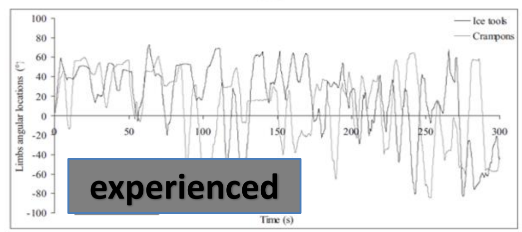
Seifert. (2013)

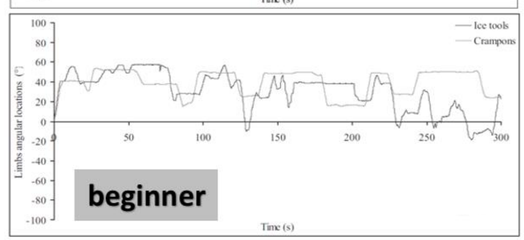
Skill differences in climbing: Different movement patterns available built up through experience

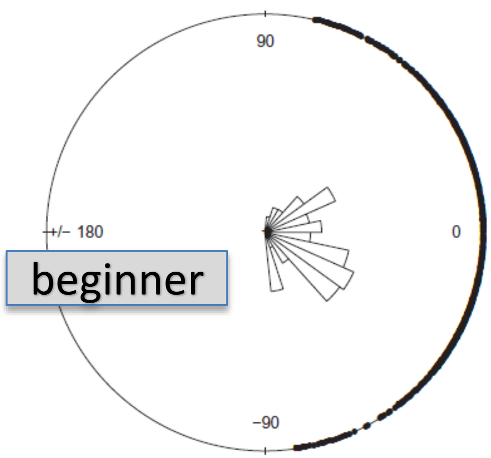












Seifert. (2013)

Interventions related to affordances in climbing

Different techniques can improve fluency

Nature of the constraints determine whether they are used

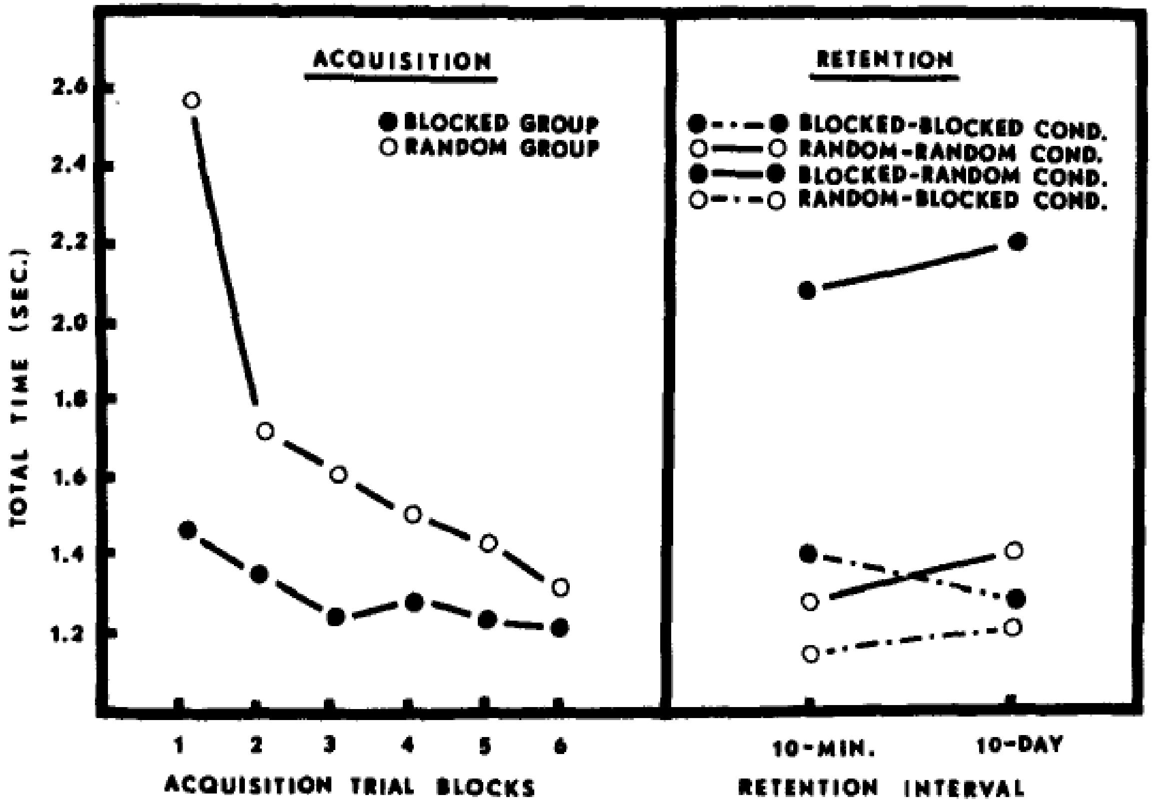
DIFFERENCES BETWEEN GROUPS* IN CLIMBING DURATION (SEC.) AND GEOMETRIC ENTROPY OF THE ROUTE'S MIDDLE SECTION

