Language of Technique

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Overview

--- Theory

Part 1: What is “good” technique

Part 2: Factors that influence technique

--- Practical Stuff

Part 3: Assessing technique and providing feedback

Part 4: My personal technique philosophy and checklists

Part 5: Technique tools

Part 6: Time check?

Good Technique

Difference between technique and style?

What do the better/faster skiers do?

Key Factors:

- Stride length
- Stride frequency
- Key joint angles
- Technique selection-strategy
- Purpose/implementation

Talking Technique

What factors influence technique?

- Grade
- Speed
- Strength
- Strategy
- Fatigue
- Effort level
- Snow conditions
- Wax

Scientific Articles

Why review?

Interpreting Science

Scientific articles are great!

...but need to consider the parameters which influence the results that are seen.

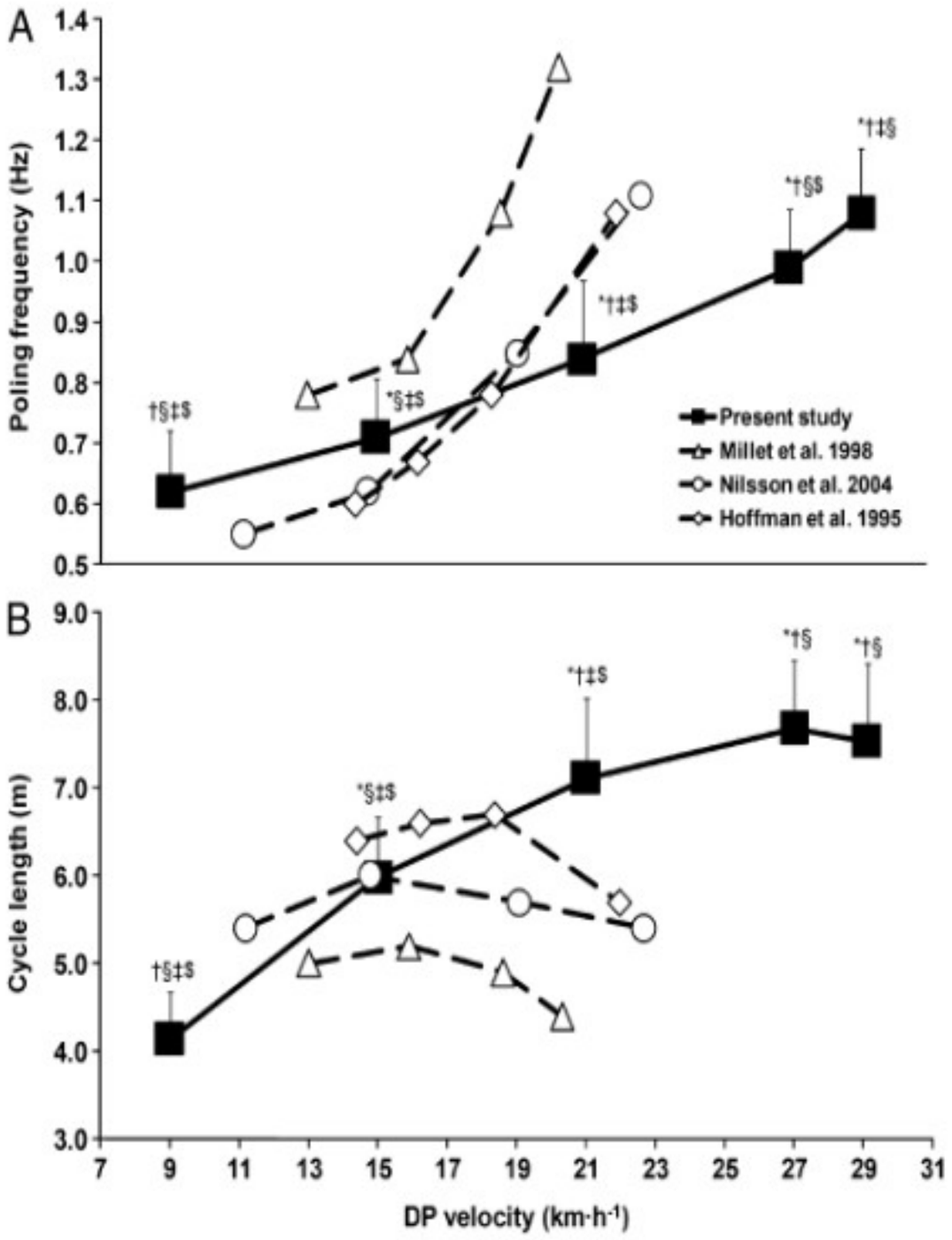
1) Subjects
   - Age/ability/gender of participants

2) What change/adaptation/stimulus/intervention was introduced to elicit a change?
   - Training (strength, endurance)
   - Effort level during testing (75%? Max?)
   - Measurements with fatigue?

