swiss olympic
spirit of sport

Swiss Olympic Science Award 2026

Book of posters

Vorwort

Swiss Olympic engagiert sich seit vielen Jahren für die Förderung der angewandten Sportwissenschaft im Schweizer Nachwuchs- und Leistungssport. Neben den Sportverbänden investieren zahlreiche Hochschulen, Institutionen und Fachpersonen finanzielle und personelle Ressourcen in die Entwicklung wissenschaftlicher Erkenntnisse, die den Athlet*innen, Trainer*innen und Verbänden direkt zugutekommen.

Mit dem Swiss Olympic Science Award (SOSA) will Swiss Olympic diesen Verbänden, Organisationen und Personen eine Plattform bieten und ihre Arbeit sowie ihre Projekte sichtbar machen. Die Veranstaltung fördert den Austausch zwischen Sportwissenschaftler*innen und Trainer*innen sowie den Wissenstransfer. Der Swiss Olympic Science Award 2026 wird anlässlich der Magglinger Trainertagung (MTT) verliehen.

Für diese Ausgabe wurden 30 Projekte mit Bezug zum Schweizer Spitzen- und Nachwuchsleistungssport eingereicht. Eine Jury aus wissenschaftlichen Mitarbeiter*innen von Swiss Olympic hat alle Poster nach ihrem wissenschaftlichen Charakter und ihrer praktischen Relevanz für Trainer*innen bewertet und 10 Finalist*innen ausgewählt. Die zehn Finalposter werden den Trainer*innen während der MTT vorgestellt und zur Abstimmung gebracht.

Die Finaljury, bestehend aus der Leiterin Sportwissenschaften von Swiss Olympic, einem Vertreter der Trainerbildung Schweiz und einem Vorstandsmitglied der Schweizerischen Gesellschaft für Sportwissenschaft, beurteilt die wissenschaftliche Qualität und die praktische Relevanz der Finalposter. Die Rangliste der Trainerabstimmung und jene der Finaljury zählen je 50 % für die Schlussrangliste; bei Gleichstand hat die Trainerrangliste Vorrang. Die ersten drei Projekte erhalten einen «Swiss Olympic Science Award».

Wir freuen uns besonders, mit diesem Book of Posters auch die 19 Projekte sichtbar zu machen, die nicht für das Finale ausgewählt wurden. Auch sie haben aus unserer Sicht in den vergangenen zwei Jahren einen wertvollen Beitrag zum Schweizer Nachwuchs- und Leistungssport geleistet. Wir hoffen, dass ihre Erkenntnisse und Ansätze die Praxis auch in den kommenden Jahren bereichern. Das Book of Posters wird auf der Webseite von Swiss Olympic veröffentlicht.

Wir danken allen beteiligten Wissenschaftler*innen und Institutionen für ihr Engagement im Schweizer Nachwuchs- und Leistungssport und ihre wertvollen Beiträge zu dieser Ausgabe.

Ittigen, im Oktober 2026

Swiss Olympic

Sarah Geboltsberger
Leiterin Sportwissenschaft

Lionel Castella
Verantwortlicher «Swiss Olympic Science Award»

1

Club Alpin Suisse CAS
Club Alpino Svizzero
Schweizer Alpen-Club
Club Alpin Svizzer

Performance determinants in Ski mountaineering sprint: data from the pre-2026 Olympic test event

Unil.

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Keywords: Ski Mountaineering, Sprint, Uphill, Transitions, Olympic Games.

Introduction

The Ski Mountaineering (SkiMo) sprint is a new winter Olympic discipline consisting of all-out effort with ski skins and poles of ≈2.5–3 min, raced in knock-out heats on a snow-covered terrain.

The course includes two uphill skiing sections (U1 and U3) separated by a very steep foot section (U2) and followed by a downhill skiing section to the finish (D) (Figure 1). Transitions (T) occur between sections to switch locomotion modes: the first (T1) involves placing the skis on the backpack to start the foot section, the second (T2) consists of putting the skis back on for the second uphill skiing section, and the third (T3) involves removing the skins and switching from an uphill to a downhill skiing setup.

At the international level, it has been shown that the U section plays a major role in explaining performance, with T being a secondary determinant, while downhill contributes only marginally (1). The aim of this study was to complete this knowledge by answering the following question:

What are the contributions of each race section to sprint time across different performance-level groups of international SkiMo athletes?

Figure 1: Sprint course and selected sections from the 2025 Milan-Cortina Olympic test event, identical to the course used at the 2026 winter Olympic games.

Methods

Milan-Cortina Olympic sprint Test Event 2025 (OSTE), part of the International Ski Mountaineering Federation (ISMF) WC, was analyzed. Total sprint time (SPT) and time spent in seven predefined race sections were quantified during the quarterfinals (QF). (Figure 1).

The first 36 men athletes according to the official time-trial qualification of OSTE were initially included (Figure 2). The top 18 athletes were assigned to the QF A and the next 18 to the QF B. To minimize potential motivational bias, only athletes who qualified for semi final (SF) in each QF were retained for analysis. Consequently, the final sample consisted of 24 athletes (12 from the QF A and 12 from the QF B).

(1) An independent Student's t-test was used to analyze differences between QF A and QF B across the different sections when the assumptions of normality were met; otherwise, the Mann-Whitney U test was used.
(2) The contribution of each race section to SPT variability was quantified as the covariance between section time and SPT relative to SPT variance, expressed as a percentage. Analyses were conducted separately for QF A, QF B. The temporal contribution of each section to SPT was also expressed as a percentage of total SPT (mean ± SD).
(3) Associations between race sections and SPT were assessed using Pearson's or Spearman's correlations, depending on the data distribution, with Bonferroni correction for multiple comparisons.

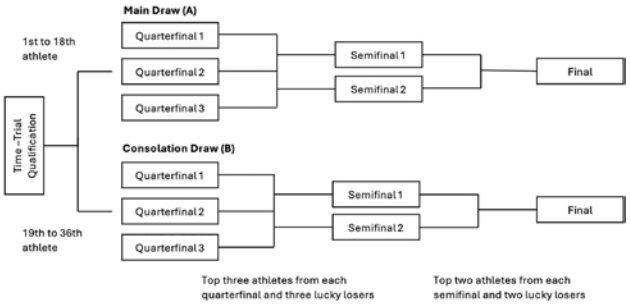

Figure 2: Milan-Cortina test event 2025 competition format.

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Results

(1) U, representing 60.1 ± 1.4% of SPT, is the only section that is statistically different between QF A and QF B. Transition (representing 18.9 ± 1.1% of SPT) and downhill (representing 20.5 ± 0.9% of SPT) are not significantly different between groups.

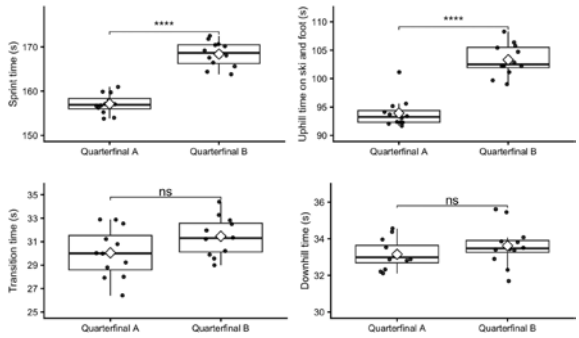

Figure 3: Box plot showing athlete variability by section and quarterfinal in 24 elite male ski mountaineering athletes who subsequently qualify for the semifinal. Total sprint time. Uphill time on ski and foot. Transition time. Downhill time. **** $P < 0.0001$, ns: not significant.

(2) T, representing less than a fifth of race time (19.1 ± 1.2%), explains almost half (46.8%) of the sprint time variability in QF A, among the world's best sprinters. It is 28 percentage points higher than in QF B.

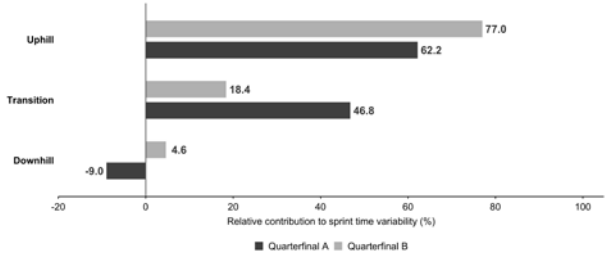

Figure 4: Relative contribution of race sections to sprint time variability during the quarterfinals in 24 elite male ski mountaineering athletes who subsequently qualify for the semi-final.

(3) U1 and T1 are associated with SPT while the other sections of the race were not.

Table 1: Time spent in the seven track sections during the quarterfinal and its correlation with SPT in 24 elite male ski mountaineering athletes who subsequently qualify for the semi-final.

Terrain	Track section	Technique	Time in section (s)	Correlation between section time and SPT
Uphill	U1	SU	76.51 ± 4.78	0.91****
	U2	FA	12.96 ± 0.85	0.48
	U3	SU	9.14 ± 0.78	0.44
	Total		98.62 ± 6.29	0.89****
Transition	T1	M1	9.21 ± 0.72	0.62*
	T2	M2	8.67 ± 0.79	0.13
	T3	M3	12.87 ± 1.23	0.33
	Total		30.75 ± 1.97	0.48
Downhill	D	DW	33.39 ± 0.98	0.22

U : Section involving uphill displacement; T : Section involving technical manipulation; SU : Skiing uphill movement; FA : Foot ascent with skis on the backpack; DW : Descent while skiing; M1 : putting the skis on the backpack; M2 : putting the skis on; M3 : taking skins off; SPT : Total sprint time in the quarterfinals. *$P < 0.05$, **$P < 0.01$, *** $P < 0.001$, **** $P < 0.0001$

Conclusion: So What?

(1) High importance of uphill time to explain ski mountaineering sprint performance

Uphill performance remains the entry ticket: Sprinters should develop their uphill performance to perform better in sprint formats.

(2) Transition time contributed more to sprint performance among the world's top ski mountaineering sprinters

Among the world's best, fast and error-free transitions are an important distinguishing factor. Sprinters should consider transitions as an integral part of training.

(3) Major performance differences appear to be established early in the race

Athletes who perform best in the early section of the race tend to achieve superior overall performance. It highlights the importance of this part of the race.

2

SFISM
Swiss Federal Institute of Sport Magglingen

«Spotting Future Champions» Verbesserte Erkennung zukünftiger Weltcup-Top-30-Athlet:innen im Ski Alpin

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Ski Alpin · Talentidentifikation · Nachwuchsselektion · Machine Learning (LSTM) · FIS- und KWO-Resultate · Weltcup

Einleitung

Kaderplätze im Leistungssport sind limitiert, eine Selektion ist deshalb unumgänglich. Ziel ist, jene Athlet:innen zu erkennen, die in ihrem Höchstleistungsalter an internationalen Wettkämpfen Podestplätze erreichen können[1]. Heutige Selektionsrichtlinien stützen sich meist auf die aktuellen Wettkampfresultate. Für die Vorhersage künftiger Leistungen sind diese jedoch nur beschränkt geeignet. Einzelne Rennen streuen beträchtlich[2], Reifungs- und Trainingsunterschiede verzerren die Prognose besonders bei Jungen[3], und frühe Wettkampferfolge sagen spätere Elite-Leistungen nur begrenzt voraus[1]. Die gesamte Resultat-Historie einer Athlet:in, kombiniert mit dem Wissen aus tausenden früheren Karriereverläufen, soll die Erkennung späterer Top-Athlet:innen verbessern.

Fragestellung

(1) Wählt ein Sequenzmodell Long Short-Term Memory (LSTM) [4] mit der gesamten Resultat-Historie spätere Weltcup-Top-30-Athlet:innen treffsicherer aus als die aktuelle, resultat-basierte Auswahl, und ab welchem Alter?
(2) Was leisten aktuelle Wettkampfresultate im Alter von 13-15 Jahren?

Methode

Datengrundlage: 2.21 Mio. Ski-Alpin-Einzelrennresultate von 70'529 Athlet:innen aus über 120 Nationen (FIS 1995–2026 + Nachwuchsrennen KWO 2005–2026) in Slalom, Riesenslalom, Super-G und Abfahrt, ausgewertet auf 31'163 abgeschlossenen Karrieren (Jahrgänge ≤ 1998).

Studiendesign: Retrospektive Beobachtungsstudie. Ein LSTM pro Geschlecht liest die Resultat-Historie chronologisch und lernt aus erfolgreichen wie nicht erfolgreichen Karrieren, welche Verlaufsmuster mit späterem WC-Erfolg einhergehen und welche nicht. Ausgabe: kalibrierte Wahrscheinlichkeit für mindestens ein späteres WC-Top-30-, Top-10- oder Top-3-Resultat (Abb. 1). Vergleich gegen Zufalls- und resultat-basierte Auswahl bei identischer Listengrösse.

Datenanalyse: Alle Kennzahlen aus Prognosen für Athlet:innen, die das Modell im Training nie gesehen hat (out-of-fold, 5-fache Kreuzvalidierung pro Athlet:in). Vergleiche mit exaktem Binomialtest und Odds Ratio (95%-CI), XGBoost[5] als Vergleichsmodell.

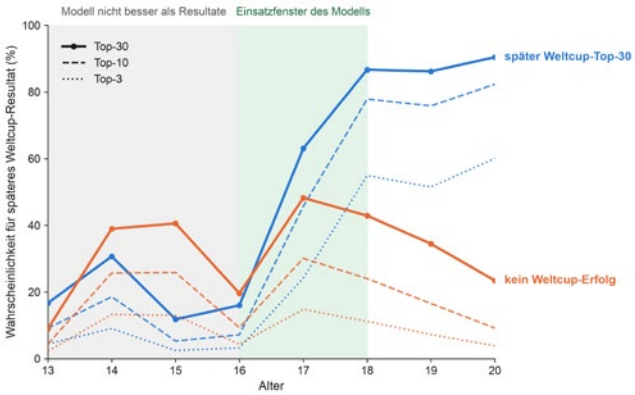

Abbildung 1. Kalibrierte Erfolgswahrscheinlichkeiten zweier echter Athletinnen (anonymisiert) je Alter. Grau: unter 16 ist das Modell nicht besser als die aktuellen Resultate, grün: Einsatzfenster (16-18). Linienstil = Ziel-Level. Wahrscheinlichkeiten ab Alter ~16/17 kalibriert, darunter Orientierung.

Resultate

(1) 16–18 Jahre: Das LSTM erkennt spätere Weltcup-Top-30-Athlet:innen besser als die rein resultat-basierte Auswahl. Signifikant bei Männern ab Alter 16 ($p \leq .003$) und bei Frauen ab Alter 18 ($p = .013$, Abb. 2).
(2) 13-15 Jahre: Bei den Männern rankt die Resultate-Regel signifikant besser ($p = .007$; grauer Bereich in Abb. 1) als das Modell. Die aktuellen Resultate allein erkennen spätere WC-Top-30 drei Mal besser als Zufall (AUC .75–.83).

Abbildung 2. Von 100 Auswahl-Plätzen sind später richtig besetzt (normalisiert). Auswahl mit Alter 18, gleich viele Plätze wie spätere Weltcup-Top-30. Männer: 226 statt 189 von N = 480 (p < .001). Frauen: 262 statt 236 von N = 442 (p = .013). Zufall im Erwartungswert 19 bzw. 24. Internationaler Pool, out-of-fold.

Limitationen

- Nur Wettkampfdaten ohne Training, Physis, Psyche, Verletzungen, Reifestatus[3]. Einzelfälle bleiben unvorhersehbar. Spätere WC-Top-Athlet:innen können dem Modell entgehen.
- Selektions-Bias: Wer nicht mehr gut ist oder aufhört, verschwindet aus den Daten. Wer gefördert wird, hat bessere Chancen.
- Retrospektive Studie, nicht kausal.
- Nachwuchsdaten (KWO) nur für die Schweiz. Internationale Junior:innen werden erst ab FIS-Einstieg sichtbar.

Schlussfolgerung

(1) Im Übergangsfenster 16-18 Jahre, wo real selektioniert wird, hat das LSTM aus denselben Daten die bessere Trefferquote als die rein resultat-basierte Auswahl.

(2) Harte Früh-Selektion lässt sich mit Daten nicht begründen. Selbst ein gutes Ranking sagt den Einzelfall nicht sicher voraus. Im Altersbereich von 13-15 Jahren sollte deshalb so wenig wie möglich aufgrund reiner Wettkampfresultaten selektioniert werden.

Das Modell kann als ergänzendes Werkzeug zur Kaderselektionen angewendet werden. Es kann Athlet:innen nicht ganzheitlich erfassen und bewerten. Faktoren wie Umfeld, Motivation, Gesundheit und Verletzungen bleiben dem Modell verborgen. Die Prädiktion zukünftiger WC-Top-Athlet:innen bleibt begrenzt vorhersehbar.

So What!?

- **Unser Modell wurde mit über 30'000 abgeschlossenen Karriereverläufen trainiert. Es berechnet für jede:n Athlet:in Wahrscheinlichkeiten zukünftige WC-Top-30-, Top-10- und Top-3-Resultate zu erzielen.**
- **Das Modell erkennt WC-Top Athlet:innen im Alter von 16-18 Jahren insgesamt verlässlicher als die rein resultat-basierte Auswahl.**
- **Einzelfälle bleiben unvorhersehbar - es gibt immer Ausnahmen! Spätere WC-Top-Athlet:innen können dem Modell entgehen.**

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Bern University of Applied Sciences

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Federal Office of Sport FOSPO

SMART+ Modell der Spielintelligenz

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Universität Bern[1], Schweizerischer Fussballverband[2], Eidgenössische Hochschule für Sport Magglingen[3]

Keywords: Fussball, Spielsportarten, Spielintelligenz, Entscheidungsfindung, Talentselektion, Nachwuchsförderung, individuelle Förderung

Einleitung: Die Herausforderung «Spielintelligenz»

Spielerinnen und Spieler, die komplexe und dynamische Situationen im Spiel clever lösen können, sind gefragt. Spielintelligenz ist das Schlagwort! Trotz ihrer hohen Bedeutung ist das Konzept jedoch abstrakt und schwer greifbar: Was genau macht «Spielintelligenz» aus – und wie kann man sie trainieren?