	Climb 1		Climb 2		Climb 3		Climb 4		Climb 5	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Climbing Duration										
Arm Crossing	25.0	21.7	12.3	6.5[a]	16.4	19.0[a]	11.4	8.9[a]	13.0	9.2
Dual Grasping	43.3	33.7	25.3	13.5[b]	22.6	7.6[b]	23.4	9.3[b]	15.5	5.7
Control	19.7	1.9	25.8	12.4[b]	21.6	4.9[b]	23.6	7.4[b]	19.7	7.5
Geometric Entropy										
Arm Crossing	0.77	0.39[a]	0.47	0.18[a]	0.57	0.38[a]	0.41	0.23[a]	0.57	0.34
Dual Grasping	1.46	0.66[b]	0.96	0.40[b]	1.05	0.32[b]	0.92	0.40[b]	0.69	0.20
Control	0.70	0.17[a]	0.92	0.22[b]	0.75	0.22[b]	0.81	0.21[b]	0.67	0.21

*Arm Crossing, Dual Grasping, Control. [a,b] Significant performance differences between groups for each measure and climb are indicated by different superscripts ($p < .05$).

Boschker. (2002)

Variability during practice promotes retention and transfer through a more extensive exploration of affordances



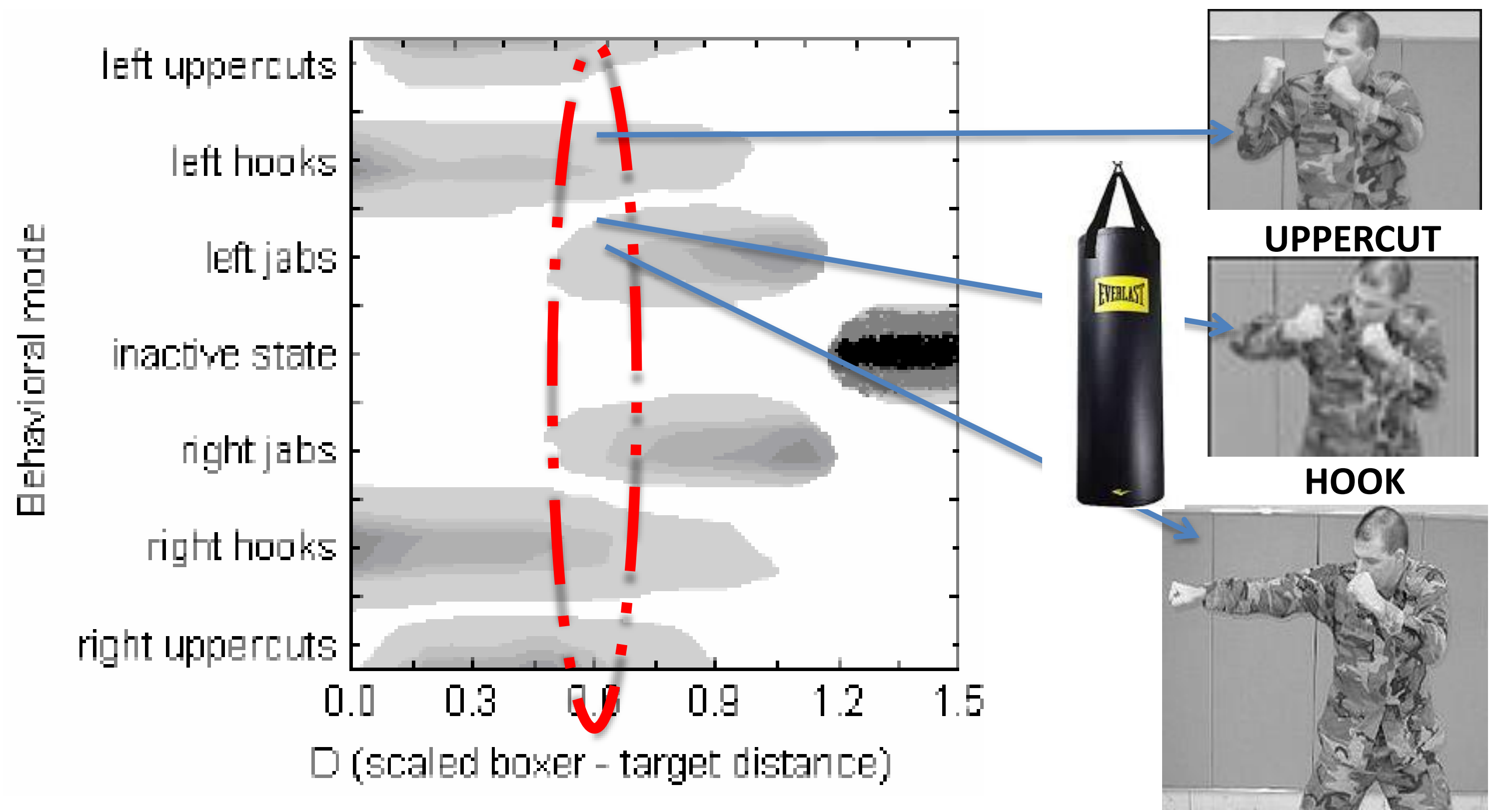
Shea. (1979)

