

ORAL PRESENTATION PROPOSAL – IRCRA 2018 CONGRESS

**QUALITATIVE ANALYSIS OF TWO OF 2017’S GREATEST ASCENTS AND A
PROPOSED CONCEPTUAL MODEL FOR MAXIMUM-DIFFICULTY SPORT
CLIMBING AND ENERGY SYSTEM REQUIREMENTS**

Eric J. Hörst

Founder and president of Training For Climbing, LLC.

Eric.Horst@TrainingForClimbing.com

Keywords: Training for Climbing, Rock Climbing, Climbing Economy, Adam Ondra, Margo Hayes

Length: 20 – 30 minutes, including brief video analysis highlights of climbing routes *Biographie* and *Silence*.

Abstract

Maximum difficulty sport climbing entered a new realm in 2017 with multiple barrier-breaking events, including the first female 9a+/5.15a ascents and the completion of the world’s first 9c/5.15d route. Qualitative analysis of two of these ascents, along with a growing body of peer-reviewed climbing research, support the conceptual model of maximum-difficulty sport climbing as an intermittent near-maximal effort activity. High economy and optimal bioenergetics are obtained via a “climb fast between long rests” strategy that maximizes anaerobic alactic and aerobic power output. Effective training interventions must target development of all three energy systems, with particular emphasis on increasing the more trainable anaerobic alactic and aerobic (climbing-specific VO^2) energy systems.

Introduction

The past year featured several extraordinary and barrier-breaking ascents including multiple female 9a+/5.15a ascents (Margo Hayes, Anak Verhoeven, Angy Eiter) and Adam Ondra's mind-boggling ascent of *Silence*, the world's first 9c/5.15d. While these achievements exemplify indomitable focus and technical perfection reminiscent of an Olympic Gold Medal performance, sport climbing at the highest level also demands expression of both high levels of anaerobic and aerobic power. While many other sports tend to favor either high anaerobic power (e.g. sprinting and gymnastics) or high aerobic power (distance running, swimming, and similar), elite-level sport climbing—as exemplified by ascents such as *Silence*—demands a rare combination of high anaerobic power (dynamic moves and crux boulders), anaerobic capacity (20 to 90 seconds of sustained near-maximal effort), and high aerobic power (climbing-specific VO_2) to drive rapid recovery during brief between-grip “micro rests” and longer mid-route rest positions. Qualitative analysis of Hayes' and Ondra's ascents provide clues as to the necessary success strategy and energy system requirements of maximum-difficulty sport climbs.

Analysis

Video analysis of two of the year's most remarkable ascents—Margo Hayes' first female ascent of *Biographie* (5.15a) and Adam Ondra's first ascent of *Silence* (5.15d)—reveal surprising similarity of climbing pace and strategy despite vast differences in the cliff angle, hold size, and route length. *Biographie* is 30 meters long with a cliff angle of $\sim 120^\circ$ and numerous small-hold crux sequences, whereas *Silence* is 50 meters long, severely overhung ($\sim 150^\circ$) with several long, extreme core-intensive boulder problems on generally better holds (than *Biographie*).

Video Analysis of Margo Hayes' Ascent of Biographie

Analysis of Hayes' ascent of *Biographie* reveals a high-intensity stop-and-go modus operandi reminiscent of intermittent sprint (or intermittent maximum effort) sports such as hockey, football, and mixed martial arts. Hayes climbed through each of the crux sections in less than 55 seconds. Each of these bursts of high-intensity climbing was followed by a much longer period of static recovery at mid-route rest positions.

Biographie has five difficult sections of climbing separated by relatively poor-quality rest positions. Hayes' high-rate climbing gets her through each of the five difficult sections at 45, 38, 28, 42, and 55 seconds, respectively. While climbing, Hayes' finger flexor muscle time under tension on the tiny hand holds was just 1 to 5 seconds per grip with an average rate of new hand hold acquisition of ~ 3.5 seconds. Hayes paused at poor rest positions for just over 1 minute whereas she lingered for more than 3 minutes at the two better static rest postures. In climbing *Biographie* Hayes spent more time, in aggregate, resting than she did climbing.

Video Analysis of Adam Ondra's First Ascent of Silence

Analysis of Ondra's barrier-breaking ascent reveals a remarkably fast redpoint climbing pace. Having rehearsed the route many times over two years of occasional work, Ondra climbs at a startlingly fast pace and with a remarkable lack of errors (only one foot slip and no visible hesitation finding holds). It can be assumed the ascent was made with exceptionally high economy.