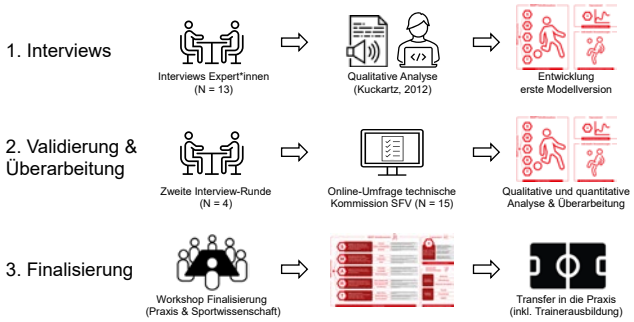
Genau hier setzt das von Swiss Olympic geförderte Projekt «Entwicklung der Spielintelligenz im Nachwuchsfussball» an. Ziel des Kooperationsprojekts des Schweizerischen Fussballverbands mit der Universität Bern und der Eidgenössischen Hochschule für Sport Magglingen ist die Entwicklung einer Methodik zur zielgerichteten Beurteilung und Förderung der Spielintelligenz. Um dieses Ziel zu erreichen, ist ein grundlegendes gemeinsames Verständnis von «Spielintelligenz» essenziell.

Fragestellungen

- Was verstehen Expert*innen aus der Praxis unter «Spielintelligenz»?
- In welchen Verhaltensweisen zeigt sich «Spielintelligenz» auf dem Platz?
- Über welche Kompetenzen müssen Spieler*innen verfügen, um spielintelligent handeln zu können?

Methode: Entwicklung von SMART+

Das SMART+ Modell basiert auf Praxiswissen von Expertinnen und Experten im Schweizer Fussball. Dieses wurde in einem mehrstufigen Prozess systematisch gesammelt, ausgewertet und validiert:



Resultat: Das SMART+ Modell der Spielintelligenz

SMART+ besteht aus 3 Teilen: SMART Verhaltensweisen (Abb. links) sind konkrete spielintelligente Verhalten, die im Spiel direkt beobachtbar und coachbar sind. Diese 15 Verhaltensweisen lassen sich in fünf SMART Komponenten einteilen. Zur Spielintelligenz gehört auch das Improvement (Abb. rechts oben), also Verhalten, das einen schnellen und nachhaltigen Lernfortschritt ermöglicht. Diese sind im Entwicklungsprozess beobachtbar. SMART Verhaltensweisen hängen zudem von individuellen Voraussetzungen der Spielerinnen und Spieler ab (Abb. rechts unten), die im Entwicklungsprozess gezielt trainiert werden können.

SMART Verhaltensweisen

SMART Komponenten

S	**Situation:** Verhaltensweisen, die das Erkennen und den Einbezug relevanter situativer Faktoren in die Entscheidung zeigen.	Kontext	Der Spieler bezieht Rahmenbedingungen wie den Spielverlauf oder die Platzbedingungen in Aktionen mit ein.
		Stärken & Schwächen	Die Spielerin bezieht eigene Stärken, die der Mitspielerinnen und Schwächen der Gegnerinnen in Aktionen mit ein.
		Spielidee	Der Spieler bezieht die Spielidee der Trainerin sowie des Teams in seine Aktionen mit ein.
M	**Management (Raum & Zeit):** Verhaltensweisen, die sich in raum-zeitlichen Bedingungen und dem damit verbundenen (Zeit-)Druck zeigen.	Timing	Die Spielerin führt ihre Aktionen im richtigen Moment aus.
		Antizipation	Der Spieler erkennt frühzeitig, wie sich eine Situation entwickelt, und bezieht dies in seine Aktionen mit ein.
		Ruhe	Die Spielerin behält auch in engen und hektischen Situationen die Ruhe und findet Lösungen.
A	**Action:** Verhaltensweisen, die auf Kompetenzen in der Entscheidungs-findung hindeuten.	Flexibilität	Der Spieler reagiert innerhalb seiner Aktionen flexibel und schnell auf veränderte Umstände und passt die Lösung an.
		Kreativität	Die Spielerin überrascht mit ihren Aktionen und ist unberechenbar für die Gegenspielerinnen.
		Risikoabwägung	Der Spieler wägt Risiko und Ertrag seiner Aktionen ab
R	**Readiness:** Verhaltensweisen ohne Ball, die sich kontinuierlich, also ohne klaren Start- oder Endpunkt, während des Spiels zeigen.	Stellungsspiel OFF	Die Spielerin schafft durch ihre Positionierung und ihr Freilaufen Möglichkeiten für das Team.
		Stellungsspiel DEF	Der Spieler minimiert durch seine Positionierung Gefahren für das eigene Tor und verteidigt vorausschauend.
		Orientierung	Die Spielerin nimmt den Raum aufmerksam wahr und passt aktiv ihre Körperposition an.
T	**Team:** Verhaltensweisen, die Mitspieler*innen in aussichtsreiche Situationen bringen oder ihnen helfen, diese zu lösen.	Spiel lenken	Der Spieler beeinflusst den Spielrhythmus und die Ausrichtung seines Teams.
		Spielfortsetzung	Die Spielerin ermöglicht durch ihre Aktionen eine verbesserte und möglichst erfolgsversprechende Spielfortsetzung.
		Kommunikation	Der Spieler gibt hilfreiche Informationen weiter.

im Spiel beobachtbar

Improvement

+

Verhalten, das einen schnellen und nachhaltigen Lernfortschritt ermöglicht.

- Die Spielerin lernt nachhaltig aus erfolgreichen sowie nicht erfolgreichen Aktionen und bezieht dies in zukünftige Aktionen mit ein.
- Der Spieler versteht die Vorgaben des Trainers und setzt diese in spezifischen Spielsituationen um.
- Die Spielerin setzt sich bewusst mit Fussball auseinander und setzt gewonnene Erkenntnisse im Spiel um.

im Entwicklungsprozess beobachtbar

Individuelle Voraussetzungen

Verhaltens-übergreifend	Erfahrung
	Wahrnehmung
	Taktisches Verständnis
Verhaltens-abhängig	Technik
	Persönlichkeit
	Athletik

als spezifische Entwicklungsfaktoren trainierbar

Fazit: Spielintelligenz wird greifbar

SMART+ macht das zuvor abstrakte Konstrukt «Spielintelligenz» anhand beobachtbarer Verhaltensweisen greifbar. Dies ermöglicht es, Stärken und Entwicklungsfelder in einzelnen Komponenten der Spielintelligenz zu erkennen und daraus gezielte Fördermassnahmen abzuleiten. Das Konzept SMART+ wird aktuell schweizweit in die Ausbildung von Trainern, Scouts und Talentmanagern integriert.

So What?!

Das SMART+ Modell bietet für Trainerinnen und Trainer …

- … ein gemeinsames Verständnis von Spielintelligenz.
- … greifbare Indikatoren zur Spielintelligenz-Beurteilung.
- … eine Methodik zur zielgerichteten Entwicklung der Spielintelligenz.
- … konkrete Anknüpfungspunkte für weitere Spielsportarten.

Für weitere Infos und Materialien:
Besucht unseren J+S Lernbaustein (verfügbar in DE/FR/IT)

Referenzen
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Mind To Win

Systematically Developing Psychological Competencies in the Swiss Sports System

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Keywords: Thriving · psychological competence development · ecological systems approach · FTEM · youth high-performance sport

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SO WHAT?!

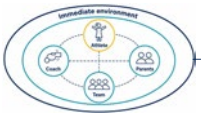
- Psychological competencies should be developed just as systematically as technical, tactical, and physical components.
- Mind to Win provides a shared framework: What should be developed from F3 to E1? When do specific topics become relevant? How can they be integrated into training and coach education? Who is responsible?
- Not only for practice but developed with practitioners: The content is jointly developed, piloted, and refined with sports federations, coaches, athletes, and sport psychology professionals.

Introduction

Psychological competencies shape how athletes learn, collaborate, manage demands, and perform under pressure. Although some psychological resources and materials already exist within the Swiss performance sport system, they remain fragmented and are not yet connected through a shared language or a developmentally aligned, cross-federation framework. Mind to Win addresses this gap.

Goal

Together with partners from research and sport practice, Mind to Win co-develops an evidence- and practice-informed framework for psychological training aligned with the FTEM model [1]. It will underpin coach education modules, learning units, and practical exercises. Thriving serves as the overarching objective, integrating well-being, personal development, and performance [2]. Guided by an ecological-systems perspective [3], the project views the promotion of thriving as a shared responsibility of athletes and their immediate environment, particularly coaches and, where relevant, parents.



Thriving

Research and Development Questions

1. Which psychological competencies and supportive environmental conditions promote thriving?
2. When, how, and by whom should these competencies be developed and these environmental conditions be shaped along the FTEM framework?

Methods

Collaborative, evidence- and practice-informed project| 2025–2028 | 5 Work Packages

1. **Generate knowledge**
   Analyze scientific literature as well as Y+S and federation documents. [Jan 25 – Sept 26]
2. **Structure Collaboratively**
   Consolidate psychological factors with education leads, coaches, and experts in workshops, and prioritize them developmentally along FTEM. [Sept 25 – Sept 26]
3. **Develop the Product**
   Compile training methods, develop sport-specific examples, and prepare learning materials. [Oct 26 – Jun 27]
4. **Test in practice**
   Pilot the content with coaches and athletes. [From summer 2027]
5. **Evaluate, Refine, Embed Long-Term**
   Assess comprehensibility, practical relevance, and feasibility. Integrate educational materials and courses into Y+S and TBS. [From 2028]

Stakeholders: Federation education leads, coaches, athletes, sport psychology experts and, where relevant, parents. Participation varies by project phase.
Methods: Literature & material review, concept mapping, co-design workshops, pilot testing, implementation evaluation.

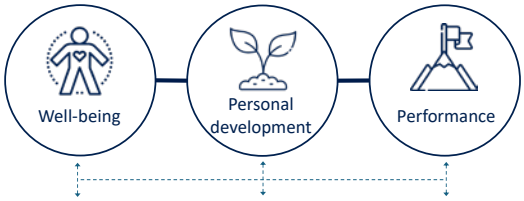
Impact for Coaches

WHAT should be developed?
Core psychological competencies and supportive environmental conditions

HOW can they be developed?
Through training design, communication, feedback, reflection, and routines

What should coaches focus on?
Relationships, motivational climate, psychological safety, basic psychological needs, and fostering personal responsibility

Results – Current status



Work together in a supportive way
e.g., Communication / Trust / Team Culture

Strengthen oneself and stay healthy
e.g., Self-care / Load management / Seeking help

Act self-determined and value-based
e.g., Motivation / Values / Responsibility

Master challenges
e.g., Emotion regulation / Volition / Setbacks

Act situationally and stay focused
e.g., Concentration / Routines / Decisions

F3 – T1 – T2 – T3 – T4 – E1

These contents are developed progressively in a spiral from F3 to E1. As demands increase, so do autonomy, complexity, and transfer to new situations. Because the FTEM framework is independent of age, athletes' age and developmental stage are also taken into account.

Conclusion

Mind to Win addresses a key implementation gap in the Swiss sports system by embedding psychological competence development along the FTEM athlete pathway. It equips and empowers the athlete's environment—including coaches and parents—to create conditions in which thriving can be fostered through psychological competence development.

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5

HOW TO WORK ON MEANINGFUL QUESTIONS IN ELITE WINTER SPORTS: A FIVE-STEP EBP PROCESS APPLIED TO SKI CROSS INJURY PREVENTION

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Keywords: *evidence-based practice (EBP) · applied research · elite winter sports · ski cross · injury prevention · video analysis · coach–scientist collaboration · dashboard*

SO WHAT!?

- ➢ Build a strong relationship between coaches and sport scientists first — it is the base of every successful project.
- ➢ Work along five steps: relevant question → available evidence → setup → parameters & statistics → communication of results.
- ➢ Return results in a form coaches actually use — the interactive ski cross dashboard puts four seasons of injury data into coaches' hands and grows every season.

INTRODUCTION

Most sport-science research is experimental and laboratory-based. Its applied outcome for elite sport is questionable[2], its transfer to elite settings is limited[5], and p-values and conclusions depend on sample size[1]. In elite winter sports such as ski cross (SX), weather, terrain and snow conditions make field research even harder — and incidences are too few to reach statistical significance. Coaches, however, work in an **n = 1** world: waiting to be 95% sure means being left behind[4]. Applied settings therefore need a **suitable research design** — and a process for asking **meaningful questions**.

EVIDENCE-BASED PRACTICE (EBP)

EBP is the fusion of **coaches'** expertise and experience, **athletes'** values and **research evidence** to improve the **decision-making process** related to elite sport performance[4].

AIM & QUESTION

How can meaningful questions in elite winter sports be asked *and* solved? We present the **five-step EBP process** and demonstrate it on a real project: quantifying potential injury situations in SX across four World Cup seasons[6,7].

METHOD — THE FIVE-STEP PROCESS OF DEVELOPING EBP[3]

A **strong relationship** between a sport's key stakeholders (coaches, athletes, administrators) and scientists is the foundation of the whole process (Fig. 1)[3]. **Left:** the generic process — **right:** its application in the SX injury dashboard project.

GENERIC PROCESS[3]	APPLIED: SX INJURY DASHBOARD
A. Identification of the relevant question Communication with stakeholders; clear delimitation of what will be implemented, and by when.	SX ranks among the **highest-injury-risk** World Cup disciplines[6], yet injuries become known only after the fact. With the Swiss-Ski SX team we asked: where and why do risky situations occur?
B. Check available evidence Other sports and studies with similar needs.	Official injury reports are **rare and retrospective**; four master's theses[7] each covered one slice — valuable, but partial and underpowered.
C. Choose a setup Feasible in the real setting; capture as many environmental factors as possible.	Systematic **video analysis** of all World Cup races 2018/19–2021/22 (13 venues, incl. Beijing 2022), stored in one event-level database, drillable down to the sub-obstacle.
D. Choose parameters to investigate & statistics Relevant level of precision; surrogate measures to increase the sample size; suitable statistical methods.	**Surrogate measures** of injury risk: crash, out-of-balance, contact, rank shift[8]. Rates per athlete-hour (true exposure) and % per passage; effects of obstacle, sex, venue and heat phase.
E. Communication of results to stakeholders Appropriate language and form to present results.	An **interactive dashboard** for the coaching staff: pooled for statistical power, drillable for detail — it grows and gains power every season (Fig. 3).

Fig. 1 — The process of asking meaningful questions and strategies to solve them in winter-sports field research[3], shown with its application in the SX injury dashboard project.

RESULTS — WHAT THE PROCESS DELIVERED IN SKI CROSS

For almost every category and obstacle type, men have a higher incident rate than women, with **contact** being the most prevalent difference (Fig. 2) - crashes are the one consistent exception. The highest crash rates occur during direction changes, while **out-of-balance events cluster on jumps (p<.05–p<.001).** At the sub-obstacle level, flat/GS-turn entries and bank-turn exits are the crash hotspots. Venue and heat-phase differences persist after exposure normalization.

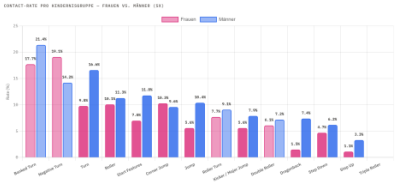

Fig. 2 — Sub-obstacle level: events by sex, four seasons pooled.

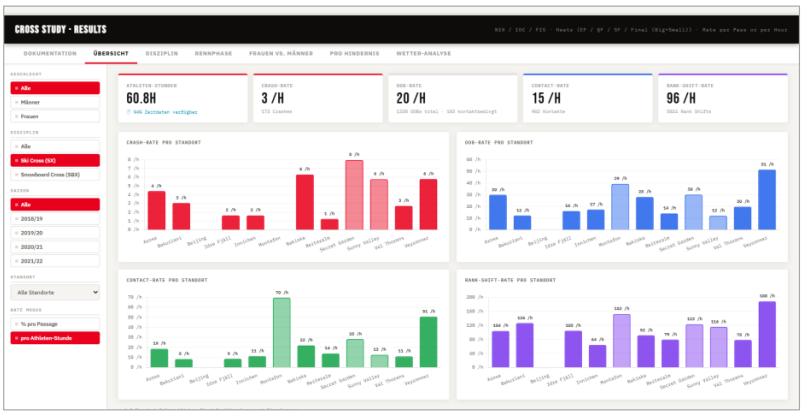

Fig. 3 — The live dashboard (step E): pooled overview, filters, drill-down per obstacle and venue.

CONCLUSION

The five-step process turned a broad safety concern into statistically powered, actionable answers — because stakeholders were involved from step A on, and results were returned in a form coaches use daily (step E). **Collaboration between coaches and research & development throughout implementation is key**; the process presented should guide future applied projects in elite sports.

Special thanks to Enrico Vetsch, Ralph Pfäffli and the whole Swiss Ski Cross Team!

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Longitudinal performance of youth soccer players: 10m sprint percentile curves adapted to biological age

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Keywords: youth soccer, talent development, performance prediction

WHY DOES THIS MATTER?

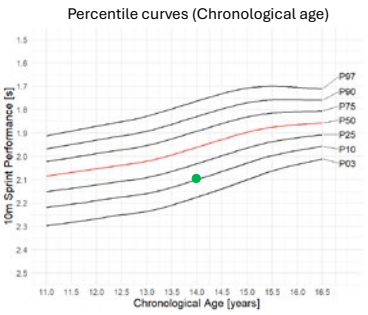
Traditional percentile curves are usually based on chronological age (CA) [1]. However, players of the same CA can differ substantially in biological maturity and are not necessarily at the same stage of development [2]. More mature players may therefore appear physically superior partly because they are further along in their development [3]. This can influence how players are evaluated, potentially over- or underestimating their performance.

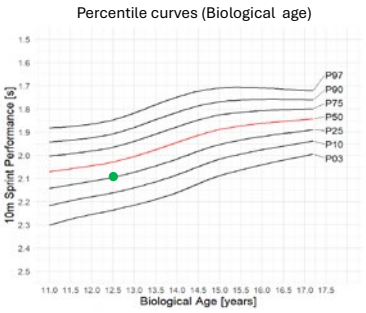
WHAT DID WE DO?