Mechanisms

- New and better solutions
- Requires adaptation
- Context specific

Guadagnoli. (2004)
Schollhorn. (2009)
Chow. (2013)

Induce exploration of affordances



Hristovksi. (2006)

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?

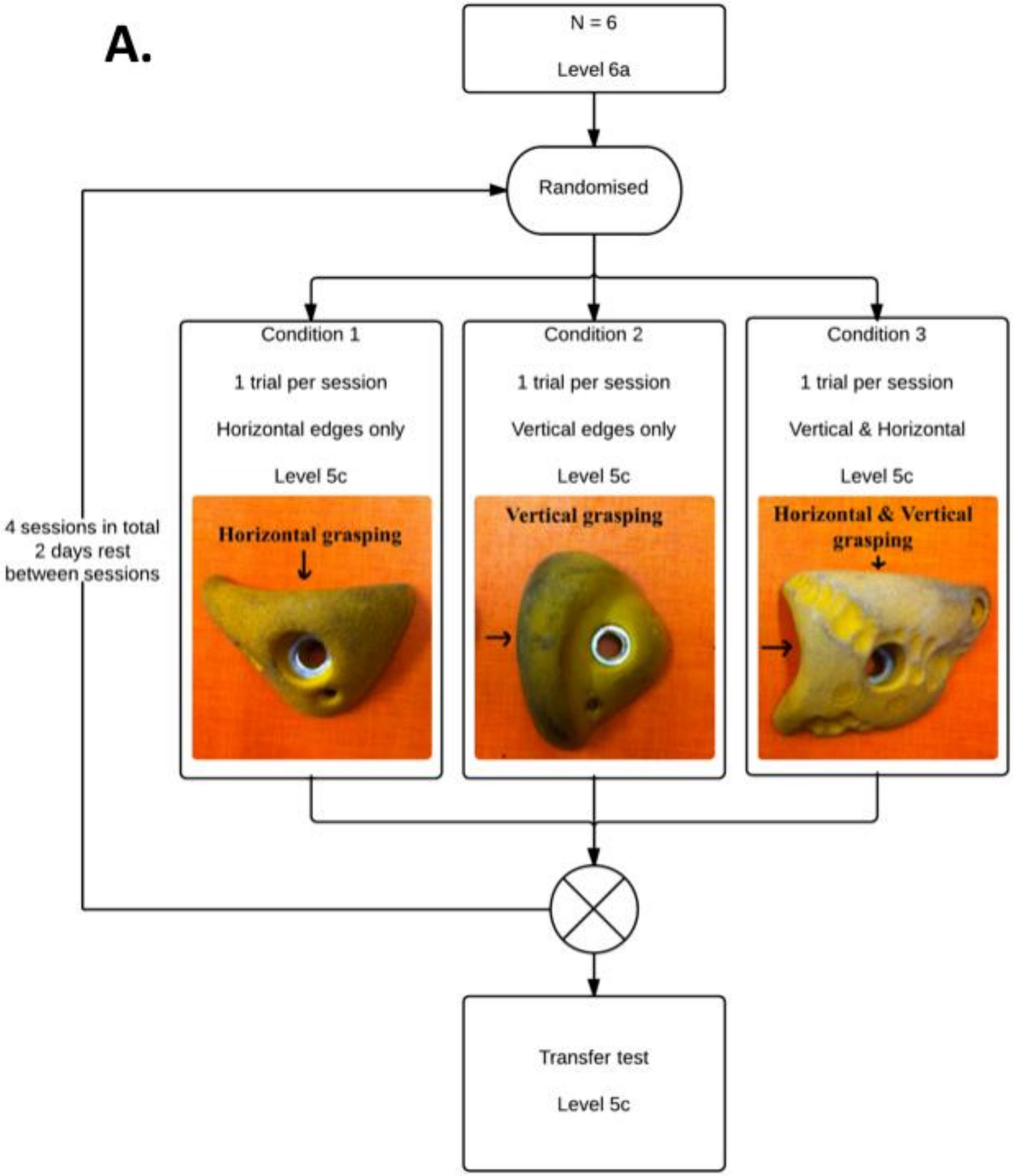
2 Global patterns of climbing can be discriminated