3) Methods of measurements – understand how those findings where measured

Personal strength of understanding – classic (it’s more straightforward)

Double Pole - Kinematics

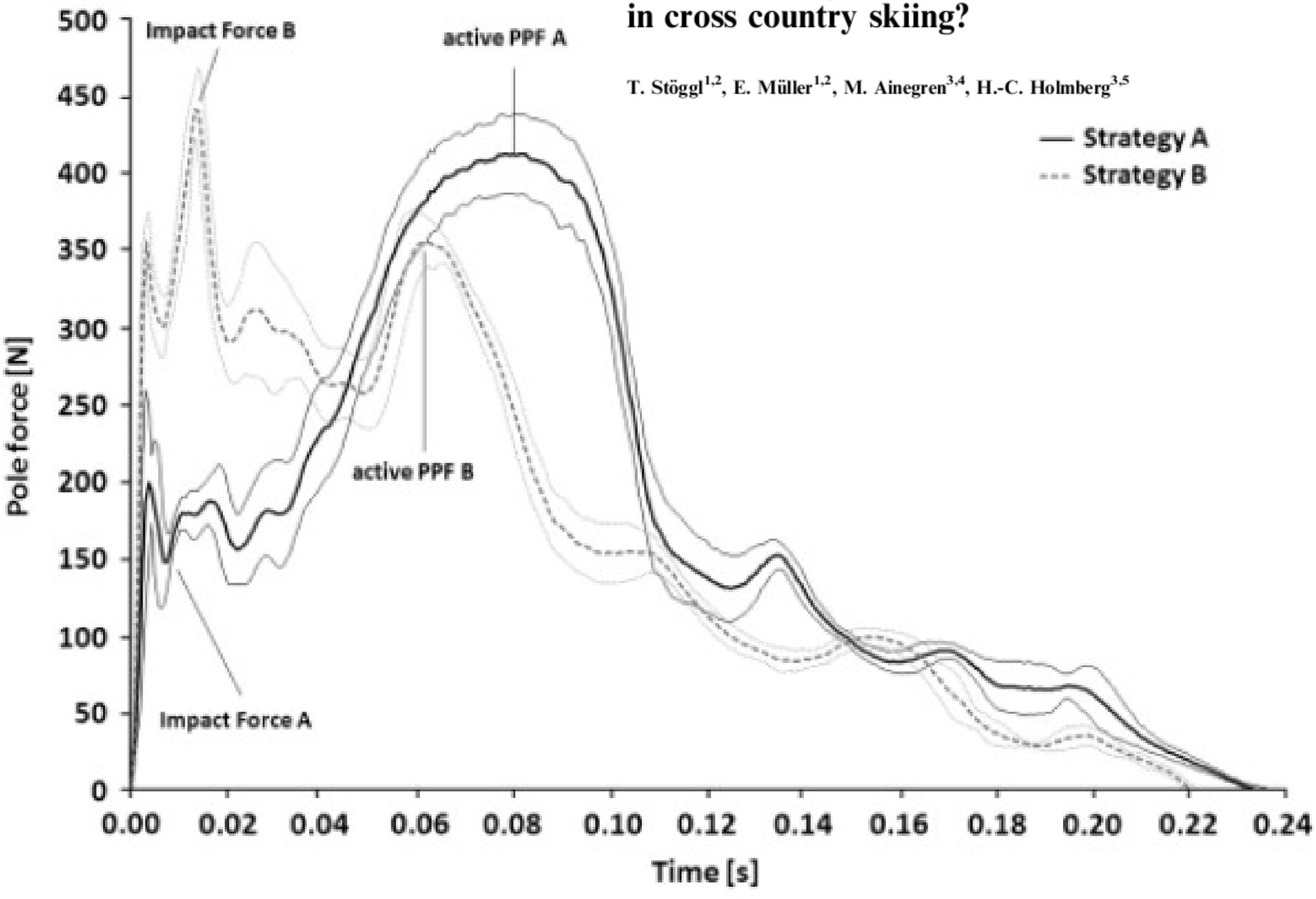


General strength and kinetics: fundamental to sprinting faster in cross country skiing?

T. Stöggl[1,2], E. Müller[1,2], M. Ainegren[3,4], H.-C. Holmberg[3,5]

*Figure 1 - Stride Length and Cycle Length Comparison *: different to 9km·h^{-1}; †: different to 15km·h^{-1} §: different to 21km·h^{-1} ‡: different to 27km·h^{-1} $: different to V_{max} (P<0.05). (Millet et al. 1998; Nilsson et al. 2004; Hoffman et al. 1995; Lindinger et al. 2009c)*

Poling – Force Curve



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— Strategy A
--- Strategy B

Double Pole - Fatigue

Effect of fatigue on double pole kinematics in sprint cross-country skiing

Raphael Zory [a,b,*], Nicolas Vuillerme [a], Barbara Pellegrini [c], Federico Schena [c], Annie Rouard [a]