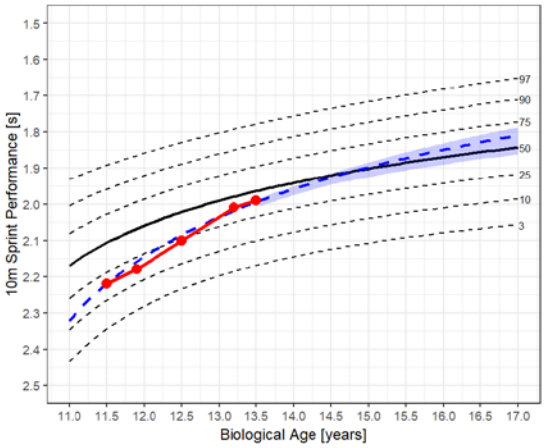
Percentile curves
(M = 9085, F = 391 observations, from 2017 - 2024)
10m sprint performance was compared using
CA vs. BA [4]

→

Longitudinal modelling
(M = 1101, F = 46 players ; ≥ 3 rep. Measures)
Linear mixed models were used to account for:
- repeated measurements
- individual baseline sprint performance
- individual rates of development
- future performance predictions







WHAT DID WE FIND?

RESULT 1
When sprint performance was evaluated relative to BA instead of CA, percentile rankings changed significantly ($p < .001$).

Late maturers: +13.5 percentile ranks
Early maturers: −20.8 percentile ranks

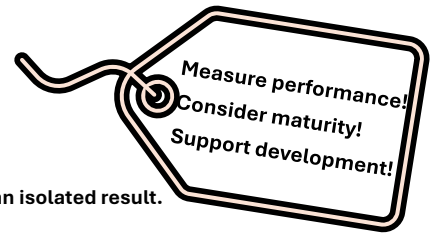
RESULT 2
BA better explained sprint performance than CA.
→ $R^2 = .22$ vs. $.18$, $p < .001$

RESULT 3
Players develop at different rates
→ Lower initial performance was linked to greater improvement over time: $r = -.79$

The same pattern was observed for female players, but changes were smaller and mostly not significant

SO WHAT?

1. CONSIDER MATURITY WHEN INTERPRETING SPRINT PERFORMANCE
Late maturers may be underestimated; early maturers may have a maturity-related advantage.
→ **Current performance ≠ future potential.**



2. LOOK BEYOND TODAY'S PERFORMANCE
Individual players show different starting levels and different rates of improvement.
→ **Repeated measurements and the player's longitudinal trend provide more information than an isolated result.**

3. TRACK DEVELOPMENT, SUPPORT, DON'T SELECT
Sprint performance is only one component of player development and is also influenced by factors beyond biological maturation.
→ **Use testing to track progress, identify areas for improvement, and support long-term development . Do not use a standalone selection tool.**

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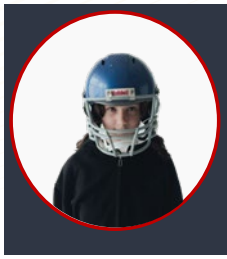

Do coaches recognize and report interpersonal violence in sport?

Laurie Schwab[1;2], Philipp Röthlin[1,3], Roberta Antonini Philippe[2] & Stephan Horvath[1]

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Keywords : Interpersonal violence, safeguarding, coaches, vignette-based study

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So what?

- Look beyond the most obvious forms of violence to recognize signs of psychological violence and neglect, which may leave no visible injury.
- Use concrete cases and safeguarding guidance to question behaviors that may have become normalized in sport.
- Become familiar with consultation and SSI reporting pathways before a concern arises.

1 INTRODUCTION

- Prevalence studies suggest that interpersonal violence affects athletes across all age groups and competitive levels (Tuakli-Wosornu et al., 2024)
- Coaches occupy a central but ambivalent position in this issue: They can both harm athletes and protect them from harm (Vertommen et al., 2017; Jaime et al., 2015).
- To safeguard athletes, coaches need to be able to recognize violence and report violence formally when necessary (Adriaens et al., 2024; Verhelle et al., 2022)

1. To what extent are Swiss coaches able to recognize various forms of interpersonal violence?
2. Does the correct recognition of violent behaviors influence coaches' likelihood of reporting these incidents to Swiss Sport Integrity (SSI)?

2 MATERIALS AND METHODS

N = 145 BTA/DTA-certified coaches (21% female; M_{age} = 48.97; SD = 11.02) were presented with four written vignettes of interpersonal violence. After each vignette, they answered two questions:

1. Does this situation constitute interpersonal violence? ("yes" = correct recognition)
2. How likely are you to report this to SSI? (0-100)

Brief descriptions of the four vignettes

Psychological violence
Persistent homophobic bullying; complaint dismissed.

Physical violence
Forced kicking-game target; recurrent bruises.

Sexual violence
Sexualized behavior and secret kisses by her long-term coach.

Neglect
Major personal stressors ignored; accommodations refused.

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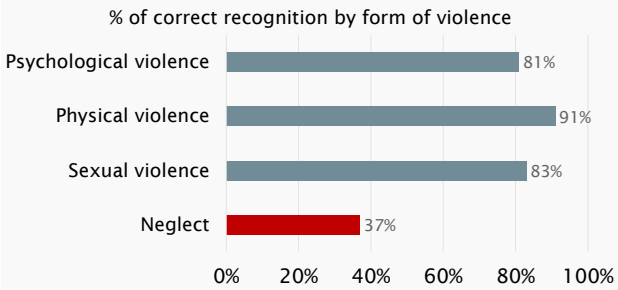
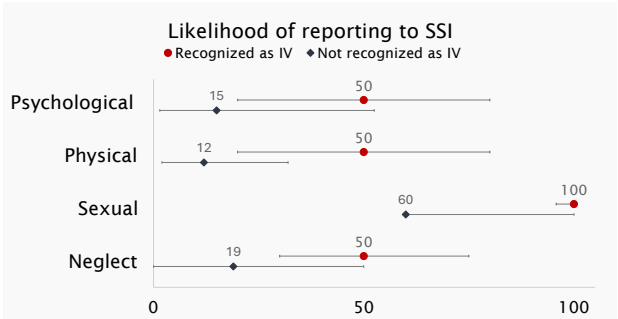
Scan to access the published paper

3 RESULTS





Note. Symbols = medians; horizontal lines = IQRs (25th–75th percentiles). Group differences: $|r_{pb}|$ = .36–.55.

4 CONCLUSION

- Recognition varied by form of violence, with neglect being the most frequently missed.
- Correct recognition was associated with a greater likelihood of reporting, but reporting intentions remained form-specific and were highest for sexual violence.
- Safeguarding efforts should strengthen both the recognition of less visible forms of violence and coaches' readiness to report all forms of violence.

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Preliminary draft of the FTEM framework for mental skill development in snowsports

Introduction

The FTEM (Foundation, Talent, Elite, Mastery) framework mainly focuses on organisational structures and physical, technical, and tactical skills, while the long-term development of mental skills remains underrepresented in both practice and research. Existing psychological programmes are often short-term and based on individual expertise, highlighting the need for a more holistic and evidence-based approach.[1]

Mental skills are essential for athlete development, contributing not only to performance enhancement[2,3] but also to injury prevention, rehabilitation, mental health, and long-term well-being[4,5]. Competencies such as self-regulation, coping, focus, visualisation, and resilience support athletes throughout their careers and help them manage challenges beyond sport.

Despite their importance, mental skills training is rarely integrated systematically into athlete development frameworks.[1] Within the Swiss sports system, no holistic and evidence-based pathway for mental skill development currently exists, resulting in fragmented and inconsistent psychological support and emphasizing the need for a structured framework.

So What? – Implications for practice

Mental skills should be trained like physical, technical, and tactical skills – systematically, progressively, and over many years.

- Start mental skill development early
- Progress skills across the FTEM pathway
- Integrate mental training into everyday practice
- Use a common language across coaches, staff, and athletes
- Adress performance and lifelong health

Methods

The research line, in collaboration with Swiss-Ski, focused on the development of a mental FTEM (Foundation, Talent, Elite, Mastery) framework. The project followed an evidence-based best-practice approach. As a first step, a needs assessment was conducted to identify relevant content, delivery formats, and contextual information related to the development of mental skills.

The practical perspective was complemented by stakeholder insights into how mental programs can be structured and implemented.

To capture the entire athlete pathway, focus group interviews were carried out with athletes and coaches who had progressed through the Swiss Snowsports system.

These perspectives were complemented by a scoping review that examined long-term mental development for injury prevention.

All these building blocks were ultimately integrated into a first draft of the mental FTEM framework for Snowsports.

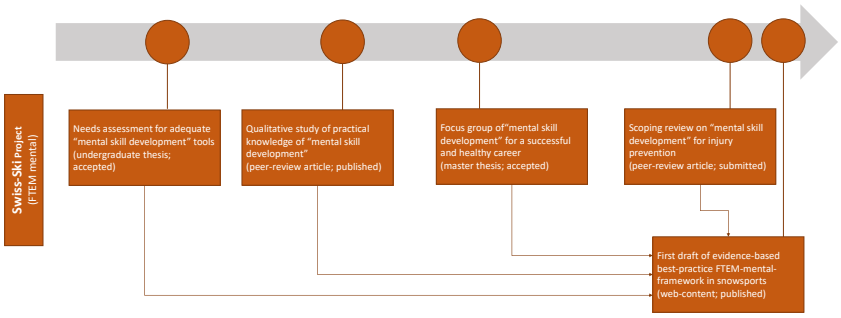


Figure 1: Outline and output of the Swiss-Ski project (PRIMED)

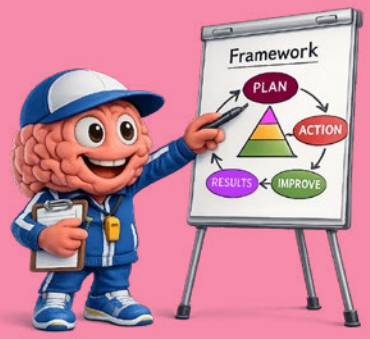
Results

Foundation 1	Foundation 2	Foundation 3	Talent 1	Talent 2	Talent 3	Talent 4	Elite 1	Elite 2	Mastery
U8	U8 –U10	U10–U12	U12–U14	U14–U16	U18–U21	U21	U23	>23	>23
Freude am Tun	Freude am Tun	Zielsetzung erlernen	Zielsetzung ausbauen	Zielsetzung ausbauen	Motivation aktiv regulieren	Eigenmotivation fördern	Eigenmotivation ausbauen	Eigenmotivation ausbauen	Eigenmotivation optimieren
Selbstwahrnehmung fördern	Selbstwahrnehmung fördern und Umgang mit Emotionen erlernen	Umgang mit Emotionen ausbauen und Umgang mit Gedanken erlernen	Umgang mit Emotionen und Gedanken ausbauen	Umgang mit Emotionen und Gedanken ausbauen	Umgang mit Emotionen und Gedanken festigen	Optimierung der Emotions- und Gedankenregulation	Optimierung der Emotions- und Gedankenregulation	Optimierung der Emotions- und Gedankenregulation	Optimierung der Emotions- Gedankenregulation
Aktivierungsregulation aufbauen	Aktivierungsregulation aufbauen	Aktivierungsregulation individualisieren	Optimaler Leistungszustand (OLZ)	Optimaler Leistungszustand (OLZ)	Wettkampfstrategien aufbauen	Wettkampfstrategien ausbauen	Optimierung der Aktivierungsregulation	Optimierung der Aktivierungsregulation	Optimierung der Aktivierungsregulation
Spielerische Bewegungssteuerung ermöglichen	Spielerische Bewegungssteuerung ermöglichen	Bewusstsein für Körper und Bewegungen schaffen	Bewegungsvorstellung aufbauen	Bewegungsvorstellung ausbauen	Ganzheitliche Bewegungsvorstellung aufbauen	Lebhafte Bewegungsvorstellung aufbauen	Lebhafte Bewegungsvorstellung ausbauen	Lebhafte Bewegungsvorstellung ausbauen	Lebhafte Bewegungsvorstellung optimieren
			Fokus aufbauen	Fokus aufbauen	Fokus festigen	Fokus festigen	Fokus ausbauen	Fokus ausbauen	Fokus optimieren
Positives Lernumfeld schaffen	Positives Lernumfeld schaffen und Teamfähigkeit fördern	Positives Lernumfeld schaffen und Teamfähigkeit fördern	Positives Lernumfeld schaffen und Teamfähigkeit fördern	Positives Lernumfeld schaffen und Teamfähigkeit fördern	Positives Lernumfeld schaffen und Teamfähigkeit ausbauen	Positives Lernumfeld schaffen und Teamfähigkeit ausbauen	Positives Lernumfeld schaffen und Teamfähigkeit optimieren	Positives Lernumfeld schaffen und Teamfähigkeit optimieren	Positives Lernumfeld schaffen und Teamfähigkeit optimieren
Analytische Fähigkeiten aufbauen	Analytische Fähigkeiten aufbauen	Analytische Fähigkeiten aufbauen	Analytische Fähigkeiten festigen	Analytische Fähigkeiten festigen	Analytische Fähigkeiten ausbauen	Analytische Fähigkeiten ausbauen	Analytische Fähigkeiten optimieren	Analytische Fähigkeiten optimieren	Analytische Fähigkeiten optimieren
Eigeninitiative ermöglichen	Eigeninitiative ermöglichen	Eigeninitiative fördern	Eigeninitiative fördern	Eigeninitiative ausbauen	Eigeninitiative ausbauen	Eigeninitiative ausbauen	Eigeninitiative optimieren	Eigeninitiative optimieren	Eigeninitiative optimieren
			Karriereplanung	Karriereplanung	Karriereplanung	Karriereplanung	Karriereplanung	Karriereplanung	Karriereplanung

Figure 2: Preliminary draft of the FTEM mental framework in snowsports. Overview of the respective mental learning content per level

Figure 3: Visualisation of the FTEM framework model on the Swiss-Ski website. Accessible via QR code

The preliminary draft of the FTEM mental framework provides a stage-based roadmap for teaching and consolidating mental competencies. Within this structure (Figure 2), preventive strategies can be introduced early – at the foundation (F) and talent (T) levels – where self-awareness, emotional control, and basic coping mechanisms are established. At the elite (E) and mastery (M) stages of the FTEM pathway, more advanced mental skills, such as goal regulation, resilience under pressure, and self determination, become central.



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9

INFLUENCE OF BAROMETRIC PRESSURE ON HYPOXIC DOSE DURING A TERRESTRIAL-ALTITUDE TRAINING CAMP IN ELITE SWISS ROWERS

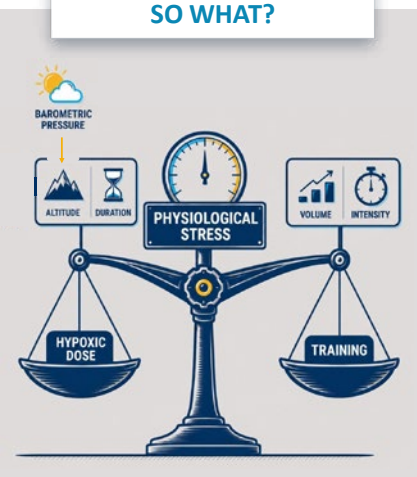
Dr. Allison DIRY[1], Forrest SCHORDERET[2], Pr. Grégoire MILLET[2]
[1] Swiss Rowing, [2] Institute of Sport Sciences (ISSUL), University of Lausanne

SWISS ROWING

Unil.

Keywords: altitude, hypoxic dose, rowing , elite

SO WHAT?



Introduction & Problematic

In altitude training camp, the external load is commonly quantified using hypoxic dose[1,2], integrating the altitude and the time spent at this altitude (*see left side of "So what?*). Although several limitations of this approach have been described, no alternative method has yet been readily applicable in field. Recent evidence showed that barometric pressure (BP) should also be considered when quantifying external load[3], as it has been overlooked in most previous studies conducted during altitude camps[4].

How does accounting for barometric pressure (BP) affect hypoxic dose and the evolution of physiological stress during an altitude training camp in elite rowers?

Methodology

14 elite rowers: 7 women / 7 men
AVG: 26.5 ± 1.9 years

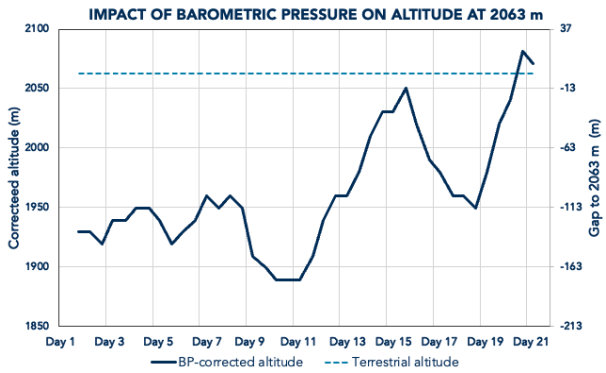
21 days / 20 nights
Altitude: 2063 m above sea level

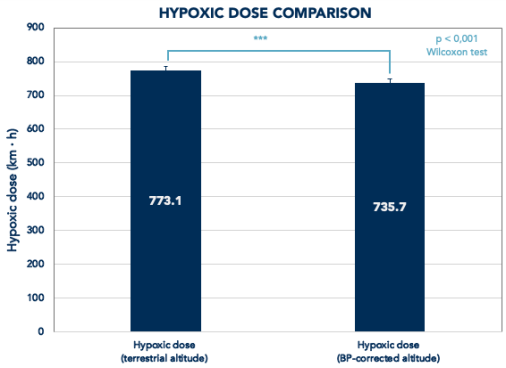
Hypoxic dose (km · h)
Altitude x duration

Barometric pressure (BP in hPa)
Numerical barometer (Greisinger GPB 3300)
2x / day: at 7 am and 8 pm

Corrected altitude (m): 44330*(1-((P_{MES}/P_0)^(1/5,255)))
P_{MES} = measured barometric pressure
P_0 = sea level barometric pressure

Results





Conclusion

Considering barometric pressure is therefore important when quantifying hypoxic dose during altitude training camps. In our case, the difference between terrestrial and corrected altitude exceeded 160 m, resulting in a significant difference in hypoxic dose. This may influence physiological responses and must be considered when interpreting physiological changes during an altitude training camp with elite athletes.