- Face-wall
- Side-wall

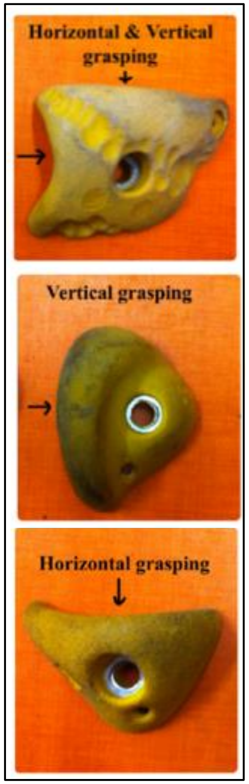
Seifert. (2013)

Design

A.

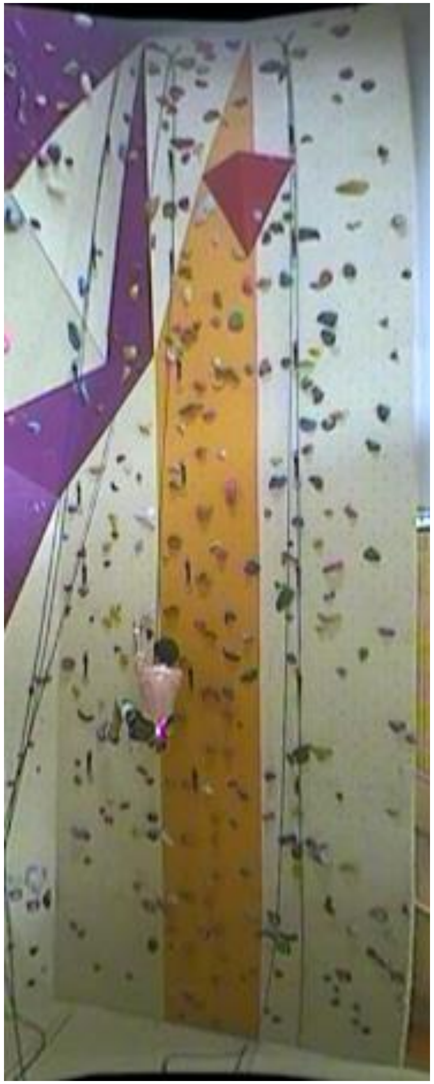


Transfer route



Design

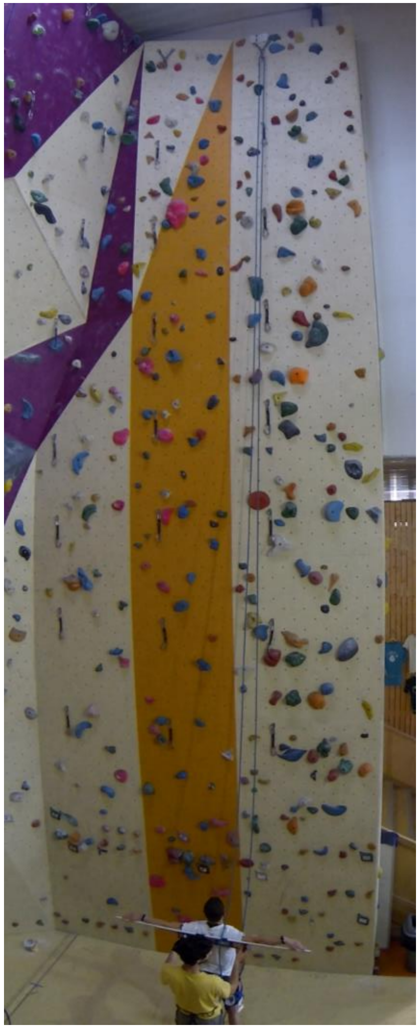
Horizontal	Vertical	Both



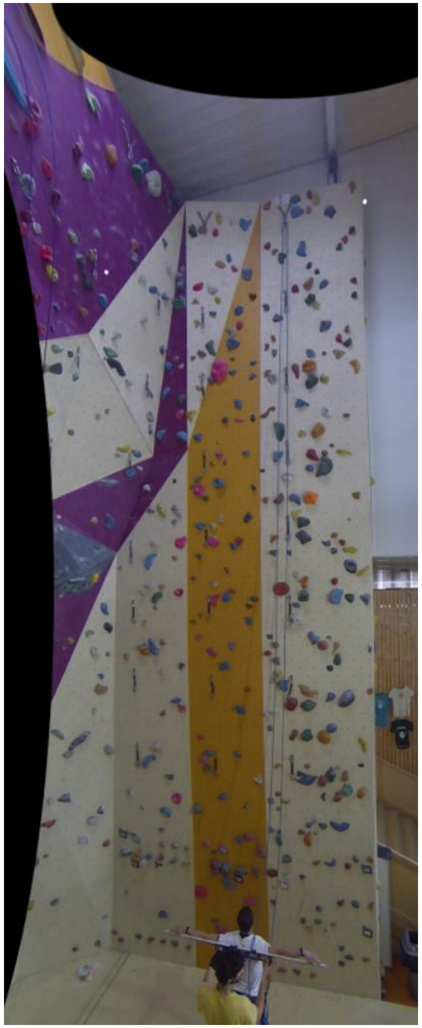
- Set to 5c
- 10.3m heigh
- 20 hand-holds