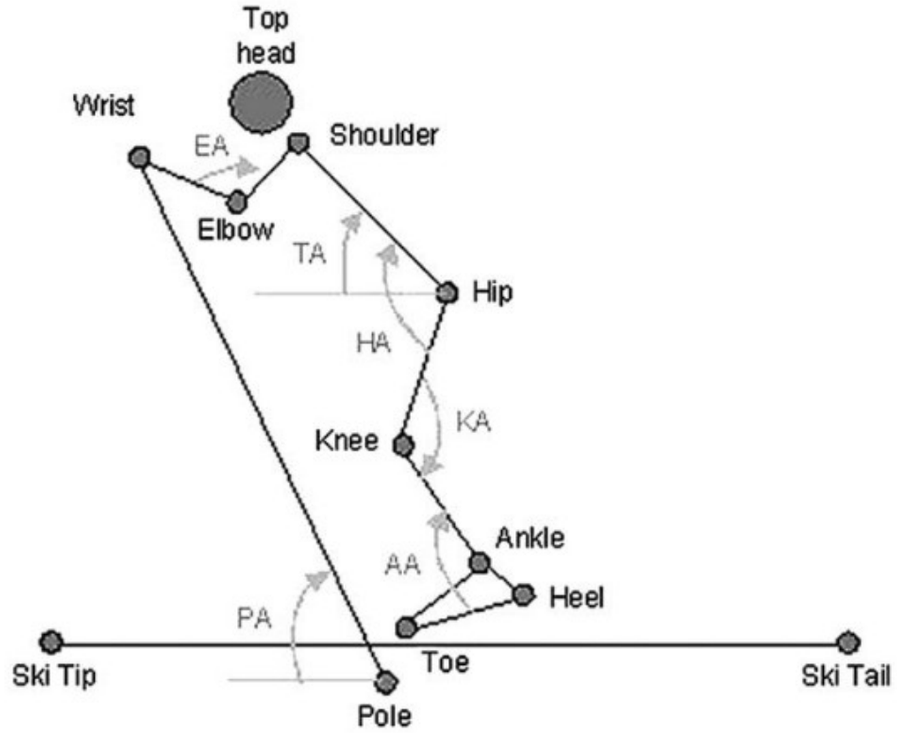
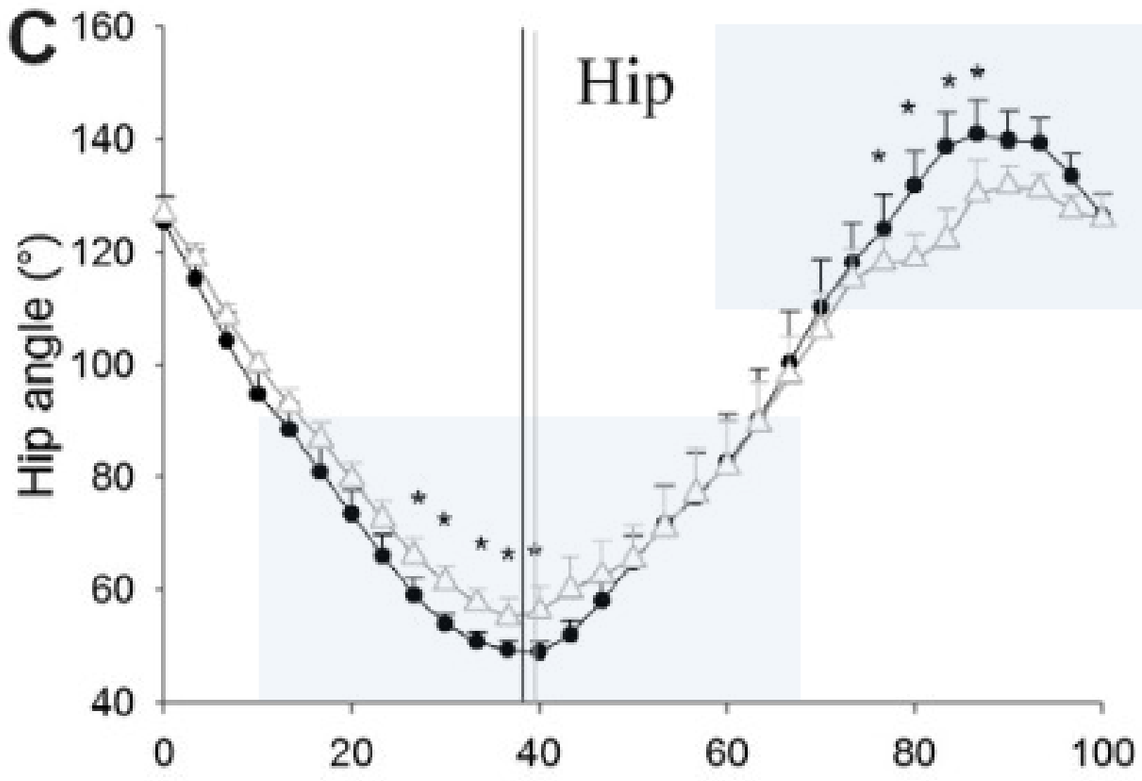
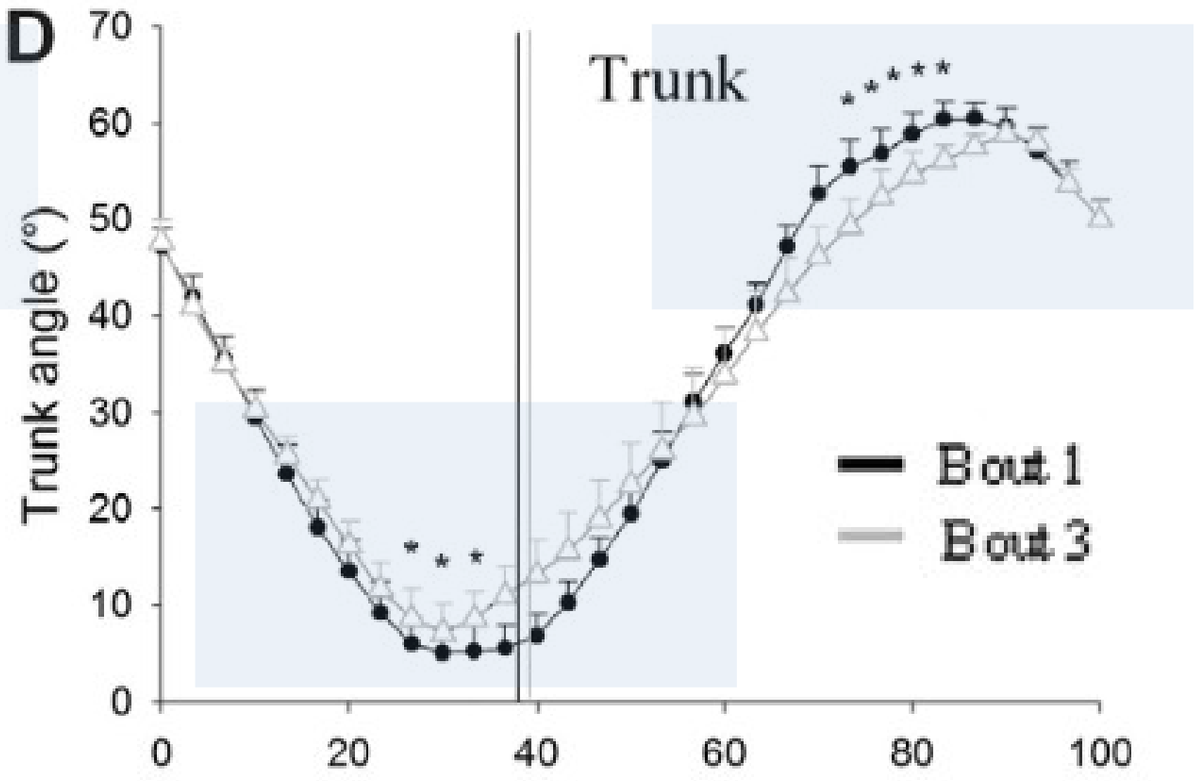