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SWISS OLYMPIC SCIENCE AWARD 2026

Live auf echten Kaderdaten

Die KI versteht. Der Code rechnet.

Sprachverständnis ohne Kontrollverlust: Sportdaten in Umgangssprache via Chatbot abfragen – und trotzdem jeder Zahl vertrauen können.

Joël Barandun[1] · Martin J. Bünner[1] · Dino Tartaruga[2] · Marco Pargätzi[3]
[1] Fachhochschule Graubünden · [2] Swiss Shooting · [3] Force8

SO WHAT?

Sportdaten sollen Entscheidungen erleichtern, nicht komplizierter machen. Trainer:innen fragen einfach in Alltagssprache – der Data-Butler liefert eine zuverlässig berechnete und überprüfbare Antwort.

EINLEITUNG · FORSCHUNGSFRAGE · METHODE

Sportdaten liegen hinter Schnittstellen und starren Dashboards. Rechnet ein Chatbot selbst, können plausible Fehler unbemerkt bleiben. Ziel: freie Fragen verstehen, Zahlen mit geprüftem Code erzeugen.

Wie wird aus einer frei formulierten Sportfrage eine verlässliche Zahl?

VALIDIERUNGSDESIGN

10	121	371
Referenzfragen	Varianten	Testläufe

Die zehn Fragen waren der prüfbare Test, nicht die Grenze des Systems; jede Referenzfrage wurde gegen unabhängig berechnete Sollwerte geprüft.

KEYWORDS

Leistungssport · Sportdaten · natürliche Sprache · KI-Assistent · Nachvollziehbarkeit

RESULTATE

10/10 — **Validierung**
Alle zehn Referenzfragen stimmen mit den unabhängigen Sollwerten überein.

0/15 — **Kontrollierte Ablation**
Ohne unsere Leitplanken traf die KI keinen Sollwert.

12×12 — **Reproduzierbarkeit**
12 Fälle × 12 Wiederholungen: identische Resultate.

Vergleich mit gpt-5.4-mini; keine allgemeine KI-Trefferquote.

DIE EHRLICHE GRENZE

Falsch verstanden? Auch Code kann einen falschen Auftrag korrekt berechnen. Darum zeigt der Data-Butler seine Interpretation und fragt nach.

SCHLUSSFOLGERUNG FÜR DEN SPORT

Teuer erfasste Daten werden endlich nutzbar.

- **Fragen statt Schnittstellen:** Kein technisches Wissen nötig.
- **Entscheiden statt zweifeln:** Entscheidungen beruhen auf prüfbaren Werten.
- **Daten schützen:** Das Modell sieht Datenzeilen erst nach Freigabe.

POTENZIAL AUF DER FORCE8-PLATTFORM

Bestehende Nutzerbasis, für die Sportdaten per Chat nutzbar werden könnten:

9'500 Nutzer:innen	**2'500** davon Coaches
ca. 200 Vereine	**17** nationale & regionale Verbände

SO ENTSTEHT EINE FALSCHE ZAHL

Die ganze Tabelle war da. Die Zahl war trotzdem falsch.

ChatGPT — Datei hochladen → KI rechnet selbst

DU

wettkampfergebnisse.xlsx XLSX
Vollständige Tabelle · alle Rohdaten

«Wie viele offizielle Wettkampfschüsse gab Nina Muster dieses Jahr ab?»

KI

Nina gab dieses Jahr insgesamt **1'360** Wettkampfschüsse ab.

✕ Klingt plausibel. Ist aber falsch.

Data-Butler — Nur fragen → geprüfter Code rechnet

DU

«Wie viele offizielle Wettkampfschüsse gab Nina Muster dieses Jahr ab?»

API Daten abrufen → Filtern → Rechnen → Prüfen

DATA-BUTLER

Nina gab dieses Jahr insgesamt **1'380** Wettkampfschüsse ab.

23 Einträge × 6 Serien × 10 Schüsse = 1'380

✓ Richtig – und die Rechnung ist sichtbar.

Dieselben Rohdaten. Nur beim Data-Butler rechnet geprüfter Code. | Die Chatoberfläche illustriert das Risiko; die gezeigte Falschzahl stammt aus einem realen Lauf der kontrollierten Ablation (gpt-5.4-mini via API rechnete dieselben Rohzeilen selbst; in zehn Wiederholungen dieses Falls kein Treffer, Streuung 740–1'660). Name geändert.

DAS KERNPRINZIP

Genau ein Job für die KI

Keine erfundenen Zahlen.
Kein Raten. Im Zweifel: Rückfrage.

Kontrollgrenze

01

Zeig mir ...

Frei fragen
Trainer:innen fragen in Alltagssprache.

→

02 · KI

Striktes Formular

Person	Nina Muster
Zeitraum	laufendes Jahr
Kennzahl	Wettkampfschüsse

Hier endet der Einfluss der KI auf die Werte.

03 · CODE

Quelle → Filtern → Rechnen → Prüfen

Geprüft ausführen
Feste Regeln erzeugen Zahl, Diagramm und Audit-Trace. Gleicher Auftrag + gleiche Daten = gleiches Resultat.

→

04

Verlässlich antworten
Verständlich für Menschen. Nachvollziehbar für die Prüfung.

Fachhochschule Graubünden University of Applied Sciences · Swiss Shooting · force8

LITERATUR

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DIE KURZE VERSION

KI für Sprache. Code für Zahlen.

SkiSense: Zeitsynchronisierte Video- und Sensordaten für gezielteres Feedback im Skispringen

Lukas Schulthess[1], Matheo Käch[2], Björn Bruhin[2,3], Michele Magno[1], Luca Benini[1], Christoph Leitner[1]

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Keywords: Skispringen, Zeitsynchronisierte Datenaufnahme, Leistungsanalyse, Feedback Verbessern, Tragbare Sensorik

So What !?

SkiSense macht sichtbar, was das Video nicht zeigt: zeitsynchronisierte Sensordaten direkt am Athleten, z. B. die Druckverteilung im Skisprungschuh [1, 2].

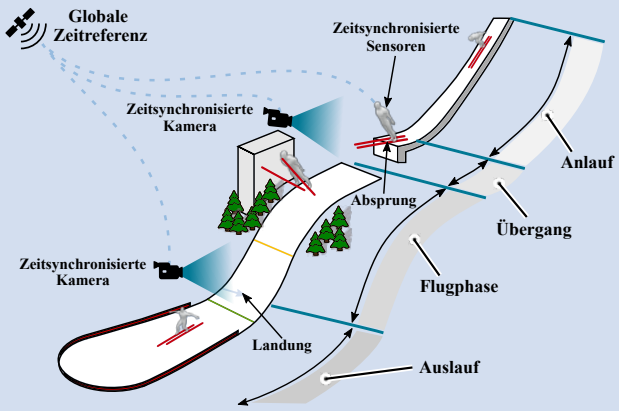
Objektive Messdaten treffen Eigenwahrnehmung: Die Nachbesprechung zwischen Trainern und Athleten wird schneller und konkreter, das Feedback gezielter und personalisierter [3].

Jeder Sprung zählt: Bei azyklischen Sportarten wie dem Skispringen mit wenigen Wiederholungen pro Training hilft SkiSense, jeden einzelnen Sprung zu nutzen [4].

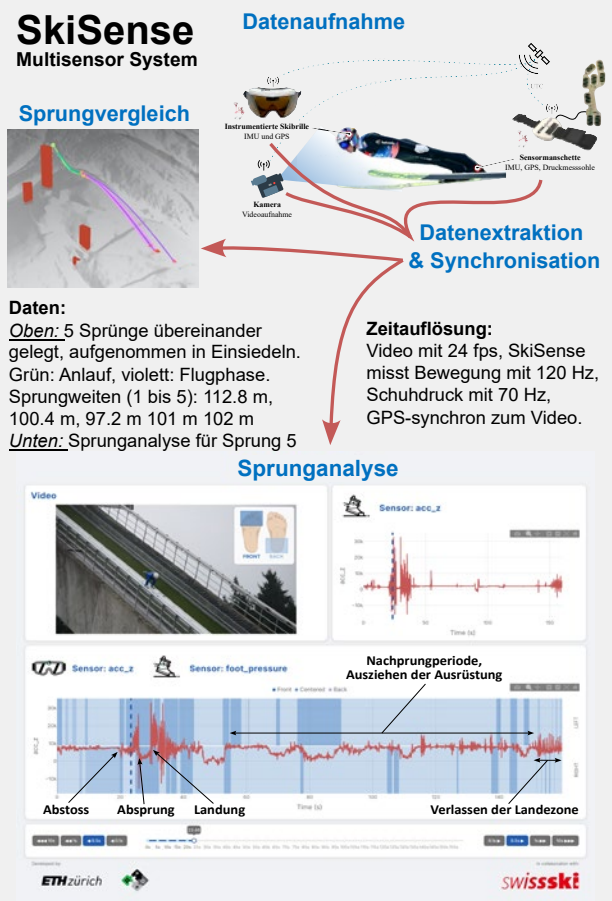
Einleitung

Motorisches Lernen braucht Wiederholung und Feedback [3, 4]. Im Skispringen ist jeder Sprung wertvoll, denn pro Training sind nur wenige Wiederholungen (ca. 4-8 Sprünge) möglich.
Gleichzeitig ist es schwierig, während des Sprungs alle relevanten Bewegungen und Belastungen bewusst wahrzunehmen und sie später zu reflektieren. Die heutige Analyse basiert vor allem auf Video- und Geschwindigkeitsmessungen und zeigt den Sprung hauptsächlich von Aussen: Kleine oder nicht sichtbare Bewegungen werden durch das Bildmaterial kaum oder gar nicht erfasst. Um das motorische Lernen zu beschleunigen, muss deshalb jeder einzelne Sprung besser genutzt werden. Dies führt zu folgender Fragestellung:

Wie lassen sich im Video verborgene Bewegungsabläufe im Skisprung sichtbar machen und für ein gezieltes Feedback nutzen?



Methoden



Daten:
Oben: 5 Sprünge übereinander gelegt, aufgenommen in Einsiedeln. Grün: Anlauf, violett: Flugphase. Sprungweiten (1 bis 5): 112.8 m, 100.4 m, 97.2 m 101 m 102 m
Unten: Sprunganalyse für Sprung 5

Zeitauflösung:
Video mit 24 fps, SkiSense misst Bewegung mit 120 Hz, Schuhdruck mit 70 Hz, GPS-synchron zum Video.

Resultate

Ergebnisse eines Skisprungtrainings: 5 Sprünge eines B-Nationalkaders von der KPT-Sprungschanze, Hillsize 117 m

- **Sprungvergleich:** Erkennung von systematischen Rechtsdrift bei Sprung 2 bis 5 mit Sprungweiten um 100 m. Sprung 1 ist gerade und mit einer Sprungweite von 112.8 m deutlich länger.
- **Sprunganalyse:** Erkennung von Asymmetrien im Fuss beim Anlauf von Sprung 5. Frontlage links, Rücklage rechts. Auf den Videoaufnahmen ist dies unsichtbar.

Fazit

SkiSense verbindet Videoanalyse und körpernahe Sensordaten zu einem umfassenden Bild des Sprungs. Trainer können Feedback dadurch gezielter formulieren, Athleten ihren Sprung besser nachvollziehen.
Das Grundprinzip der zeitsynchronisierten Datenerfassung ist **auf weitere Sportarten übertragbar**.

Kontakt: lukas.schulthess@pbl.ee.ethz.ch, christoph.leitner@iis.ee.ethz.ch

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AI-Assisted Sprint Analysis: From Race Video to Performance Data

More athletes. More races. More performance data.

Andri Feldmann[1,2], Cyril Winkler[3], Thomas Koller[3], Solange Emmenegger[4], Alice Cerutti[1], Gioele Turuani[1], Ivana Ivankovic[1]

[1]Swiss Athletics, [2]University of Bern, [3]Applied AI Research Lab HSLU, [4]Eidgenössische Hochschule für Sport Magglingen

Keywords: Tracking, AI, Computer Vision, Player statistics, Step Count, Split Times, Athletics

SO, WHAT!

A single trackside video can become structured performance data in minutes.
AI-assisted analysis reduces repetitive manual work, allows substantially more races and athletes to be analysed with the same resources, and creates data that can be stored directly for longitudinal athlete monitoring and comparison.

METHODS

The application combines camera-motion estimation, athlete tracking and pose estimation to extract race statistics from a single panning video[1]. After upload, the user assigns athletes to lanes and marks reference points on the track. These inputs allow image coordinates to be mapped to positions on the track. Tracking and pose estimation then run automatically in the background. Detected foot contacts are used to determine step counts and split times. Uncertain or missing detections are highlighted in the interface, allowing the user to review, correct or complete the analysis.

Scan the QR code to see the complete workflow in action.

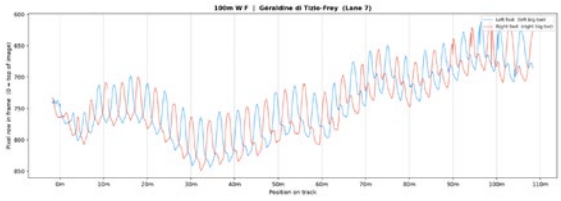

Fig. 1 Movement of the left and right foot as captured by the pose estimation.

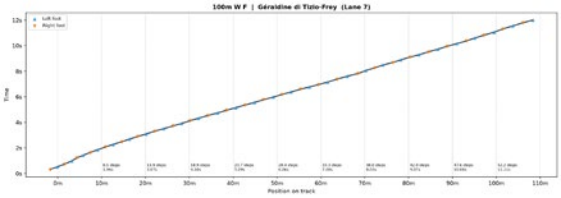

Fig. 2 Detected steps along the race and estimated split times.

RESULTS

The system was applied to race videos collected throughout the season, providing a broader dataset to evaluate the automated extraction of split times and step characteristics across athletes and competitions. Overall performance was assessed by comparing the automated output with manually determined reference data, both before (Uncorr.) and after human verification and correction (Corr.).The women's 100 m European Championship final is shown here as an illustrative example, demonstrating how the method translates a single race video into athlete-level step and split-time data. Across the workflow, uncertain or missing detections are highlighted for review, allowing the user to rapidly verify and correct the automated output. The system derived race metrics showed close agreement with manual analysis. After verification, split times differed by only ~0.02 s and step counts by ~0.1 steps on average, demonstrating that accurate race analysis can be achieved with minimal human correction.

Table 1 Results of the step counts and comparison between the corrected, uncorrected and manually obtained split times

	30 m			50 m			60 m			100 m[1]		
Athlete	Manual	Corr.	Uncorr.	Manual	Corr.	Uncorr.	Manual	Corr.	Uncorr.	Manual	Corr.	Uncorr.
Amy Hunt	17.6	17.6	18.7	26.6	26.7	27.8	31.0	30.9	32.0	48.2	48.1	49.2
Ewa Swoboda	17.4	17.3	18.4	26.6	26.4	27.7	31.0	30.8	32.8	48.9	48.7	50.7
Delphine Nkansa	18.0	18.1	19.1	27.5	27.4	28.4	32.0	32.0	33.0	50.5	50.3	51.3
Géraldine di Tizio-Frey	18.0	17.9	18.9	27.6	27.4	28.5	32.2	32.3	33.3	51.3	51.3	52.3
Dina Asher-Smith	18.0	18.3	19.6	27.5	27.5	28.5	32.0	32.0	33.0	49.8	49.8	50.8
Patrizia van der Weken	17.6	17.6	19.2	26.3	26.4	28.4	30.8	30.7	32.8	48.2	48.0	50.0
Zeynab Dosso	17.2	17.2	18.2	26.6	26.5	27.5	30.9	31.0	32.0	48.8	48.7	49.7
Sakina Keita	18.0	18.0	17.9	27.5	27.4	27.4	32.0	31.9	31.9	49.9	49.9	49.8

Table 2 Results of all split times and comparison between the corrected, uncorrected and manually obtained split times.

	10 m			20 m			30 m			40 m			50 m			60 m			70 m			80 m			90 m			100 m[1]		
Athlete	Manual	Corr.	Uncorr.	Manual	Corr.	Uncorr.	Manual	Corr.	Uncorr.	Manual	Corr.	Uncorr.	Manual	Corr.	Uncorr.	Manual	Corr.	Uncorr.	Manual	Corr.	Uncorr.	Manual	Corr.	Uncorr.	Manual	Corr.	Uncorr.	Manual	Corr.	Uncorr.
Amy Hunt	2.05	2.05	2.07	3.17	3.15	3.16	4.19	4.17	4.17	5.19	5.20	5.19	6.13	6.19	6.19	7.09	7.10	7.14	8.04	8.04	8.19	9.01	8.95	8.98	9.99	9.91	9.99	11.00	10.97	10.95
Ewa Swoboda	1.98	1.98	2.02	3.09	3.08	3.10	4.11	4.10	4.12	5.08	5.09	5.09	6.06	6.05	6.04	7.02	7.04	7.08	8.00	7.97	8.06	8.96	9.02	8.99	9.99	10.01	10.01	11.02	11.02	11.01
Delphine Nkansa	1.96	1.97	2.00	3.10	3.12	3.13	4.14	4.15	4.15	5.14	5.16	5.17	6.11	6.12	6.13	7.08	7.10	7.10	8.05	8.08	8.10	9.03	9.09	9.06	10.03	10.06	10.08	11.06	11.06	11.09
Géraldine di Tizio-Frey	1.96	1.96	1.99	3.07	3.07	3.09	4.10	4.10	4.11	5.09	5.09	5.09	6.05	6.06	6.07	7.02	7.09	7.09	8.01	7.99	8.06	9.00	9.01	9.05	10.02	10.06	10.06	11.07	11.07	11.12
Dina Asher-Smith	2.01	2.00	2.04	3.15	3.20	3.15	4.17	4.20	4.25	5.14	5.22	5.22	6.13	6.16	6.19	7.10	7.15	7.16	8.07	8.09	8.13	9.07	9.08	9.10	10.08	10.09	10.10	11.10	11.12	11.16
Patrizia van der Weken	2.04	2.02	2.06	3.15	3.22	3.22	4.20	4.25	4.23	5.17	5.21	5.21	6.13	6.17	6.18	7.11	7.13	7.14	8.08	8.13	8.15	9.06	9.11	9.11	10.06	10.09	10.09	11.10	11.09	11.07
Zeynab Dosso	1.98	1.96	2.00	3.10	3.09	3.10	4.13	4.13	4.13	5.12	5.12	5.12	6.10	6.10	6.09	7.08	7.11	7.10	8.06	8.08	8.11	9.06	9.10	9.09	10.09	10.09	10.11	11.12	11.12	11.18
Sakina Keita	2.10	2.08	2.12	3.31	3.31	3.33	4.37	4.40	4.38	5.42	5.42	5.42	6.42	6.43	6.42	7.41	7.44	7.43	8.41	8.45	8.40	9.42	9.47	9.40	10.44	10.47	10.49	11.51	11.54	11.55

[1] At 100 m the manual reference is the official finishing time. All values are given to 0.01 s, the resolution of the manual annotation.