Apparatus

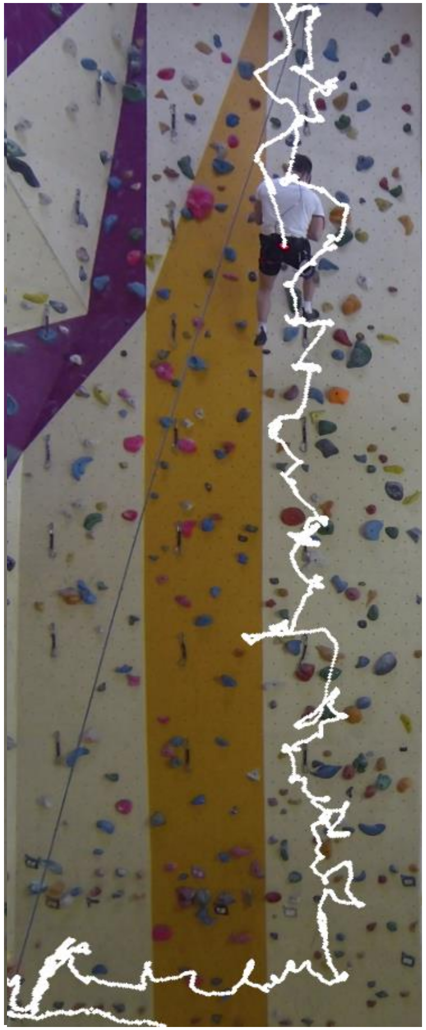
Raw



Distortion

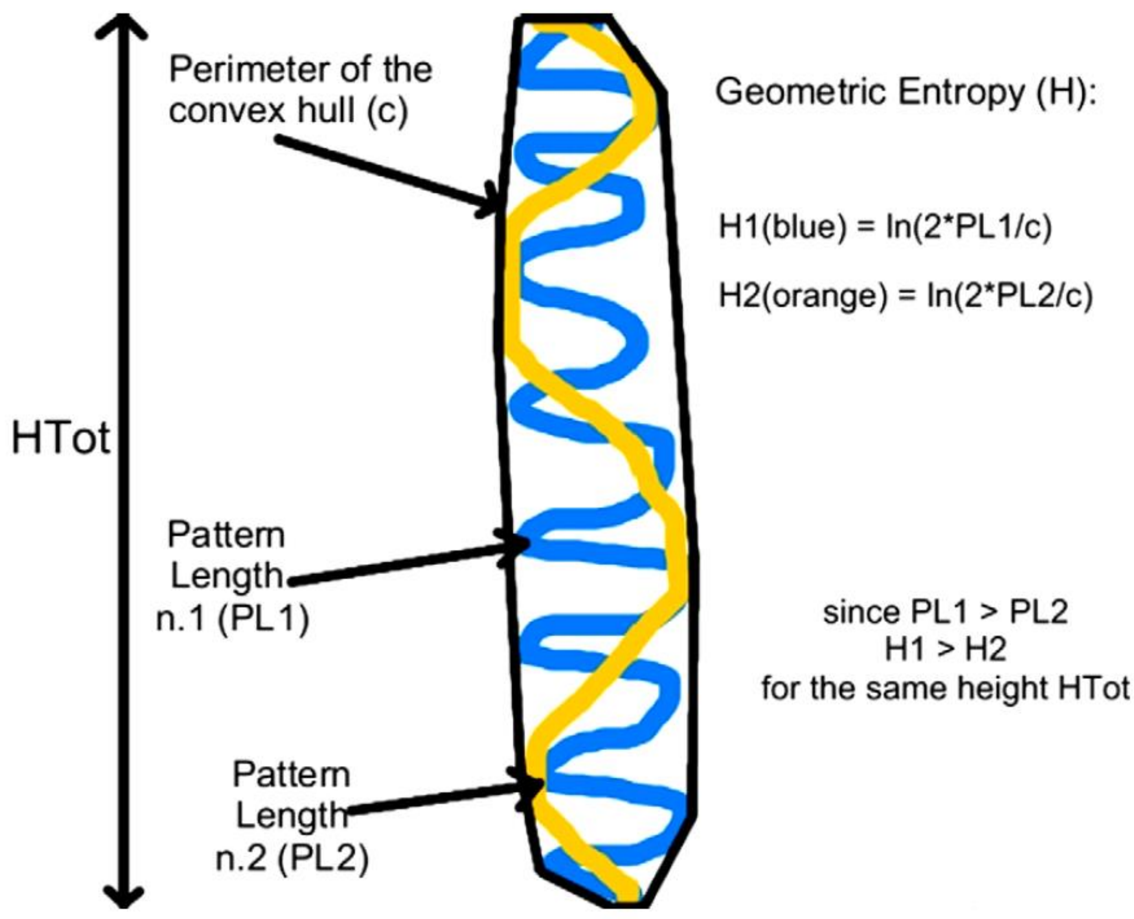


Paralax



SA-tracking

Analysis: Geometric index of entropy



Learning will only be induced in the double edged route