Fig. 2. Digitized points and studied angles for the left sides.

Fig. 4. Mean values and standard error of normalized angles for the (A) ankle, (B) knee, (C) hip, (D) trunk, (E) elbow, and (F) pole (*significant difference $p < .05$). The black and the grey vertical lines represent the end of the propulsion phase respectively at bouts 1 and 3.





Diagonal Stride - Kinematics

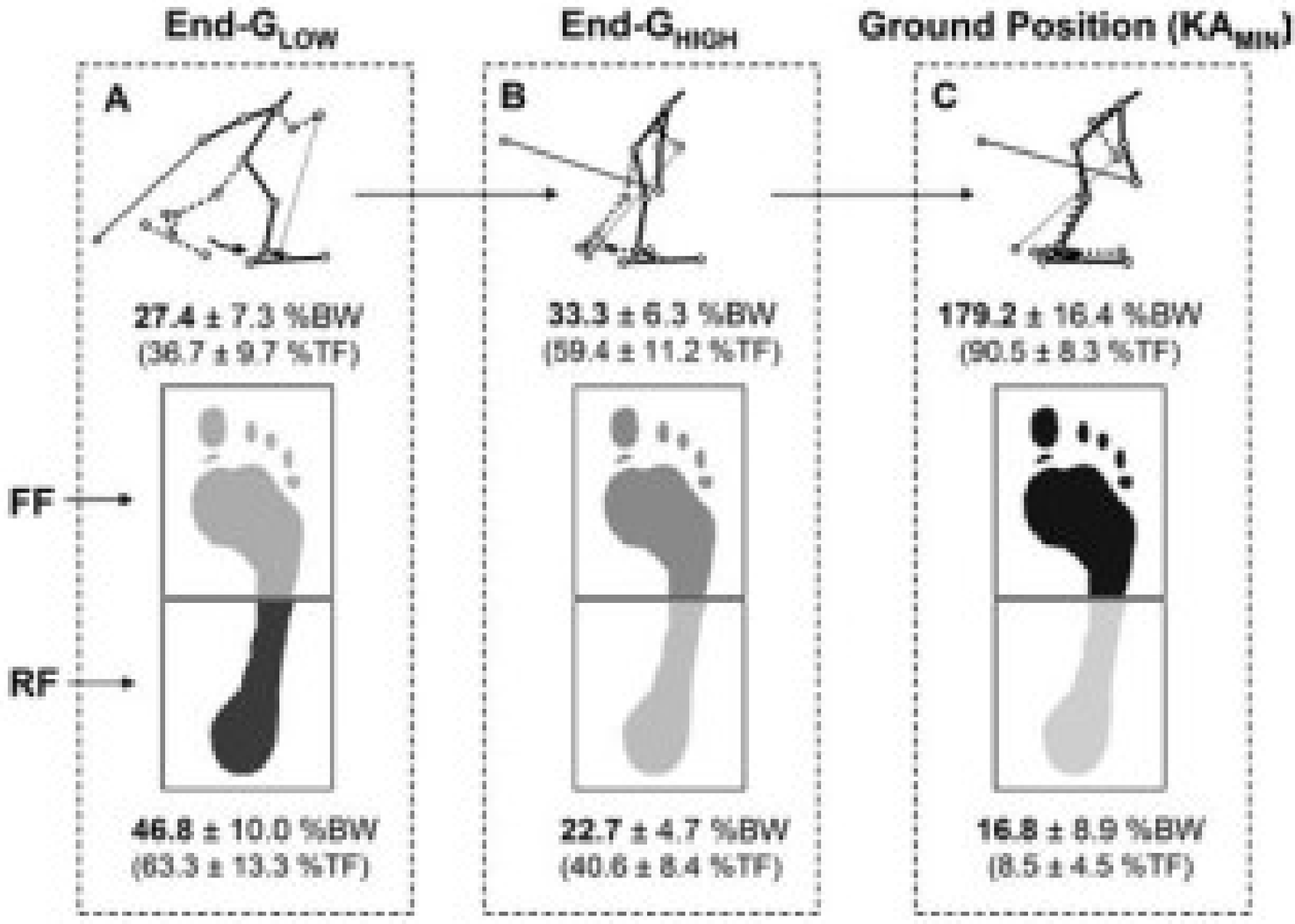


Figure 2. Force distribution between forefoot (FF) and rearfoot (RF) in % of body weight (BW) and % of total force (TF) at the A) end of initial gliding phase (End-G$_{LOW}$), B) end of second gliding phase (End-G$_{HIGH}$) and C) ground position at knee angle minimum (KA$_{MIN}$) during uphill diagonal roller skiing (9°; 11 km/h). The data are mean ± *s*.