CONCLUSION

AI-assisted sprint analysis provides race metrics that closely match manual analysis, while reducing analysis time from ~25 to ~5 minutes per race. This represents an ~80% reduction in expert analysis time, lowering personnel costs and freeing specialist resources. More importantly, the same resources can be used to analyse substantially more races and athletes, with relatively little additional cost as the system becomes increasingly automated.

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Do Athletes Train What Coaches Consider Ideal?
Reference–Practice Alignment Across the Annual Training Cycle in Elite Shooting

Dino Tartaruga[1,2], Miriam Berger, Ralf Kredel[2]

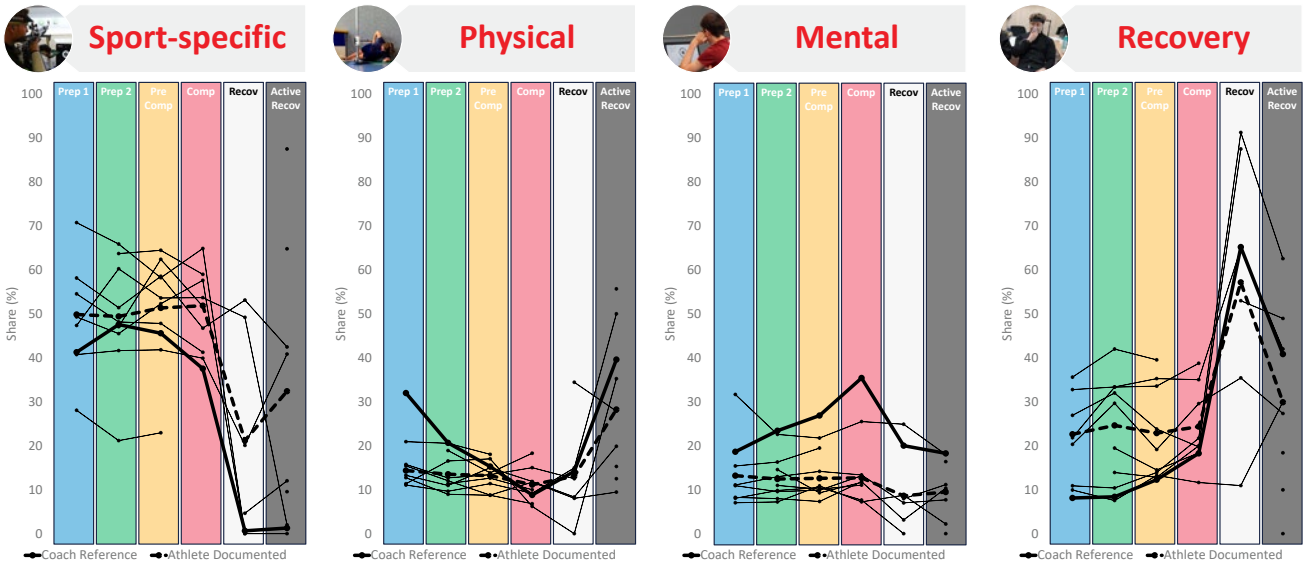
[1]Schweizer Schiesssportverband (SSV), [2]Institut für Sportwissenschaft, Universität Bern

Introduction
Periodisation structures training across a season. For Olympic shooting, specific guidance on how training content should be distributed is largely absent, and no prescription for the recovery process has been described [1]. Evaluating periodisation in practice requires asking whether documented training reflects the priorities coaches consider appropriate.

Problem Statement and Research Question
Documented training may differ from intended priorities due to individual adaptation, health, fatigue, competition schedules or documentation behaviour. Therefore, the following research question is relevant: To what extent does the distribution of training content documented by athletes align with the phase-specific distribution considered appropriate by elite shooting coaches?

Methods
Eight elite shooting coaches estimated the ideal distribution of training content across six phases of the annual cycle. Training data from nine athletes (FTEM: E1–E2) were extracted for the 2022 season from the athlete-management system.
Blank domain cells within a record were read as no documented training (= 0). Athlete–phase combinations without any record were treated as missing, as a relative distribution is undefined without volume. Of 54 possible combinations, 47 were analysed; coverage ranged from 9/9 athletes in Preparation 2 to 6/9 in Recovery.
Categories were harmonised into four domains; equipment-related activities were excluded. Each coach's distribution was rescaled to 100%, and the mean formed the coach-reference distribution. For each phase, the reference–practice gap was calculated as the documented share minus the coach-reference share. Positive values indicate a higher documented share than the reference; negative values indicate a lower share. All analyses were descriptive.

Results
Coaches periodise the composition of training; documentation does not. The coach reference for mental training rises from 18.6% in Preparation 1 to 35.4% during Competition. Documented mental shares stayed between 9% and 13% across phases, and every individual athlete's share remained flat (median individual range 8.7 pp against 17.1 pp in the reference). No athlete reached the competition reference value in any phase of the season (highest individual value 31.7%).
The mental share stayed below reference in every phase, and in four of six phases for every athlete: Preparation 2 (−11.0 pp; 9/9), Pre-competition (−14.3; 9/9), Competition (−22.7, range −28.2 to −9.9; 8/8), Active Recovery (−8.8; 8/8). In 9 of 24 phase × domain cells the gap shared the same sign in all athletes.



Discussion
No athlete-specific prescriptions were available: these are aggregated comparisons, not non-compliance. Whether the observed mental-training gap reflects actual training behaviour or documentation behaviour remains unclear. Of eight Olympic shooters interviewed elsewhere, five reported irregular or no mental training despite all considering it important [2].
Documentation is weakest where recovery management matters most: complete records covered 92% of build-up and competition phases but only 56% of the recovery phases. Those gaps are descriptive only — volume-weighting lowers the largest from +31.1 to +22.3 pp, while the mental gap during Competition holds (−22.6 vs. −22.7 pp).

Conclusion
Coaches intend the mental share to nearly double towards competition (18.6% → 35.4%). Documented training held it between 9% and 13% in every phase, and no athlete reached the competition reference value at any point in the season.
Documentation coverage was itself uneven: 92% of build-up and competition records were complete, against 56% in the recovery phases.
Distinguishing training behaviour from recording behaviour is a low-cost next step with direct consequences for how the squad plans and monitors the season.

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Filling a Gap in Swiss Talent Identification

Guided Self-Reflection with AI-supported Analysis for the PISTE «Psyche» Factor

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Keywords: Mindset Assessment · Talent Selection · AI-Assisted Qualitative Analysis · Self-Reflection · Trust · PISTE · Sport Psychology

SO WHAT !?

***"Talent sets the floor, character sets the ceiling."* - Bill Belichick, NFL Coach**

PISTE says psychological factors matter in talent identification, but the only tool left to assess them is trainer-observation with the LEMOVIS tool. **This project gives you the athlete's own voice:** A private, honest self-reflection journey an athlete does over 2–3 weeks, delivering a mindset profile, with zero extra work for you. We provide a solution to the challenge that it's simply not possible to sit down with every single one of your athletes in the PISTE talent pool.

01 INTRODUCTION

Swiss Olympic's PISTE framework flags psychological factors as part of talent identification - but three of four recommended self-report tools are discontinued. Only the trainer-rated LEMOVIS remains[1]. With 300+ PISTE candidates per year at Swiss Ice Skating, there is no scalable way to hear the athlete's own perspective through individual conversations. This project builds that missing piece: A guided self-reflection tool using voice and AI-supported qualitative data analysis.

02 RESEARCH QUESTIONS

1. Can a codebook of established psychology constructs be turned into an automated tool giving athletes and coaches an actionable mindset profile?
2. What makes athletes give honest, high-quality reflections?

What is qualitative data analysis?

Qualitative data analysis is the systematic process of turning non-numerical information - such as interview transcripts, field notes, or open-ended survey text - into meaningful insights. Its main goal is to uncover hidden patterns, core concepts, and human experiences.

03 METHOD

Codebook: Six traits (Grit, Discipline, Self-Confidence, Resilience, Competitiveness, Assertiveness) mapped onto three pillars, grounded in sport-psychology literature[2-7].

Proof-of-Concept (2025): 3 national-team speed skaters, 7–8 voice reflections over 4–6 weeks

MVP (2026–27): Swiss Olympic Innovation Hub–funded; athlete confirms every AI statement before it counts; planned integration into Swiss Ice Skating's PISTE process in 2027

Design Workshop: 7 athletes from Spitzensport RS 1/26, Magglingen

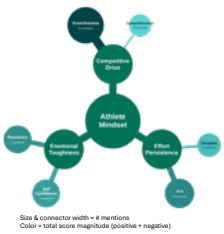
Score-Calculation using Qualitative Data Analysis:

- Each reflection is transcribed (OpenAI Whisper),
- then classified statement-by-statement to one of six traits by an LLM (Mistral 3, Swiss-hosted via Infomaniak; fixed seed, temperature 0, for reproducibility).
- Each classification carries a polarity (+1/–1) and strength (weak/medium/strong = 1/2/3).
- A trait's total score is the sum of polarity × strength across all its statements.
- AI services are Swiss-hosted via Infomaniak

04 RESULTS

The PoC data show interpretable trait profiles per athlete, with descriptive trait-mention frequencies and positive/negative reflection ratios (exploratory, not inferential).

Example Athlete Profile: 8 reflections / 23 days / avg. reflection length: ~3min



Competitive Drive

Trait	Mentions	% Positive	Pos. Score	% Negative	Neg. Score	Tot. Score
Assertiveness	13	85%	22	15%	-4	18
Competitiveness	3	67%	5	33%	-2	3

Effort Persistence

Trait	Mentions	% Positive	Pos. Score	% Negative	Neg. Score	Tot. Score
Discipline	4	100%	10	0%	0	10
Grit	8	87%	16	13%	-1	15

Emotional Toughness

Trait	Mentions	% Positive	Pos. Score	% Negative	Neg. Score	Tot. Score
Resilience	7	71%	12	29%	-4	8
Self Confidence	7	86%	12	14%	-2	10

Jeff Kitura, Head Coach Speed Skating

"...after three weeks and seven questions we had a read on my athletes' mindset that matched my own assessment remarkably well."

Central Findings of the Design Workshop:

- Good qualitative information requires honest athletes.
- Honesty requires trust in the tool, the task, and the federation.
- Trust is built through autonomy (talk → see what we understood → approve/disapprove), curiosity (learning about yourself), and never framing this as a test.

The MVP – How does it work?

Step 1: Question

Step 2: Voice Recording

Step 3: Statement Review

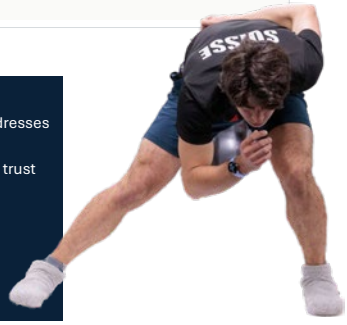
05 CONCLUSION

A codebook grounded in established sport-psychology theory translates practically into a low-burden, scalable format that directly addresses a documented gap in Swiss Olympic's own talent-ID guidance

The project has moved from PoC toward a near-ready MVP with the support of the Swiss Olympic Sport Innovation Hub. The insights on trust building elements from the athlete workshop already shapes the tool's design in practice.

Remaining Questions:

- How well this generalizes across PISTE's extensive age range,
- how trust-preserving design holds up at scale,
- and how the voice aspect may lower the barriers for athletes and improve the quality of the information.



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With the financial support of the Swiss Olympic Innovation Hub.

SCAN TO LEARN MORE About the MVP

SCAN TO LEARN MORE About scoretec

EHSM
Eidgenössische Hochschule für Sport Magglingen

Natriumbicarbonat im Radsport: Individuelle Bicarbonatantwort unter praxisnaher Wettkampfvorbereitung

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So What!? Produktwahl und Einnahmezeitpunkt von Natriumbicarbonat sollten für jede Athletin und jeden Athleten individuell und unter praxisnahen Bedingungen der Wettkampfvorbereitung getestet werden.

Einleitung

Die orale Einnahme von Natriumbicarbonat kann die Leistung bei hochintensiven Belastungen verbessern [1]. Ein Anstieg der Bicarbonatkonzentration ([HCO_3^-]) im Blut um mindestens 6 mmol/L gegenüber dem individuellen Ausgangswert wird als potenziell leistungsrelevant angesehen [2]. In der Studie von Jones et al. [2] wurde der zeitliche Verlauf von [HCO_3^-] im Blut unter Ruhebedingungen untersucht. Dabei zeigten sich grosse individuelle Unterschiede im Verlauf und in der Zeit bis zum höchsten [HCO_3^-]-Wert. Ruhebedingungen bilden die Wettkampfrealität jedoch nur unvollständig ab, da Athletinnen und Athleten vor dem Start jeweils eine individuelle Wettkampfvorbereitung absolvieren. Nach unserem Kenntnisstand wurde bisher nicht untersucht, ob ein potenziell leistungsrelevanter Anstieg von [HCO_3^-] im Blut auch unter praxisnahen Bedingungen der individuellen Wettkampfvorbereitung erreicht werden kann.

Fragestellung

Erreichen Athletinnen und Athleten mit individuell festgelegten Einnahmeprotokollen für Natriumbicarbonat unter praxisnahen Bedingungen ihrer individuellen Wettkampfvorbereitung zum simulierten Rennstart einen Anstieg von [HCO_3^-] im Blut um mindestens 6 mmol/L gegenüber dem individuellen Ausgangswert?

Methode

Bei 30 Athletinnen und Athleten aus den Swiss-Cycling-Nationalkadern Bahn und MTB wurden insgesamt 50 Testdurchgänge mit unterschiedlichen Produkten und individuellen Einnahmeprotokollen unter praxisnahen Bedingungen der Wettkampfvorbereitung durchgeführt. Jeder Testdurchgang wurde dahingehend beurteilt, ob zum simulierten Rennstart ein Anstieg von [HCO_3^-] im kapillären Blut um mindestens 6 mmol/L gegenüber dem individuellen Ausgangswert erreicht wurde.

Resultate

In 21 von 50 Testdurchgängen (42 %) wurde zum simulierten Rennstart ein Anstieg von [HCO_3^-] im Blut um mindestens 6 mmol/L gegenüber dem individuellen Ausgangswert erreicht (Abbildung 1A). Insgesamt erreichten 18 von 30 Athletinnen und Athleten diesen Anstieg in mindestens einem Testdurchgang. Auch bei Testdurchgängen mit demselben Produkt variierten der zeitliche Verlauf und die Höhe des [HCO_3^-]-Anstiegs (Abbildung 1B).

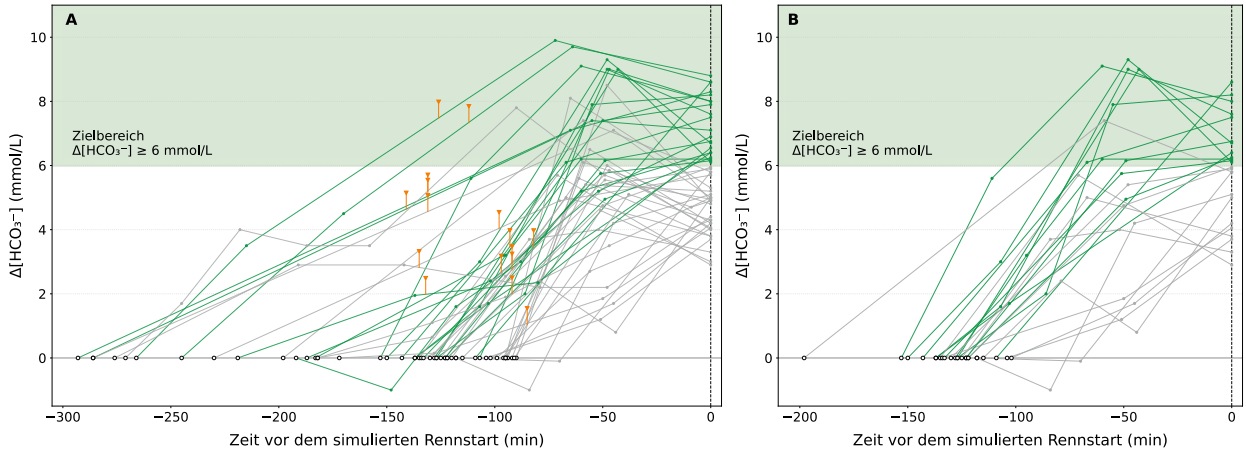

Abbildung 1: Veränderung des [HCO_3^-]-Werts im Blut gegenüber dem individuellen Ausgangswert. Jede Linie repräsentiert einen Testdurchgang. ***A:*** *alle eingeschlossenen Testdurchgänge (n = 50);* ***B:*** *Maurten-Testdurchgänge (n = 24). Grüne Verläufe erreichten zum simulierten Rennstart Δ[HCO_3^-] ≥ 6 mmol/L, graue Verläufe erreichten Δ[HCO_3^-] < 6 mmol/L. Offene Kreise markieren die erste Einnahme, orange Dreiecke eine gegebenenfalls zweite Einnahme.*

Schlussfolgerung

Der angestrebte Anstieg von [HCO_3^-] im Blut um mindestens 6 mmol/L gegenüber dem individuellen Ausgangswert wurde mit den untersuchten Produkten und Einnahmeprotokollen nicht in allen Testdurchgängen und nicht bei allen Athletinnen und Athleten erreicht. Die Variabilität der [HCO_3^-]-Antwort im Blut auch innerhalb der Testdurchgänge mit demselben Produkt spricht dafür, Produktwahl und Einnahmezeitpunkt individuell und unter praxisnahen Bedingungen der Wettkampfvorbereitung zu testen.