Siefert. (2013)

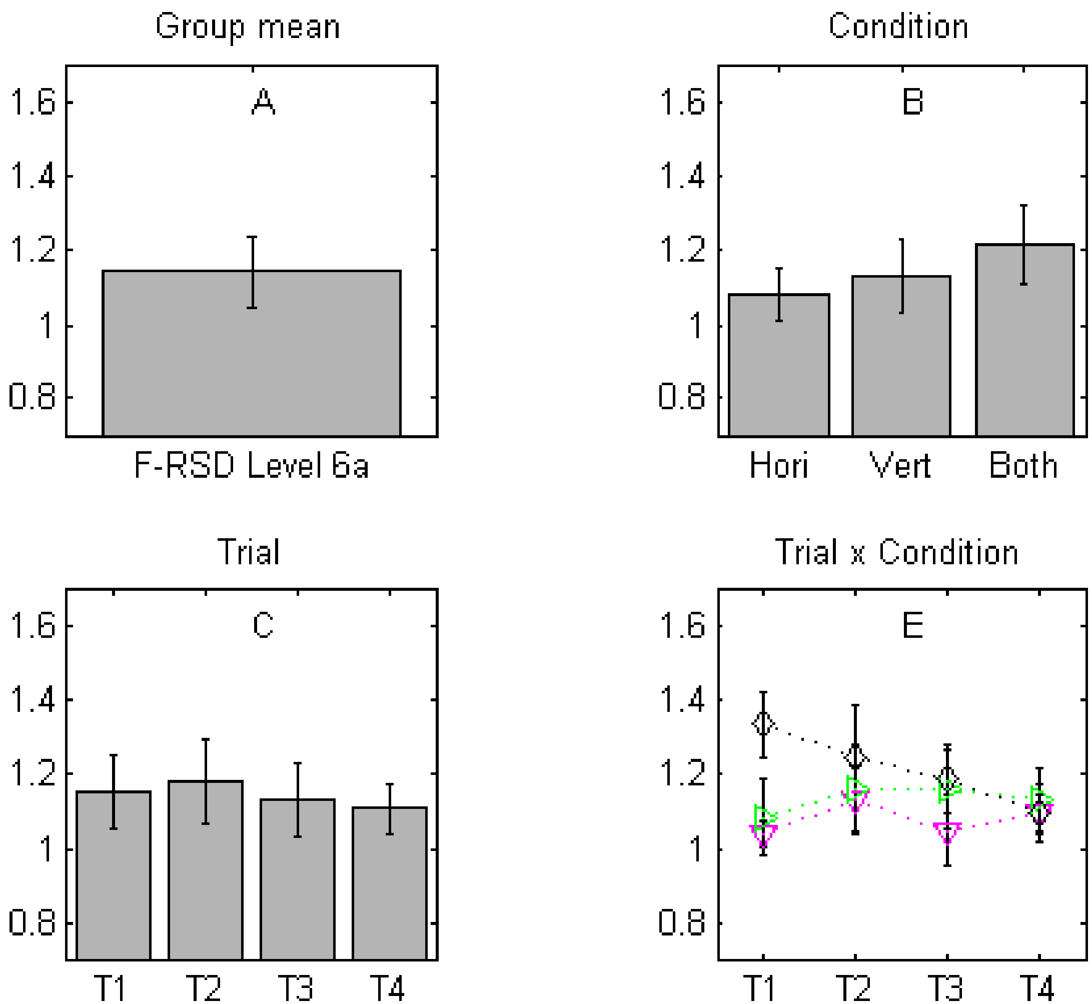
Climbing fluency will transfer to new condition of the same difficulty and hold usability, but with different hold locations