1-2 Skate Kinematics – Training Adaptations

- Is this better technique or are the athletes adapting to the relative stress of the test?

Changes in biomechanics of skiing at maximal velocity caused by simulated 20-km skiing race using V2 skating technique

O. Ohtonen[1] | S. J. Lindinger[2] | C. Göpfert[1,2] | W. Rapp[3] | V. Linnamo[1]

Table 1. Performance, physiological measures and the technical parameters including full-cycle timing of phases, range of displacement (ROD) and root-mean-squared (RMS) acceleration in June and January at a fixed demand (6°, 3.5 m · s^{-1}).

	June	January	Magnitude of differences (ES)	
1000-m time (s)	270 ± 14	250 ± 10*	−1.63	Large
O_2-cost (mL/min)	4050 ± 368	3769 ± 388*	−0.75	Moderate
Total mass (kg)	79.8 ± 8.7	78.3 ± 8.0*	−0.18	Trivial
$\dot{V}O_{2peak}$ (mL/min)	5812 ± 531	5776 ± 522	−0.07	Trivial
Cycle time (s)	1.69 ± 0.10	1.80 ± 0.07*	1.39	Large
Poling time (s)	0.70 ± 0.04	0.75 ± 0.04*	1.16	Moderate
Poling time (% of cycle time)	42 ± 2	42 ± 2	−0.01	Trivial
Reposition time (s)	0.98 ± 0.07	1.05 ± 0.06*	1.10	Moderate
Reposition time (% of cycle time)	57 ± 1	57 ± 2	0.07	Trivial
Kick time (s)	0.25 ± 0.03	0.25 ± 0.04	0.05	Trivial
Pure glide time (s)	0.73 ± 0.05	0.80 ± 0.06*	1.24	Large
Poling distance (cm)	122 ± 7	129 ± 8#	0.99	Moderate
Forward pole plant (cm)	18 ± 9	24 ± 8*	0.78	Moderate
ROD sideways (cm)	32 ± 8	40 ± 6*	1.14	Moderate
ROD AP (cm)	15 ± 2	13 ± 2	−0.78	Moderate
ROD vertical (cm)	14 ± 3	14 ± 2	0.15	Trivial
RMS sideways acceleration ($m \cdot s^{-2}$)	2.9 ± 0.3	2.9 ± 0.3	−0.14	Trivial
RMS AP acceleration ($m \cdot s^{-2}$)	3.4 ± 0.5	3.1 ± 0.3*	-0.56	Small
RMS vertical acceleration ($m \cdot s^{-2}$)	3.0 ± 0.3	2.7 ± 0.4*	−0.89	Moderate
RMS resultant acceleration ($m \cdot s^{-2}$)	5.6 ± 0.5	5.2 ± 0.4*	−0.86	Moderate
RMS resultant acceleration pure glide ($m \cdot s^{-2}$)	4.4 ± 0.5	3.9 ± 0.4*	−1.11	Moderate
RMS resultant acceleration poling ($m \cdot s^{-2}$)	6.1 ± 0.8	5.7 ± 0.7	−0.40	Small
RMS resultant acceleration kick ($m \cdot s^{-2}$)	7.1 ± 0.7	7.0 ± 0.7	−0.22	Small

Data are mean ± standard deviation. All technical parameters are from accelerometer analyses except for forward pole plant (relative to ankle position) which was calculated from video analysis. Total mass is body mass + equipment mass. $N = 11$, except for ROD and RMS accelerations where $N = 10$.

ES: effect size.

*Different from June ($P < 0.05$).

#$P = 0.051$.

Strength

Table 3. Summary of significant Pearson's product-moment correlation coefficients between maximal speeds in double poling (DP), diagonal stride (DIA) and V2 skating and variables in the strength tests, and kinetic and kinematic variables at submaximal and maximal speeds ($n = 16$)

	DP	DIA	V2
Strength tests			
Brutal bench (reps)	0.65**	0.51 NS	0.26 NS
Bench press: 1RM (kg)	0.24 NS	0.28 NS	0.57*
Bench press: power at 70 kg (W)	0.66**	0.59*	0.37 NS
Bench pull: 1RM (kg)	0.51 NS	0.61**	0.48 NS
Bench pull: power at 60 kg (W)	0.67**	0.72**	0.43 NS
Bench pull: peak power (W)	0.48 NS	0.71**	0.43 NS
Squat jump: jump height (m)	0.43 NS	0.59*	0.68**
Squat jump: peak force (N)	0.68**	0.55*	0.23 NS
Squat jump: rate of force development (N/s)	0.75**	0.66**	0.27 NS
Biomechanical variables at submaximal speeds			
Cycle rate (Hz)	−0.70**	−0.62**	−0.41 NS
Cycle length (m)	0.73***	0.64**	0.40 NS
Poling time (s)	0.72**	0.38 NS	0.14 NS
Swing time arms (s)	0.70**	0.62**	0.44 NS
Swing and gliding time legs (s)		0.64**	0.54*
Time-to-peak pole force (s)	0.90***	0.72**	0.17 NS
Rate of force development poles (N/s)	−0.02 NS	−0.58*	0.40 NS
Impulse of pole force (Ns)	0.60*	0.08 NS	0.62**
Biomechanical variables at maximal speeds			
Cycle length (m)	0.62**	0.28 NS	0.67**
Poling time (s)	0.01 NS	−0.65**	−0.33 NS
Distance in poling phase (m)	0.69**	−0.20 NS	0.28 NS
Push-off time legs (s)		−0.26 NS	−0.70**
Time-to-peak leg force (s)		−0.30 NS	−0.76***
Rate of force development legs (N/s)		0.55*	0.67**

*$P<0.05$, **$P<0.01$, ***$P<0.001$.