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Which side to go? Digital Twins allow to Optimal Routing in Olympic Sailing

Keywords: decision support system, digital twin, stochastic routing, wind forecast, sailing strategy

Introduction

In Olympic sailing, choosing which side of the course to protect is often the difference between winning and losing. When racing upwind, a boat must zigzag toward the mark. The fastest route depends on wind distribution across the course and on how the boat performs at different wind speeds and angles. Olympic classes like iQFoil, 49er, ILCA, Formula Kite, 470, and Nacra 17 differ substantially—for instance, optimal angles: boat 1 peaks at x°, boat 2 at y°.
Traditional routing tools used in offshore racing fail at the Olympic scale. The spatial resolution of weather models is too low, comparable to the whole racing area size, and temporal resolution exceeds race duration. Building on the "Meteo and Tidal" project that supported the Swiss Sailing Team through Paris 2024, we developed a stochastic approach to overcome these limitations.

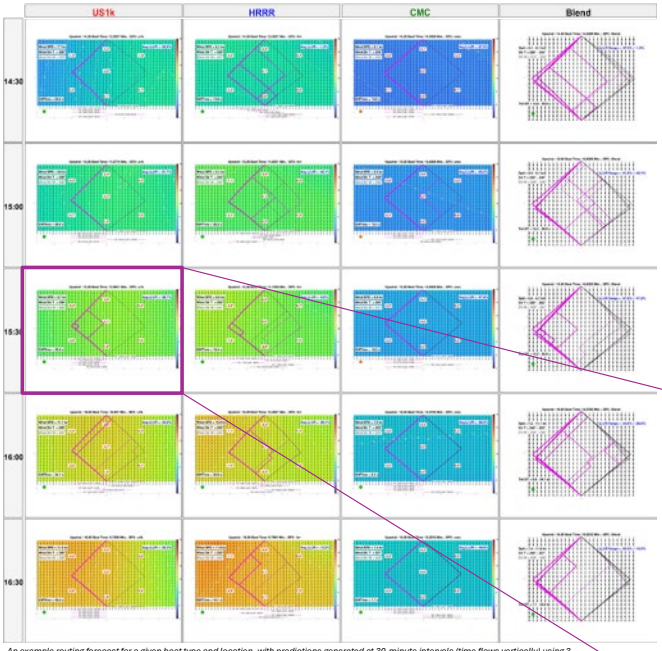
Research question: How can we give to the athletes before the race, for a given Olympic class and racing course, the optimal route?
In order to achieve this, three key factor have to be met: 1) reliable wind forecast for the racing course and time, 2) top-performance data-based digital twin for each boat class, and 3) on the basis of 1-2, the optimal route, as an actionable forecast of the winning lane.

During the preparation for the Olympic Games in Paris (Marseille for sailing), the winning lanes of hundreds of upwind legs were analysed and filtered by scenarios and classes to let emerge winning pattern on the racing courses. Even if reliable, it was a slow and time-consuming process. These are two samples of the data we collected in 2022 and 2023 ready only few month before the Games.

Sailing **experience is crucial** to make right strategic decision, what if we can **accelerate the process by predicting winning lanes**?

So what !?

- **Stats over instinct:** digital twin data identifies the faster route per boat class.
- **Statistically robust:** Clear winner = commit; tight margin = check that out!
- **Efficient prep:** Dashboard automates analysis, saving focus for race tactics.



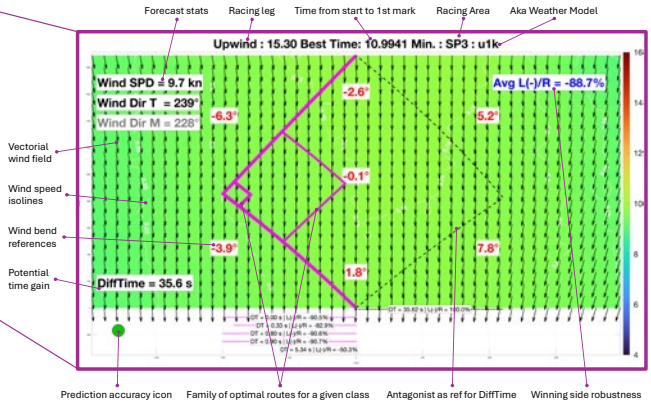
An example routing forecast for a given boat type and location, with predictions generated at 30-minute intervals (time flows vertically) using 3 weather models (one for each column). Colours indicate the wind magnitude, arrows the wind direction (see zoom on the right for further details).

Method

Boat performance For each class, we construct a data-based digital twin. Raw GPS data is purchased from the SAP Sailing platform, providing tracking from internationally recognised events of the past Olympic cycle. We filter the top-ten competitors and extract their speed data. From this raw material, our team performs all subsequent processing — cleaning noise and spikes, post-processing, and building the final performance model. The model accounts for moding — adjustments crews make to optimise the boat's setup for wind intensity and desired upwind angle. This is not a theoretical specification but a digital twin reflecting real-world speeds shaped by our own analysis.

Wind field Wind data is sourced through our partnership with Meteomatics, providing access to multiple weather forecast models. By querying several models for the same time and location, we generate a range of plausible wind fields. Additional variation is introduced by accounting for wind-direction oscillations, producing scenarios capturing inherent uncertainty. The reconstruction and validation of wind fields from real on-water measurements — core expertise contributed by CNR— bridges the gap between prediction and reality. During 2025 tests at Silsersee, wind fields reconstructed from instrumented marks validated forecast models against ground truth.

Solver For each scenario — defined by time, weather model, racing area, and boat type — the solver computes the minimum-time route using Sequential Quadratic Programming, developed with FHGR. The system explores multiple locally optimal solutions by varying the number of tacks (turns into the wind) and starting side. The output is a family of routes revealing sensitivity to input parameters.



Results

In 2025, the system was validated during test regattas at Silsersee with the iQFoil Youth Team, comparing computed routes against GPS-tracked winning lanes with satisfactory alignment.

In 2026, the tool moved to operational use during two stops of the Sailing Grand Slam circuit: Kiel (June) and Los Angeles (July), where racing took place at San Pedro and Long Beach — the future Olympic venues.

Key findings so far:
- The solver reveals numerous locally optimal solutions for the same scenario; families of solution showing the same pattern provide to robust solution.
- Solution sensitivity to weather model varies across scenarios — the tool helps to filter through the weather model offering winning option for each of them.
- Class-specific routing is a structural necessity: different boat types produce distinctly different families of optimal routes under the same wind conditions.

Conclusions

The project demonstrates that a data-based digital twin combined with multi-model wind forecasts and a rigorous solver can produce actionable routing guidance at the Olympic scale.
For coaches, the practical value is twofold: class-specific guidance on which side to protect before the start, and revelation of when solutions are stable or unstable to prioritise factors to monitor during racing. The system functions already; however, it requires further calibration not yet completed. We are validating predictions by comparing routing from the digital twin with actual race tracking data and on-field wind measurements. This ongoing validation is essential to build coaches' trust in the tool. The project is meant continue through the Los Angeles Test Event 2027, aiming for full operational readiness for the Olympic Games 2028.

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SUi sailing team | FH GR Fachhochschule Graubünden University of Applied Sciences | meteo matics | Consiglio Nazionale delle Ricerche

SWISS OLYMPIC SCIENCE AWARD 2026

Der virtuelle Windkanal: Mit KI, Kamera und Coach zur aerodynamisch perfekten Position im Ski Alpin

Eine Interventionsstudie am Sportgymnasium Davos

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Keywords · Ski Alpin · Aerodynamik · Frontfläche · Echtzeit-Feedback · Motorisches Lernen

SO WHAT!?

In den Speed-Disziplinen des alpinen Skirennsports geht bis zur Hälfte des gesamten Energieverlusts auf den Luftwiderstand zurück. Die Hockposition ist die Haltung, über die Athlet*innen ihn direkt beeinflussen können. Für ihr gezieltes Training fehlte bislang eine standardisierte Methode mit unmittelbarem, objektivem Feedback. Der virtuelle Windkanal schliesst diese Lücke. KI, Kamera und Coach machen die aerodynamische Position erstmals im Trainingsalltag messbar und trainierbar. Das Training ist sicher, wetterunabhängig und jederzeit wiederholbar (Morath, 2026).

Training der aerodynamischen Hockposition. Live gemessen, sofort zurückgemeldet und funktional überprüft durch den Trainer.

12 EINHEITEN · 7 WOCHEN · SPORTGYMNASIUM DAVOS

Messaufnahme im virtuellen Windkanal. Hockposition in kompletter Rennausrüstung vor Greenscreen. Bild FH Graubünden

EINLEITUNG UND FORSCHUNGSFRAGE

In der Abfahrt entscheiden Hundertstel. Die Luftwiderstandskraft wächst quadratisch mit der Geschwindigkeit, ihre Reduktion gewinnt mit dem Tempo daher überproportional an Bedeutung (Elfmark et al., 2021). Von ihren Bestimmungsgrössen ist die projizierte Frontfläche die einzige, die Athlet*innen unmittelbar und kurzfristig beeinflussen können. Eine standardisierte Trainingsform mit objektivem Feedback fehlte dafür bislang. Daraus folgt die Frage der Studie. **Verbessert ein siebenwöchiges Training mit dem virtuellen Windkanal, verglichen mit regulärem Training, die aerodynamische Qualität der Hockposition von Nachwuchsathlet*innen?** (Morath, 2026)

STUDIENDESIGN

Quasi-experimentelles Prä-Post-Kontrollgruppendesign
N = 27 · 20 Intervention / 7 Kontrolle
12 Einheiten in 3 Phasen über 7 Wochen
Beide Messzeitpunkte ohne Feedback
Rund 20 Minuten pro Athlet*in und Einheit
Auswertung ANCOVA mit PRE-Wert als Kovariate (Morath, 2026)

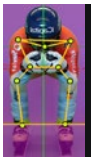
METHODE

So wird aus einem Kamerabild Training.

01

Position einnehmen

Komplette Rennausrüstung. Standardisiert vor der Frontkamera.



02

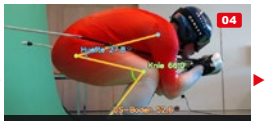
Die Software misst
Silhouette und projizierte Frontfläche

03

Sofort verstehen

ENDGESCHWINDIGKEIT
134.6 km/h

Eine kleinere Fläche erscheint direkt als höherer Tempowert.



04

Der Coach vergleicht
Haltung und Winkel mit der Zielposition

05

Wiederholen. Lernen.

Intervalle machen eine gute Position reproduzierbar, nicht nur zufällig erreichbar.

Resultate

-16 % Frontfläche in 7 Wochen. Im Modell +12 km/h.*

TRAININGSGRUPPE -16 % · KONTROLLGRUPPE -4 %

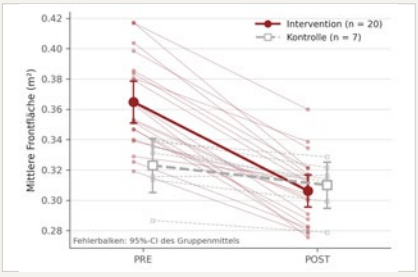
Das entspricht rund 10 Metern Vorsprung auf einer 250 m langen Gleitpassage.**

20 von 20

Athlet*innen verkleinerten ihre Frontfläche. Ohne Ausnahme.

BEREINIGTER TRAININGSEFFEKT
-280 cm²
Zusätzlich gegenüber der Kontrollgruppe, für den unterschiedlichen Startwert bereinigt.
Entspricht -0.028 m² · 95%-KI [-0.044; -0.013] · p = .001 · d = -1.33

PRE und POST massstäblich übereinander, rot die Flächenreduktion der Trainingsgruppe. Von 0.365 auf 0.306 m², rund 590 cm² und damit fast ein A4-Blatt. Bereinigter Gruppenunterschied 280 cm².



Frontflächenverläufe beider Gruppen von PRE zu POST. Dünne Linien zeigen individuelle Verläufe (Intervention rot, n = 20, Kontrolle grau, n = 7), grosse Marker zeigen die Gruppenmittel mit 95%-Konfidenzintervall (Morath, 2026).

* Rohwert der Trainingsgruppe (0.365 auf 0.306 m², das entspricht -16.2 %). Die Geschwindigkeitsangabe ist ein Modellwert aus dem konstanten Widerstandsmodell (v ~ 1/√A) und entspricht rund +9 % oder gut +12 km/h bei einer für die Speed-Disziplinen typischen Referenzgeschwindigkeit von 130 km/h. Der adjustierte, um den Ausgangswert bereinigte Gruppenunterschied beträgt -0.028 m² (rund -7.7 %, im Modell rund +5 km/h). Alle Werte im Simulator gemessen, keine Messung auf Schnee.

** Modellabschätzung. Endgeschwindigkeit im konstanten Modell (v ~ 1/√A), Zeitgewinn linear skaliert nach Brownlie et al. (2010), wonach 5.2 % mehr Luftwiderstand 0.19 s über 250 m kosten.

SCHLUSSFOLGERUNG

Training im virtuellen Windkanal verbessert in Verbindung mit dem begleitenden Coach-Feedback die funktionale aerodynamische Position messbar und robust. Nächster Schritt ist der Transfer auf Schnee.

AUSBLICK

Verbesserte Erfassung der funktionalen Position (Kraftmessplatte und/oder verbesserte Pose Estimation) · Robustere Erfassung der Frontalfläche · Cloud-Infrastruktur · Rollout an nationale Leistungszentren

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GOOD PRACTICE IN MATCH- UND PAUSENANSPRACHEN IM FRAUENFUSSBALL

Eine gesprächslinguistische Analyse zielführender Kommunikation in Traineransprachen

Mirjam Strässle
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Keywords: Fussball, Match- und Pausenansprachen, Kommunikation

Mirjam Strässle

So What!?
Relevanz für die Praxis

Match- und Pausenansprachen dienen der Motivation und bereiten Spieler*innen auf den Match vor. Die Ergebnisse dieser noch laufenden Dissertation sollen zu einem vertieften Verständnis der Trainer-Athleten-Kommunikation beitragen und helfen, die Mechanismen zielführender Match- und Pausenansprachen besser zu verstehen. Die bisherige Analyse zeigt, dass unter anderem strukturierende Elemente, aber auch gezielte Wörter zur Aufmerksamkeitssicherung die Effektivität von Traineransprachen erhöhen.

AUSGANGSLAGE

Bisherige Analysen zu Traineransprachen untersuchten das Thema vor allem quantitativ und anhand imaginärer Szenarien. Dabei lag der Fokus mehrheitlich auf der Kategorisierung der Ansprachen sowie deren Effekten auf Aspekte wie Motivation oder Selbstwirksamkeit (Lutz 2022: 69, 199). Es fehlen also qualitative Studien, die den Übermittlungsprozess von Traineransprachen betrachten.

Für dieses Dissertationsprojekt wurde eine U20-Frauenfussball-Mannschaft während der Saison 25/26 begleitet, mit dem Ziel, aus den Daten eine *Good Practice* für zielführende Traineransprachen zu entwickeln. Dabei werden die Perspektiven von Trainer*innen und Spielerinnen berücksichtigt.

FRAGESTELLUNG

Lässt sich sprachliches Handeln in den Daten als gelungen bewerten – auch in Bezug auf die Ziele der Trainer*innen und Spielerinnen? Lässt sich das so systematisieren, dass eine *Good Practice* für Match- und Pausenansprachen formuliert werden kann?

METHODE

Die Dissertation verortet sich im Gebiet der Sprachwissenschaft. Die *Good Practice-Analyse* befasst sich mit gelungener mündlicher Kommunikation und leitet daraus Lösungen für kommunikative Probleme ab. Als Methode dient dabei die Gesprächsanalyse.

Proband*innen:
20 Spielerinnen zwischen 16 und 20 Jahren sowie
3 Trainer und 2 Trainerinnen

1. Datenbeschaffung
Audio- & Videoaufnahmen von 27 Ansprachen; Befragung der Trainer*innen (mündlich) und Spielerinnen (schriftlich)

→

2. Qualitative Analyse
Analyse der Einzelansprachen unter Einbezug der Perspektiven von Trainer und Spielerinnen.

→

3. Vergleichende Analyse
Analyse aller Ansprachen zur Ausarbeitung einer *Good Practice*. → [Analyse noch nicht abgeschlossen]

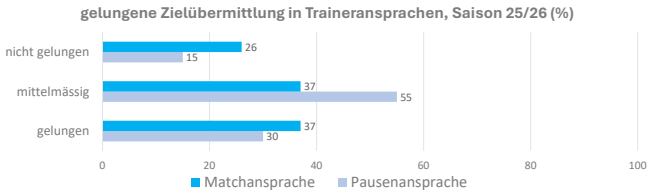
Bei der vergleichenden Analyse wurden die Ansprachen in ein Spektrum von GELUNGEN bis NICHT GELUNGEN eingeteilt. Nicht gelungene Ansprachen wurden nicht für die *Good Practice*-Analyse berücksichtigt.