Guadagnoli. (2004)
Schollhorn. (2009)
Chow. (2013)

Sibella. (2007)

Geomtric index of entropy = log2(2Distance/convex hull)

Results: RM-ANOVA

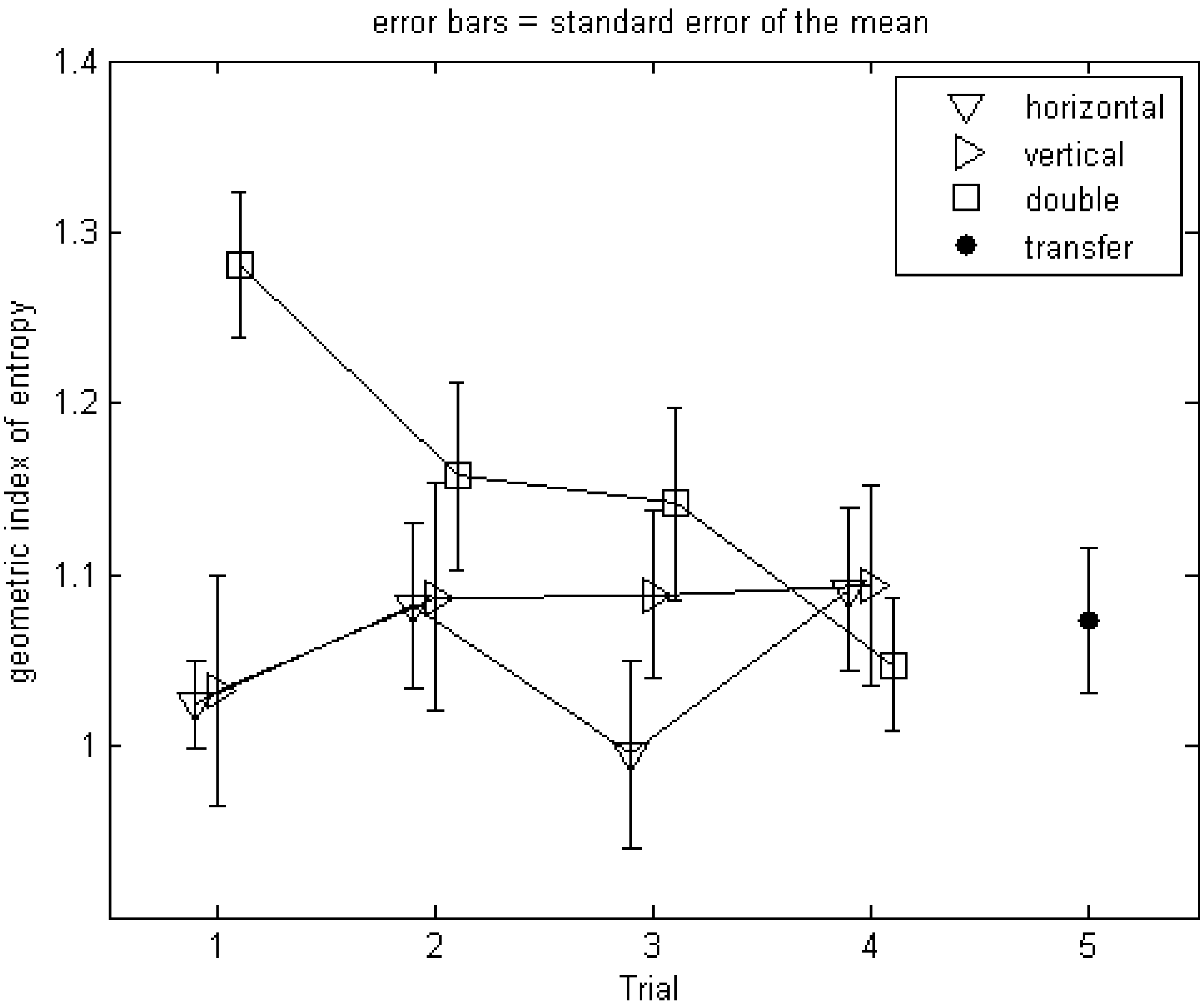


Main effects:

- **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

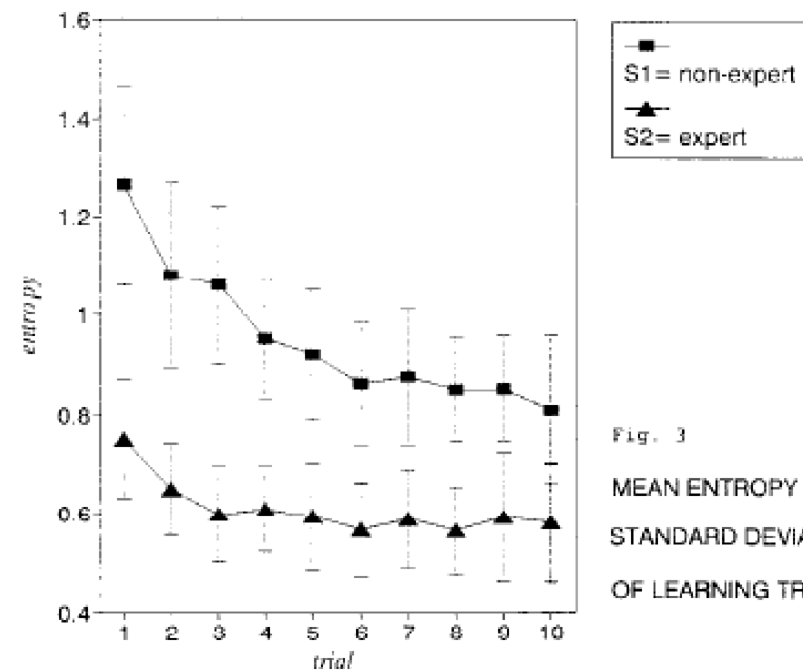
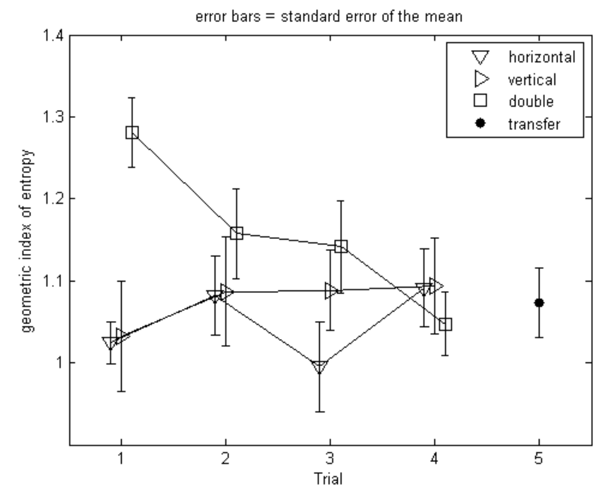


Fig. 3

MEAN ENTROPY AND STANDARD DEVIATION OF LEARNING TRAJECTORIES

Discussion: transfer effect

- The uncertainty represented in the route fascilitated 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 fascilitating transfer

end

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