Silence is a long route (50 meters), yet in total Ondra spent more time resting than climbing. After 20 meters of 8b+/5.14a introductory climbing to reach a rest position, the first crux is a complex, contorted 12-move V15 boulder problem which Ondra climbed in 50 seconds to reach the next rest position. The second crux is a 20-move (8 hand moves and 12 foot moves) sequence which Ondra climbed in just 25 seconds—a lightning rate of one hand or foot move every 1.25 seconds! After a brief rest, Ondra fired through the third crux, an ultra-steep 30-move (12 hand moves and 18 foot moves) sequence which he completed in an astounding 56 seconds—less than 2 seconds per hand and foot move.

Mid-route rests on *Silence* included a couple of knee bars which allowed for hands-free high-quality recovery, whereas two other poor rest positions Ondra paused at for only a little over 30 seconds each.

Discussion

Biographie and *Silence* present significant differences in technical challenges and route length, yet Hayes and Ondra ascended their respective routes with remarkable similarity in strategy and pace. Both Hayes and Ondra climbed the hardest sections of their respective routes in less than 60 seconds from rest position to rest position—an apparent necessity in order to maintain high enough power output for doing the routes' many near-maximal moves. Both Hayes and Ondra exhibited extremely brief finger flexor time under tension with an average finger grip of just 3 to 4 seconds per hold. Supporting their fast rate of climbing were near technically perfect performances. Neither climber adjusted their finger grips or hesitated during their well-rehearsed crux sequences, and only one time during each ascent did Hayes and Ondra experience even a minor “foot pop”. Both climbers exhibited astonishing accuracy of movement despite an exceptionally fast rate of movement. Ironically, in successfully climbing their respective project routes both Hayes and Ondra spent more time resting than actually climbing!

Given the remarkable similarity in climbing pace and economy, time spent resting, and strategy, I propose a conceptual model of maximum sport climbing as a long-form “intermittent sprint sport” or, perhaps more accurately, an “intermittent near-maximal effort sport”. It is well documented that intermittent sprint activities draw heavily on anaerobic alactic energy production during brief high-intensity efforts, although each successive effort increasingly draw on the anaerobic lactic and aerobic energy systems. Furthermore, brief “micro rests” (~1 second of perfusion) in between successive finger grips and longer periods of recovery (at rest postures) between high-power crux sequences elicit high O^2 kinetics to drive recovery via oxidative phosphorylation. This relatively balanced need of all three energy systems to contribute to ATP production, with particularly high demands on the anaerobic alactic

and aerobic systems, is supported by research showing the respective contributions 42% (aerobic), 36% (alactic) and 22% (lactic) among elite climbers tested in a lab setting (Bertuzzi et al. 2007).

Both Hayes and Ondra were able to pause and breathe deeply for at least 30 seconds at poor recovery positions—theoretically long enough for ~50% of PCr resynthesis—whereas they tended to linger for 3 minutes or more at better rest positions—sufficient for 90+% of PCr recovery and substantial intracellular clearance of H^+ and lactate from muscle. Knowing that fast-phase recovery from peripheral fatigue is primarily an aerobic process, a strong cardio-respiratory system is an asset to accelerate recovery at marginal mid-climb rests and between climbs. Schöffl, et al. (2006) have shown that climbers who perform generalized aerobic training recovered faster between climbs. Locally (finger flexors), high capillarity, mitochondria density, and O^2 kinetics are essential. Fryer, et al. (2015) have shown that elite climbers de- and re-oxygenate the finger flexors faster than non-elite climbers.

Conclusion

Qualitative analysis of recent leading-edge ascents by Margo Hayes and Adam Ondra, along with a growing body of peer-reviewed climbing research, support the conceptual model of maximum-difficulty sport climbing as an intermittent near-maximal effort activity. High economy and optimal bioenergetics are obtained via a “climb fast between long rests” strategy that maximizes anaerobic (alactic) and aerobic power output. Effective training interventions must target development of all three energy systems, with particular emphasis on increasing the anaerobic alactic and aerobic (climbing-specific VO^2) energy systems.

Biography: Eric Hörst is an internationally renowned author, researcher, climbing coach, and accomplished climber of 40 years. Hörst is also one of the world’s most knowledgeable climbing coaches and his eight books (and many foreign translations) have sold more than 360,000 copies worldwide. The third edition of his best-selling *Training for Climbing* was released in 2016. Eric has written hundreds of magazine articles, appeared on numerous TV broadcasts, and his training techniques and photos have appeared in many publications around the world over the last 25 years. He has co-authored one research paper: “*Behavior Analysis and Sport Climbing*”, Journal of Behavioral Health and Medicine, 2010, with Dr. Richard Fleming. Hörst maintains the popular *Training4Climbing.com* site and he broadcasts a monthly climbing science and training podcast available on iTunes and elsewhere (search for “Eric Hörst’s Training for Climbing podcast”).