Fragebogen Spielerinnen und Trainer*innen

SCHLUSSFOLGERUNG

- Die laufende Analyse zeigt, dass sich Match- und Pausenansprachen nach ihrem Gelingen beurteilen lassen. Einige Ansprachen sind also erfolgreicher als andere, wobei mit einem Spektrum von GELUNGEN – MITTELMÄSSIG GELUNGEN – NICHT GELUNGEN gearbeitet werden muss. Ebenfalls hat sich gezeigt, dass nicht ganze Ansprachen als (nicht) gelungen bewertet werden können, sondern eher Sequenzen innerhalb von Ansprachen.
- Erfolgreiche Ansprachen unterscheiden sich in ihrer sprachlichen Realisierung von nicht erfolgreichen. Es wird somit möglich, Strategien zur erfolgreichen Inhaltsübermittlung auszuarbeiten. Nachfolgend werden erste Ergebnisse dazu gezeigt; die Analyse wird in den kommenden Monaten abgeschlossen.

BISHERIGE ERKENNTNISSE

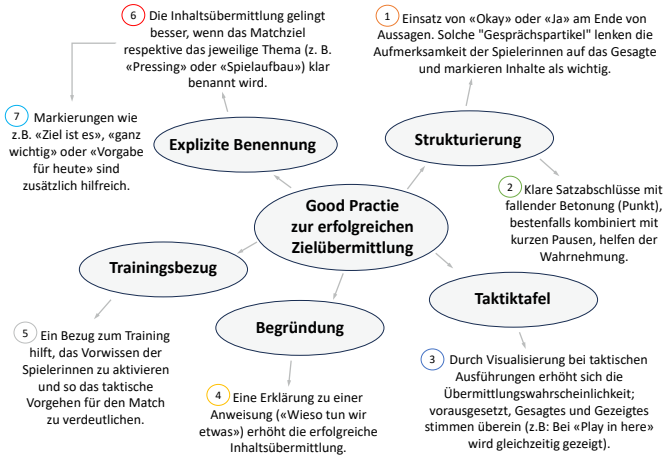


Bei der erfolgreichen Zielübermittlung gilt: Je mehr Spielerinnen dasselbe Ziel nennen, desto erfolgreicher wird die sprachliche Übermittlung innerhalb einer Ansprache bewertet. Bei einer Übereinstimmung von ≥ 70% gilt die Zielübermittlung als "gelungen", bei 50-69% als "mittelmässig" und bei ≤ 49% als "nicht gelungen".

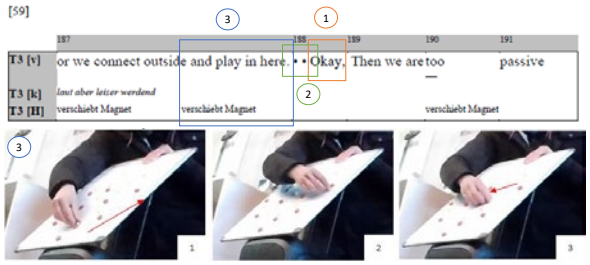
Information zur Transkription

•	Pause von ¼ Sek.	—	spezielle Wortbetonung	[k]	Kommentare zur Red-Art (z.B. *schnell*, *laut*)
••	Pause ½ Sek.				
•••	Pause ¾ Sek.	[v]	Gesagtes	[H]	Handlung / Gestik

Ausschnitt 1: Beispiel einer transkribierten Matchansprache



Ausschnitt 2: Beispiel einer transkribierten Pausenansprache



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Performance Modelling and Manoeuvre Scoring in Formula Kite

Keywords : performance analysis, manoeuvre evaluation, instrumented board, data-driven coaching

Introduction

In most Olympic sports, coaches rely on objective data to assess athletes — split times in swimming, power output in cycling, force plates in athletics. In **Formula Kite** (Olympic kiteboarding on hydrofoils), such tools have been largely absent. Coaches typically evaluate performance through visual observation alone, making it difficult to track progress objectively or compare athletes quantitatively.
Our project aimed to fill this gap by developing two tools: (1) a **performance model** that identifies which body actions and equipment settings most influence speed, and (2) a **scoring system** to rate the quality of manoeuvres (turns) — the moments where races are often won or lost.

So what !?

Targeted training. The model identifies actions that truly impact speed.
Numeric scoring. Three metrics make manoeuvre evaluation objective.
Visible biomechanics. The SenseBoard reveals under-foot forces, previously impossible to measure.

Karl Meeder, Formula Kite Youth Medalist, Swiss Sailing Team, Photo: Sailing Energy

Research Questions: Which measurable parameters have the greatest impact on sailing speed, and how can we score manoeuvres objectively so coaches can give targeted feedback?

Method

Athletes: elite Swiss Formula Kite riders
Instruments used: GPS tracker on each rider (speed, direction, board angles), **load sensors** on kite lines (how hard the kite pulls), **SenseBoard** — a custom instrumented board developed with UNIL/EPFL that measures forces under each foot and body weight shifts
What we measured: Speed, direction, board heel (lean), pitch (nose up/down), kite line tension, foot forces, body position, wind conditions
What we analysed: ~40 speed runs and 245 turns (168 tacks, 77 gybes). We used statistical methods to determine which parameters best explain speed differences and built three scoring metrics to rank each manoeuvre

Results

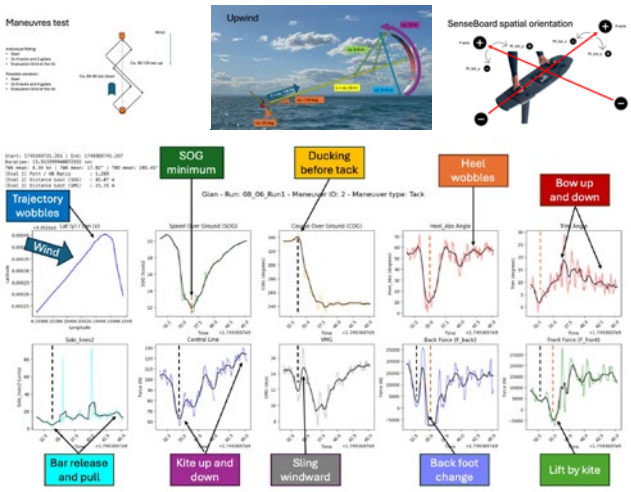
Speed Model: We found that speed can be predicted from a small set of measurable factors with good accuracy (**80% of speed variation explained**; rising to **86%** when foot-force data from the SenseBoard is included).
The most influential factors were:

- **Board heel angle** — how much the board leans
- **Trim/pitch** — nose up or down
- **Kite line tension** — how hard the kite is pulled
- **Direction changes** — how smoothly the rider steers

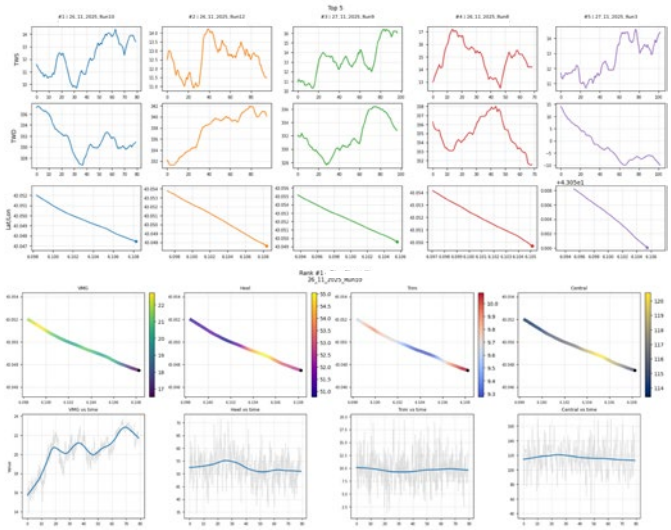
These are all parameters the athlete can actively control and the coach can train.
Manoeuvre Scoring System: Three simple metrics were developed to rate each turn:

- **Trajectory efficiency**: distance wasted vs. straight-line path
- **Speed retention**: how much speed is lost during the manoeuvre
- **Position gain**: progress up/down-course during the manoeuvre

Each manoeuvre gets three scores, allowing coaches to pinpoint specific weaknesses (e.g., a rider who turns efficiently but loses too much speed, or one who keeps speed but drifts too much in the turn).



Manoeuvre in detail: after being ranked, each tack or gybe (turns upwind or downwind) can be studied with this dashboard



Performance analysis of straight-line runs: top five sorted and ranked, with the best run examined in detail below

Conclusions

This project brings Formula Kite closer to the data-driven coaching standards of other Olympic sports. We identified the physical parameters that most affect speed and created an objective scoring system for manoeuvres. The SenseBoard proved viable despite being in early development. More data collection will refine the model, but the foundation enables evidence-based feedback from day one. Future work will extend scoring to race starts and mark rounding.

Authors

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Romain Corbel – EPFL Student

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Höhentraining verbessert die Leistungsfähigkeit und die hämatologischen Parameter bei Elite-Handbiker*innen mit Querschnittslähmung

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Einleitung

Die positiven Auswirkungen des Höhentrainings auf nicht behinderte Sportler sind gut belegt.[1-4] Für Sportler mit einer Rückenmarksverletzung (SCI) liegen jedoch nur begrenzt Erkenntnisse vor.[5, 6] Eine Rückenmarksverletzung beeinträchtigt neben den sensorischen und motorischen Funktionen auch das autonome Nervensystem. Dieses steuert unter anderem viele physiologische Funktionen der Organe und kann daher auch die Anpassungsfähigkeit gegenüber externen Stressfaktoren beeinflussen.[8-11]

Fragestellung

Ist die Durchführung eines Höhentrainingslagers bei elite-Handbiker*innen möglich und welche Veränderungen der Leistungsfähigkeit und hämatologischen Parametern treten auf.

Methode

In zwei aufeinander folgenden Jahren, wurde ein dreiwöchiges Höhentrainingslager durchgeführt. Sportler*innen wohnten dabei auf 2020 Metern Höhe, während das Training entweder in dieser Höhe oder im Tal auf 650 Metern durchgeführt wurde. Vor und nach jedem Trainingslager wurden die maximale Sauerstoffaufnahme ($\dot{V}O_{2peak}$), die relative maximale aerobe Leistung (rPO_{max}) und die Hämoglobinmasse (Hb_{mass}) bestimmt.

Tabelle 1: Höhenexposition und Trainingscharakteristika der einzelnen Trainingslager

	Jahr 1	Jahr 2
Höhenexposition		
Tage (Total)	19	24
Stunden (pro Tag)	19 (0)	20 (0)
Stunden (gesamt)	369 (4)	483 (3)
Trainingsstunden		
Tiefe Höhe	25 (3)	26 (4)
Mittlere Höhe	13 (3)	19 (5)
Total	38 (7)	46 (6)
Wochen TSS		
Tiefe Höhe	519 (77)	378 (112)
Mittlere Höhe	214 (77)	310 (103)
Total	733 (181)	688 (103)
Trainingslager TSS		
Tiefe Höhe	1410 (209)	1294 (385)
Mittlere Höhe	580 (208)	1063 (354)
Total	1990 (491)	2358 (354)

TSS = Training Stress Score. Mittelwert (Standardabweichung) angegeben. Tiefe Höhe ≤1200m.ü.M., Mittlere Höhe 1250-3000m.ü.M. [4]

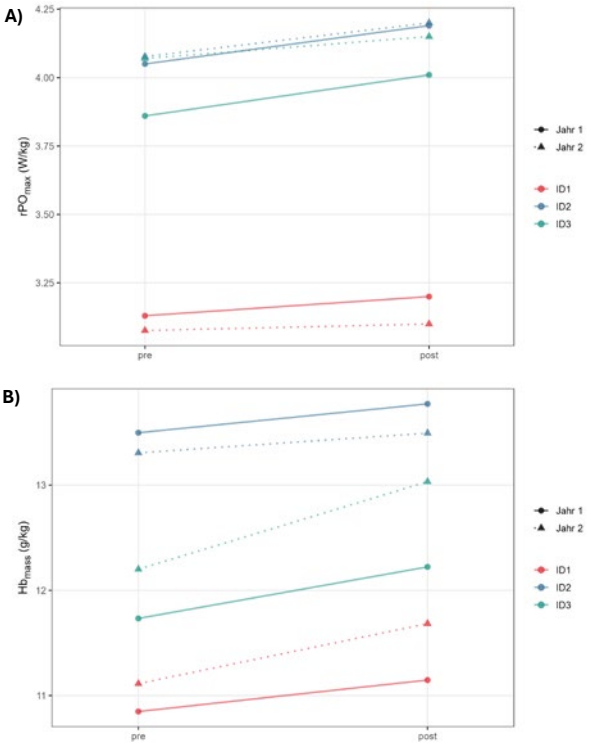
Resultate

Alle drei Athleten absolvierten beide Trainingslager, was die Durchführbarkeit des angewandten Protokolls belegte. Die Athleten verbrachten im ersten Jahr durchschnittlich 369 (4) Stunden und im zweiten Jahr 483 (3) Stunden in der Höhe (Tabelle 1). Im Durchschnitt der Trainingslager und über alle Athlet*innen hinweg verbesserten sich die Werte für $\dot{V}O_2$peak (3,5 %), rPOmax (2,5 %) und HBmass (3,7 %).

Keywords

Para-Handbike, Höhentraining , Para-Sportler*innen, Hypoxie, aerobe Kapazität, Hämoglobinmasse, Rückenmarksverletzung

Abbildung 1: Resultate für A) die relative maximale Leistung (rPO_{max}) und B) relative Hämoglobinmasse (HB_{mass}).



Take home message

In dieser Untersuchung werden die Ergebnisse von zwei aufeinanderfolgenden Höhentrainingslagern zur Vorbereitung auf einen Grossanlass bei drei Spitzensportler*innen mit Rückenmarksverletzung präsentiert. Die Ergebnisse lassen positive Auswirkungen auf die Leistungsfähigkeit und die hämatologischen Parameter erkennen. Diese müssen jedoch in künftigen und grösser angelegten Studien bestätigt werden.

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Die Zeit nach der Karriere beginnt während der Karriere

Ressourcen und Wohlbefinden rund um den Rücktritt aus dem Spitzensport

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Spitzensport, Karriereende, Ressourcen, Rücktritt, Übergang aus dem Sport

So What !?

Der Grundstein für einen erfolgreichen Übergang wird bereits während der aktiven Karriere gelegt. Trainer:innen können Athlet:innen unterstützen, wichtige Ressourcen für die *Zeit danach* aufzubauen.

Einleitung

Der Übergang aus dem Spitzensport in das Leben nach der Sportkarriere gilt als entscheidende Entwicklungsphase für das spätere Wohlbefinden (Stephan, 2003). Dabei verläuft dieser Übergang sehr unterschiedlich. Während die einen Athlet:innen den Rücktritt als Krise erleben, sehen die anderen darin eine Chance für einen Neuanfang und die persönliche Entwicklung (z. B. Schmid et al., 2026). Ein möglicher Grund dafür ist, dass es Typen von Athlet:innen gibt, die sich darin unterscheiden, welche Kombinationen von Ressourcen sie während ihrer Karriere aufbauen und im Übergang nutzen, um neue Anforderungen zu bewältigen (Stambulova, 2016).

Fragestellung

1. Welche Ressourcentypen lassen sich finden – vor, während und ein Jahr nach dem Rücktritt?
2. Wie stabil bleiben diese Ressourcentypen während des Übergangs?
3. Wie hängen diese Ressourcentypen mit dem Wohlbefinden nach dem Rücktritt zusammen?

Methode

Prospektive Längsschnittstudie

t_1: aktive Karriere — t_2: beim Rücktritt — t_3: 1 Jahr danach

- Athletische Identität
- Resilienz
- Selbstwert
- Soziale Unterstützung
- Wohlbefinden

N = 119 Schweizer Eliteathlet:innen

♀46%, ♂54%

$M_{Rücktrittsalter}$ = 29.3 Jahre

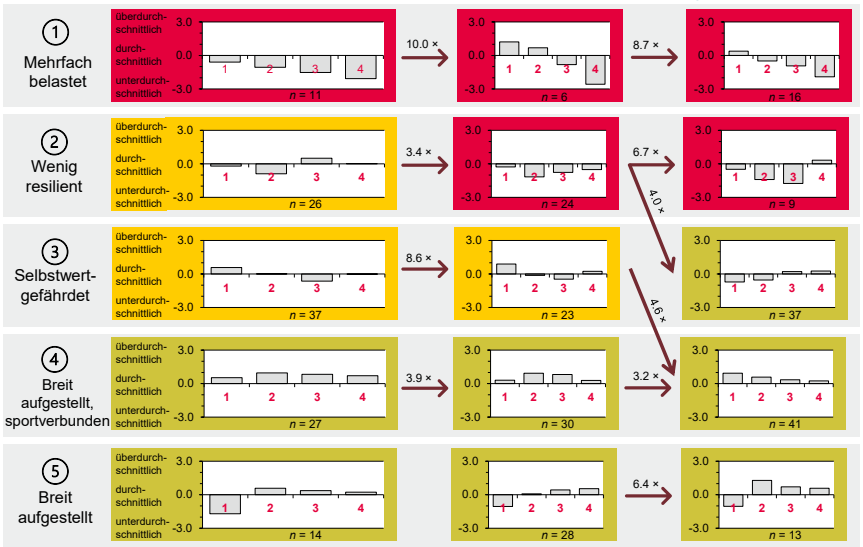
Clusteranalyse (LICUR) und Mixed ANOVA

Resultate

1 Fünf Ressourcentypen

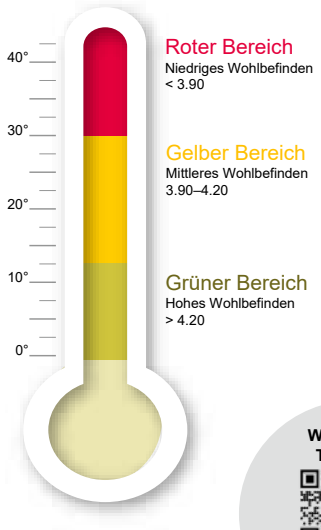
2 Typen bleiben weitgehend stabil

3 Typen unterscheiden sich im Wohlbefinden



Wohlbefinden-Thermometer

Die Temperatur visualisiert das gemessene Wohlbefinden (Skala 1–5; WHOQOL Group, 1998).



Weitere Tipps

Fazit

Vulnerable Ressourcentypen sind bereits während der aktiven Karriere erkennbar und bleiben über den Übergang hinweg weitgehend stabil. Für das Wohlbefinden scheint weniger eine einzelne Ressource als ihre Kombination bedeutsam zu sein. Die Förderung dieser Ressourcen sollte deshalb bereits während der aktiven Karriere ansetzen.