NS, not significant.

Strength

Important Considerations:

- Athletes get stronger – changes ski kinematics

- Some younger athletes CANNOT ski like adults

Tactics/Effort Level

Alex - https://youtu.be/3vQyhpb7-pA

Good Racing Moves:
Alex also one of the king's of smart racing moves.
https://youtu.be/mGYaBkE0uf4?t=6479

Kalla:
https://youtu.be/QjhtNSDOpt8?t=821

Common Limitations

<u>Propulsion time:</u>
As speed increases, the potential time to push decreases = reduced propulsion time

- Human muscle cannot contract fast enough
- Technqiue needs to optimize propulsion vs. efficiency

-> also applies to lower limbs in classic -> propulsion time even more limited

Skating:
- Poling similar limitations to classic, but legs have relatively long push times.

Investigation of role of Stretch Shortening Cycle (SSC)

Changes in upper body muscle activity with increasing double poling velocities in elite cross-country skiing

Stefan Josef Lindinger · Hans-Christer Holmberg · Erich Müller · Walter Rapp

Assessing Technique - Homework

- Important
  - “Be a student of the sport”
- Watching WC Racing
- Evaluating the strengths/weakness and goals of your skiers
- Develop an image of ideal technique
  - General factors: tempo, rhythm, intent etc...
  - Specific factors: timing, joint angles etc...

Practical Stuff

Disclaimer: these are opinions mixed with facts!

These lists of suggestions are not exhaustive – technique is a little bit of art mixed with science

Implementing the Five-A Model of Technical Refinement: Key Roles of the Sport Psychologist

Howie J. Carson & Dave Collins

*para-phrased table

The 5 A's	Purpose	In practice	Notes:
Analysis	Identify athlete requirements and readiness to change	Observation, Video,	Athlete may need convincing of change!!!
Awareness	De-automate the erronous technique	Cues, contrast training etc...	Use of models (live or video), focusing on contrasts
Adjustment	Modify the erronous technique	Leave it to the athlete as much as possible. Changing cues.	Recommend using self video of "best attempt" to re-inforce.
Re-automation	Internilize the change to subconscious control	Coaches keep watching, even after automation - can add more holistic cues	Mental simulation of movement can be helpful
Assurance	Increase confidence and automation during high pressure conditions	Contextualize new skills into competition	Leave appropritate gap until new skills is intorduced.

Implementing the Five-A Model of Technical Refinement: Key Roles of the Sport Psychologist

Howie J. Carson & Dave Collins

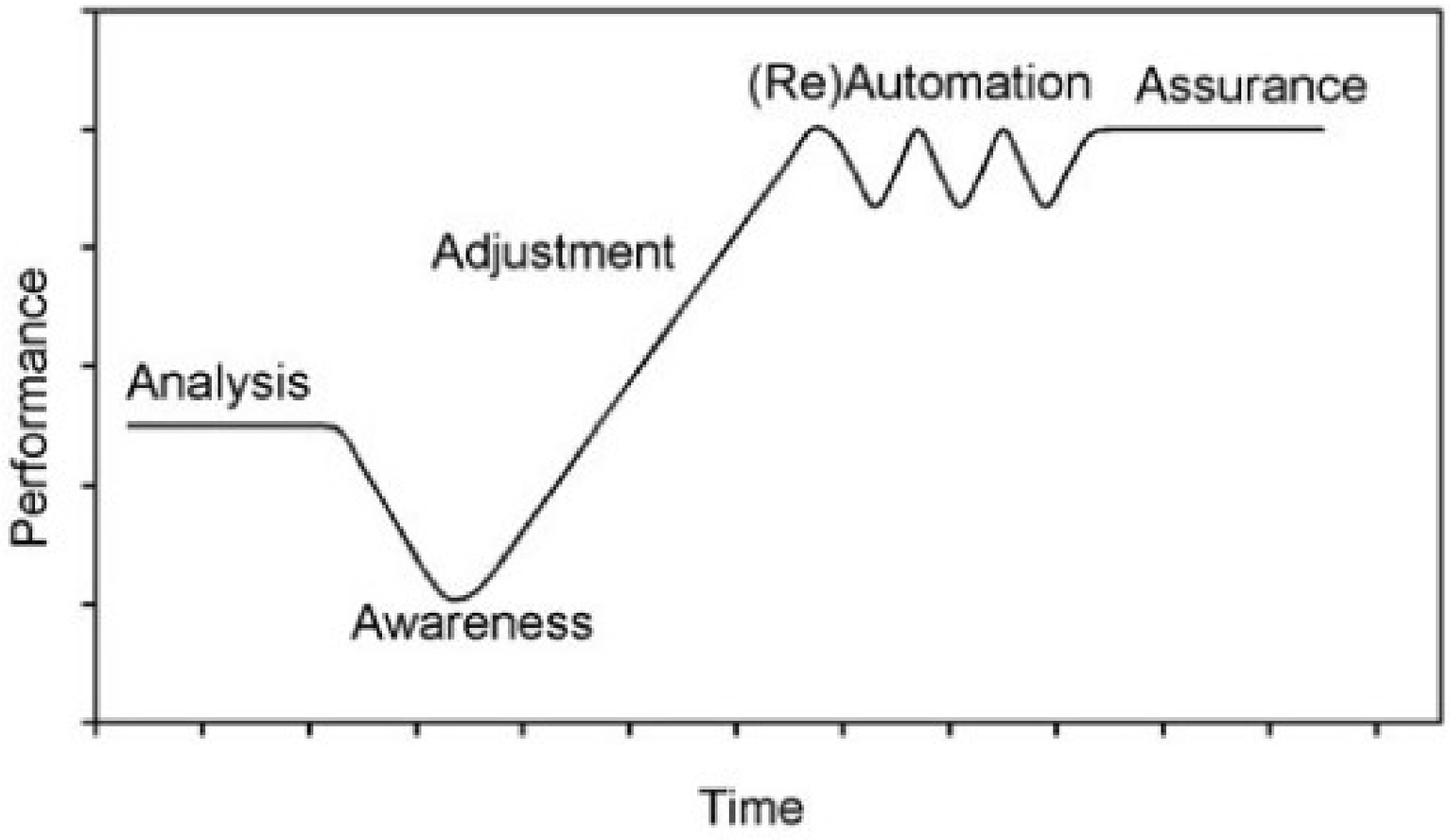


Figure 1. Performance impact of each stage within the Five-A model.

Integrating Science

Important Considerations:

- All athletes interpret feedback differently

- All athletes have a different reference/starting point

- Scientific literature is good background info, but sometimes over-simplified or exagatory instruction may still be necessary to instigate change for the skiers

- Ask them to go for it. Failing is ok (I think...)
https://www.instagram.com/p/BbgKXEeBT0c/

Providing Technique Feedback

Different enviroments to provide feedback:

1) Before the session

2) In-session

3) Post-session

Before Session Technique Work

1) Skiing mechanics awareness test

2) Video Review

From archives of the athlete

“Ideal” from elite athletes

In and Post Session

In-session:

1) “On-the-fly”

2) Group instruction/feedback

3) Video-feedback cycle 1v1, 1v2 etc...

Post Session:

1) Video Analysis

Coach-Athlete Interactions

<u>Depending on situation and athlete:</u>

Cordial Greeting -> how are you or wassup’ g?

Background information – what are you working on?

Opportunity to asses - is the athlete ready for feedback?

Do you have something to offer?

- Good to have something ready or in the back of your mind.

Coach-Athlete Interactions

Interaction Strategies

- Feedback Sandwhich

- Questioning-Answer Feedback (more experienced athletes)

Types of Feedback

- Extrinsic (concrete feedback - “*more bend in the ankles and knees”)*

- Intrinsic (“feeling” movements – “*crush the eggs under your feet”)*

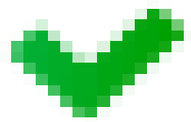
Sometimes giving feedback is hard because there is no goal or point to be scored with good technique.

Technique Check List

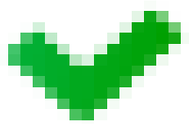
Some practical notes...

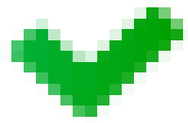
Technique Check List

My philosophy:

1) Range of motion 

2) Delibrate force application 

3) Timing 

4) Frequency and “gear” selection 

= increased force (usable) = power

= faster, easier skiing!

Check List - DP

Range of Motion:

- Athletic stance throughout
- Shoulders must go up and down
- Hips must go forward and backward
- Elbows must move forward-backward

Deliberate Force Application:

- Power applied “through the poles”
- Amplitude of “jump” appropriate to effort -> strength

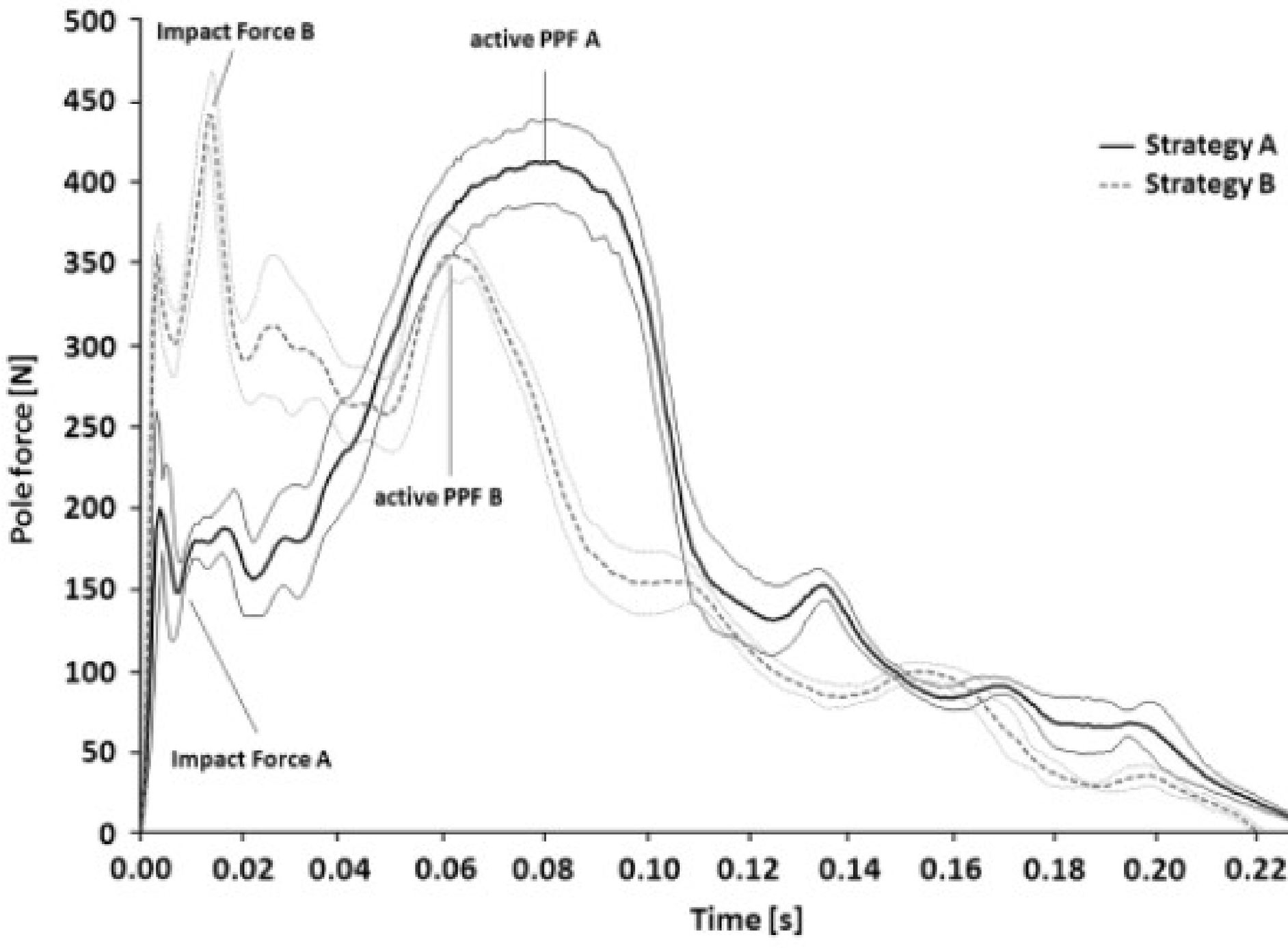
Timing

- Shoulder-Hands-Hips
- Preperation period
- Knee ROM

Frequency/Strategy:

- Mix of frequencies – appropriate to terrain/strengths

Check List - DP



Check List - DP

Sprint – Klaebo.
https://youtu.be/GprwjLmj3q0?t=196

Distance - Klaebo:
https://youtu.be/p2BPQhiJwRw?t=110

Diggins vs. Nilsson in very fatigued state:
https://youtu.be/7srUTw9NNMc?t=105

Older:
https://youtu.be/oPakJr0Vduc?t=47

Check List - DIA-Herringbone

Range of Motion:

–> capacity for changes in glide/recovery phase length

Styles:

1) Basic/normal stride:

- Good length and gliding time
- “Reaching down the track”
- https://www.youtube.com/watch?v=Ba7cicPZxB4

2) Running style -> herringbone:

- Hip position -> heel raise -> stomp
- Sprint:https://youtu.be/nmaumELGL0Y?t=110
- Distance with herringhone:
- https://youtu.be/p2BPQhiIwRw?t=56

Check List - DIA-Herringbone

Force Application Principles:

- Good pre-load-release –> compression and snap
- Weight transfer during push
  = being on one foot at a time -> better grip!

Timing:

- Hip position at kick/stomp

Frequency/strategy:

- Always adjusting!
- Inclusion of glide phase – don’t just Klaebo!
- Special note: strategy -> running vs. gliding at max speed/effort

Check List - One-Skate

Notes:

- 3D nature of skating more difficult to pin-point problems/fixes

Check List - One-Skate

Range of Motion:

- Athletic stance
- Very similar to DP ROM, just slightly reduced
- Hands - appropriate amount back

Deliberate Force Application:

- Very similar to DP for upper body
- Push to the side from the toes
- Pre-load, compression snap

Check List - One-Skate

Timing:

- Pole plant/kick at same time
- Similar to DP timing (upper body)

Frequency/strategy:

- Usage of substyles
  - Distance
  - Hop
  - Double push

Check List – Two-Skate

Range of Motion:
- Bigger, more amplitude than one-skate
- Longer preperation phase
- Upper body motion adding good momentum

Deliberate Force Application:
- Good leg pushes
    - higher speed, legs become more effective

Timing
- Hands-shoulders-hips

Frequency/Strategy:
- Usage

Video:
https://youtu.be/-s4dKipUY4w
https://youtu.be/fnjpLIpajKA?t=129

Check List – Offset

Range of Motion:

- More compact technique
- Steadiness in hips, avoid “roll-out”
- Minimal-moderate upper body movement to follow legs

Deliberate Force Application:

- Similar size and length of pushes left to right legs
- Different styles have different timing for kick
  - Gliding step
  - Stutter hop step
  - Hop step

  https://youtu.be/3xWdRSdSLt0?t=152
  - Super Sprint step (for 100m sprint!)

  https://youtu.be/xXdycaiZtEI?t=90

Check List – Offset

Frequency/Strategy:

- Centre of Mass Position (conceptually)
  - https://youtu.be/aT9n31M_Z0o?t=232
- Gliding skis vs. hopping skis
  - https://youtu.be/AO7XnwQNnzE?t=575

Timing:

- Nothing too special to add
- Poles more syncronized at higher speeds

Three-dimensional Force and Kinematic Interactions in V1 Skating at High Speeds

THOMAS STÖGGL[1,2] and HANS-CHRISTER HOLMBERG[2,3]

Technique Tools

- Youtube
- XC Ski Nation
- Cross Country Skiing Technique App (Bundesampt for Sport BASPO)
- Dartfish, HUDL etc...
- Research articles (some are open access)
- many more...