- ✓ Beziehungen ausserhalb des Sports stärken
- ✓ Selbstwert nicht ausschliesslich an den Erfolg im Sport knüpfen
- ✓ Frühzeitig Zukunftsperspektiven thematisieren
- ✓ Strategien zum Umgang mit schwierigen Karrierephasen fördern

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Modeling Kitesurfing: From Real-World Data to Predictive Performance Models

Keywords: kite surfing, performance analysis, performance prediction, data-driven model

Introduction

As in every racing sport, the goal in Formula Kite is to complete the course in the shortest possible time. However, optimizing performance is challenging because speed is influenced by many different factors. Some of these, such as wind speed or wind direction, are external conditions that the athlete cannot control, while others, including board handling and body position are directly influenced by the athlete. The goal of this project is to analyze real-world performance data and investigate the relationships between different parameters and how they affect the performance. Based on these insights, predictive models are developed to estimate the speed (or other performance metrics) from measurable input variables.

A Swiss Sailing Team Formula Kite Elite Squad athlete. Photo: Sailing Energy

So what!?

The developed performance models can be integrated into virtual environments to create simulations, allowing athletes and coaches to study how changes in specific parameters influence performance under controlled conditions.

Approaches such as reinforcement learning can be used to explore optimal strategies and identify actions that maximise speed in different racing scenarios.

This approach is not limited to kitesurfing. By collecting specific data, customized predictive models can be developed and adapted to the specific characteristics and performance objectives of different sports.

Research Question

Can data-driven models accurately predict an athlete's speed during both, straight line surfing and maneuvers, providing a foundation for virtual simulations that support performance optimization?

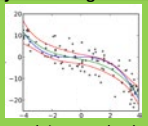
Methodology

A dataset containing real-world performance measurements was provided by the Swiss Sailing Team. The data was cleaned, processed, and analyzed to identify relationships between different performance parameters. Since straight line surfing and maneuvers involve fundamentally different dynamics, they were modeled separately. The following model approaches were used, evaluated and compared. The models were assessed based on their ability to reproduce the measured speed and predict performance accurately.

Linear Regression

Linear regression is a statistical method that models the relationship between variables by fitting the best straight line through the data.[1]

Polynomial Regression

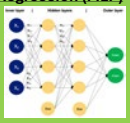


Polynomial regression is a statistical method that models the relationship between variables by fitting a polynomial function of degree *n* to the data.[2]

Random Forest Regression

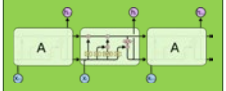
Random forest regression combines multiple decision trees. Within each tree, data is split based on feature values to produce a prediction.[3]

Multilayer Perceptron Regression (MLP)



MLP is a neural network consisting of connected layers of neurons that process inputs through weighted connections and nonlinear activation functions.[4]

Long-Short-Term Memory Network (LSTM)



LSTM is a neural network that uses previous inputs and internal memory states to learn patterns in sequential data.[5]

Results

The correlation analysis showed that the different parameters do not contribute equally to the athlete's speed over ground (SOG). Interestingly, when analyzing upwind and downwind surfing separately, the importance of individual parameters changed. Some variables had stronger influence during riding upwind, while others became more relevant when riding surfing. For straight line surfing, the most accurate predictions were achieved using a random forest regression model. The average difference between the predicted and measured SOG was only 0.37 knots, corresponding to an error of approximately 1.5%. For maneuvers, the LSTM was chosen, with an average prediction error of 0.7 knots or around 3.6%.

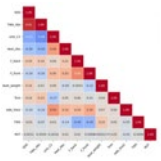


Fig 1: General correlation

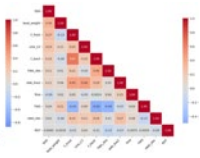


Fig 2: Upwind correlation

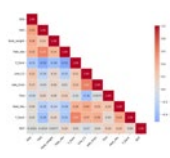


Fig 3: Downwind correlation

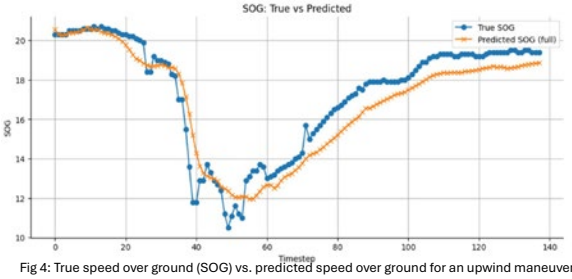


Fig 4: True speed over ground (SOG) vs. predicted speed over ground for an upwind maneuver.

Conclusion

The results demonstrate that even with a limited amount of data, accurate performance prediction models can be developed for a complex sport such as kite surfing. With larger datasets, these models could be further improved and provide even more precise predictions. Such data-driven approaches can support athletes and coaches in identifying areas for improvement and optimizing their performance. These models also have potential applications in athlete training by providing immediate feedback on adjustments that the athletes can do to improve their performance.

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Load Management in a Volleyball Academy in Switzerland - The Knowledge and Practice of Athletes and Coaches

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KEY WORDS Load Management, Youth Athletes, Coaches, Communication, Injury Prevention

SO WHAT?

- Load management mainly relies on communication.
- A trustworthy, safe, and healthy environment is needed for optimal athlete-coach communication and load management.
- School leaders and academy committees should establish a clear framework that defines everyone's roles, rights, and responsibilities.

INTRODUCTION

- Youth athlete development models and consensus recommend load management to prevent injury[1,2].
- Load management is complex, and its application faces multiple barriers[3].
- Little is known about how these principles are implemented in real-world youth sports settings.

AIM

To understand how load management is perceived and applied in a youth volleyball academy by exploring:

1. Why it is important
2. How it is implemented in practice

METHODOLOGY

- Qualitative approach
- Five focus groups (interviews) with 2 coaches and 24 Athletes (13-18 years old)
- Thematic analysis

RESULTS & DISCUSSION

"The aim is that they are progressing, so in a higher level that the movement is correct and avoiding injuries" (Coach)

1 WHY

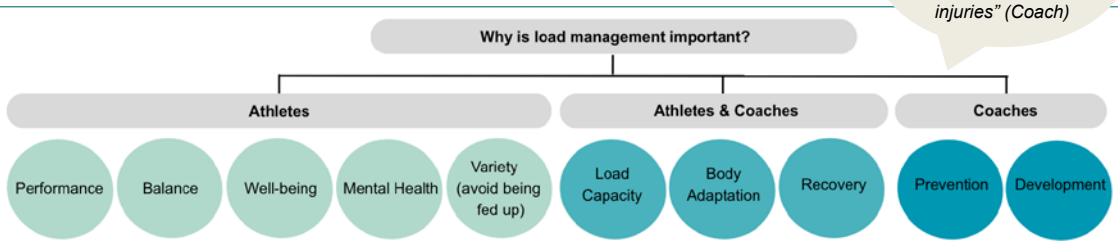

Figure: Representation of Athletes' and Coaches' Perception of Why Load Management is Important

2 HOW

"We always have a coach we like more, who understands us better." (Athlete)

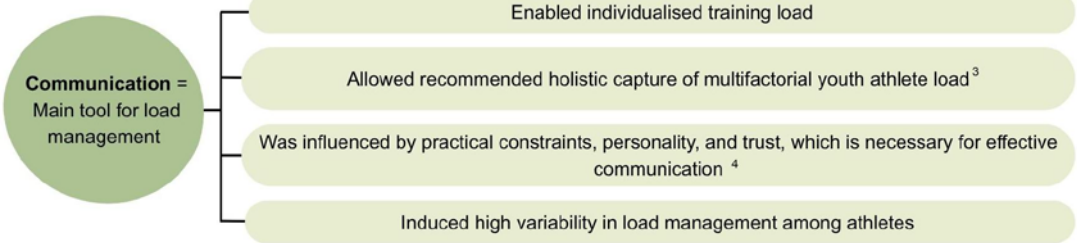

Figure: Representation of Results and Discussion on How Load Management is Implemented in Practice

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From Sprint Videos to a Technique Reference Model for the Max-Velocity Phase

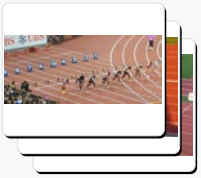
Sasha Pagani (EHSM), Dr. Solange Emmenegger (EHSM), Adrian Rothenbühler (Swiss Athletics)

Introduction

Video analysis and the ALTIS Kinogram are commonly used to assess sprint technique **(Bezodis et al., 2012; Bissas et al., 2018; Pfaff & McMillan, n.d.)**. However, technical evaluation largely relies on the coach's visual interpretation **(Lees, 2002; Whelan et al., 2016)**.
Markerless Human Pose Estimation offers the possibility to automatically extract kinematic information from conventional video footage without requiring markers or laboratory-based motion-capture systems **(Van Hooren et al., 2023)**.
The aim of this study was to determine which parameters are required to build a reference model of the max-velocity sprint phase and how this model can be visualised in a way that supports existing coaching practice.

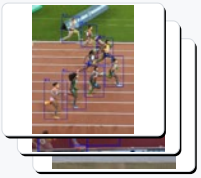
Methods

1 Competition videos



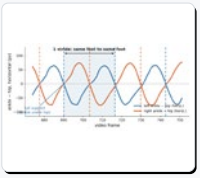
Multiple competition videos are analyzed — different competitions, many athletes.

2 Pose estimation & tracking



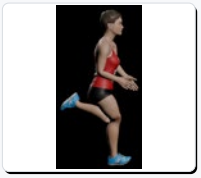
An AI model finds every athlete and tracks each joint, frame by frame.

3 Stride extraction & normalisation



For every track, individual stride cycles are extracted, quality-checked and normalised in space and time.

4 Reference model



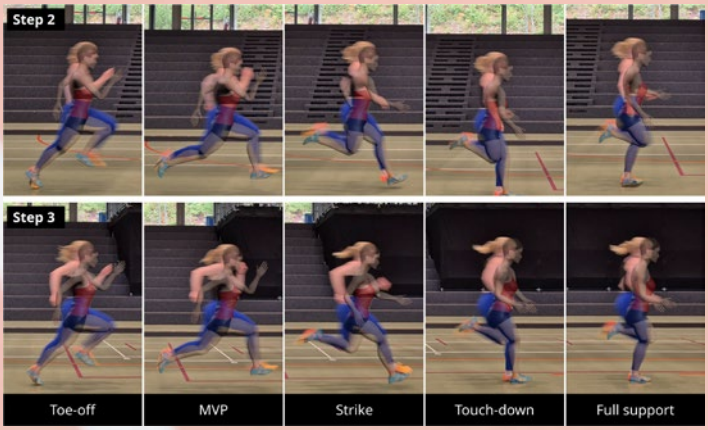
Selected high-quality strides are combined into one reference movement of the max-velocity phase.

So what!?

This study shows the potential to derive a sprint reference model for the max-velocity phase from existing race footage and use it for visual comparison with athletes filmed by their coaches , without markers or laboratory equipment.

Results

A reference model of the max-velocity sprint phase was generated from 11 high-quality strides across 6 athlete tracks and visualised as a 3D human model. Automatic detection of the five ALTIS Kinogram positions showed good agreement with manual annotation, with a mean absolute deviation of 0.56 frames across 106 annotated events.



Animated reference model!

Conclusions

Video analysis and the ALTIS Kinogram are commonly used by sprint coaches to assess running technique. However, technical evaluation largely relies on the coach's visual interpretation.
Markerless Human Pose Estimation offers the possibility to automatically extract kinematic information from conventional video footage without requiring markers or laboratory-based motion-capture systems.
The aim of this study was to determine which parameters are required to build a reference model of the max-velocity sprint phase and how this model can be visualised in a way that supports existing coaching practice.

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POSITIVE YOUTH DEVELOPMENT IN/THROUGH/AND DESPITE ELITE YOUTH SPORT

Identifying ideal-types of the person↔environment fit in former elite youth football players

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Keywords: talent development; coaching; parenting; football; relational developmental systems; qualitative research

INTRO 01

Positive Youth Development (PYD) in elite sport is not only about producing elite performers, but about developing athletes who stay engaged in sport (**participation**), develop psychosocial and emotional resources that extend beyond performance and remain valuable across life domains (**personal development**), and acquire resources that can become the foundation for elite **performance** (the 3Ps; Côté et al., 2014). Research has identified many characteristics of "optimal" talent development environments (for a review, see Hauser et al., 2022), yet the same environment, parent or coaching behaviour may not have the same effect on every athlete, and depends on how athletes actively interpret and respond to it. Drawing on Relational Developmental Systems theory (Lerner, 2021), we therefore examined how athletes and their social environments interact with each other over time.

QUESTION 02

A. What types of developmental pathways emerge from athletes' narratives of challenge and support in youth elite football?

B. How do interactions with parents and coaches shape participation, personal development, and performance (3Ps) and contribute to the person↔environment fit ?

METHOD 03

18 male former Swiss youth elite football players (Age: 26)

~60min. Semi-structured narrative interviews

Open-ended prompts to reconstruct their trajectories
use of graphical timeline to enhance structure

purposefully sampled (Koch et al., 2025)
from previous quantitative study to capture diverse developmental pathways, including professional and non-professional outcomes

Ideal-Type Analysis (Stapley et al., 2021)
Qualitative analysis that identifyies "ideal types" based on patterns of experiences with parents, coaches, and developmental processes

RESULTS 04

THE 4 IDEAL TYPES

FOUR DIFFERENT JOURNEYS. FOUR DIFFERENT OUTCOMES.

TYPE A — THE GUIDED

Characteristics — 3/5 Professionals
- Complementary parent-coach support
- Shared developmental project

Variations across cases
Different supportive social agents (e.g. cousins, mentor coaches, families)

Person↔environment mechanisms
E→P: tailored guidance from parents and coaches
P→E: athletes interpret adversity as a constructive challenge

Outcomes
Participation: sustained elite engagement
Personal development: self-efficacy and emotional regulation
Performance: professional progression

Illustrative quote
„I had the support to manage pressure and put things into perspective."

Recommendation
Maintain trust, reflect, and gradually give athletes more responsibility

TYPE B — THE REALIST

Characteristics — 0/4 Professionals
- Autonomy supportive family
- Diversified identity ("Plan B")

Variations across cases
Different resources to bear the costs of elite progression
(e.g. absence of pressure, psychological and physiological toll)

Person↔environment mechanisms
E→P: autonomy supportive families within a demanding football system
P→E: choosing their path freely when elite sport was no longer worthwhile

Outcomes
Participation: exit due to high costs of elite football
Personal development: transferable skills
Performance: development without pro-level

Illustrative quote
„I learned a lot on my path, but professional football was not for me."

Recommendation
Support their independence, but provide extra guidance during major transitions

TYPE C — THE FIGHTER

Characteristics — 4/5 Professionals
- Performance oriented support
- "I'll show you" mentality

Variations across cases
Different narratives of agency (e.g. limiting family involvement,
using rejection as motivation)

Person↔environment mechanisms
E→P: high demands from parents and coaches
P→E: actively managed to overcome challenges

Outcomes
Participation: sustained under pressure
Personal development: competitive mindset & persistence
Performance: gains through overcoming adversity

Illustrative quote
„Pressure made me stronger; I had to prove my worth."

Recommendation
Balance high challenge with regular recovery and check-ins to prevent burnout

Note: E=environment, P=person;

TYPE D — THE MISALIGNED

Characteristics — 0/4 Professionals
- Growing misalignment with elite sport
- Protective disengagement

Variations across cases
Different sources of misalignment (e.g. clash with football culture,
perceived unfairness)

Person↔environment mechanisms
E→P: Inconsistent football system and limited guidance from parents
P→E: interpreting setbacks as personal rejection

Outcomes
Participation: protective exit
Personal development: declining confidence, need for autonomy
Performance: progressive decline

Illustrative quote
„If the environment does not value me, I choose to step away."

Recommendation
Watch for early signs of withdrawal, use open dialogue, and adjust support

SO WHAT !?

MOVE BEYOND "ONE-SIZE-FITS-ALL"
Although fully individualised approaches are rarely feasible, our IDEAL-TYPES offer a practical idea to "semi-individualise" training environments and highlights four pathways to support participation, personal development, and performance.

CONTEXT IS SUBJECTIVE
The impact of challenge depends entirely on the athlete's current state, requiring coaches or parents to constantly adjust where, when, and how support is applied.

CONCLUSION 05

If PYD (i.e. the 3Ps) emerges through person↔environment fit, rather than universally "optimal" environments, parents and coaches should consider how challenging or supportive behaviours are interpreted by a particular athlete at a particular point in development. Thus, challenges, high expectations, critical feedback, and adversity can support the 3Ps, but only when athletes experience them as meaningful and manageable opportunities for growth rather than threats to competence or continued. This requires careful timing, transparent communication, ongoing support, and opportunities to jointly reflect on challenging experiences (for applied recommendations see: Kong et al., 2025).

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Wir danken dem SFV für die Zusammenarbeit

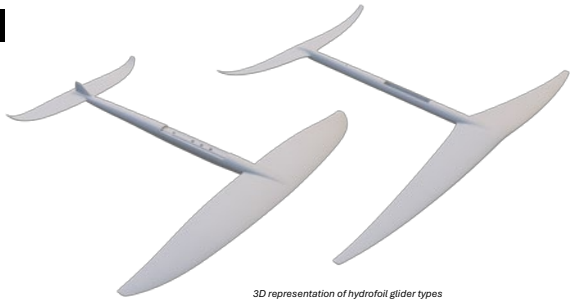
Rider-Specific Foil Performance in Formula Kite

Keywords : Formula Kite, equipment testing, paired comparison, individualisation, performance

Introduction

In nearly every sport, equipment selection matters — the right ski length, bike frame, or racket stiffness depends on the athlete. In **Formula Kite** (Olympic kiteboarding on hydrofoils), choosing the right **foil kit** (the hydrofoil set) is similarly critical. Yet equipment choices are often driven by brand reputation, anecdotal evidence, or what works for another athlete.
But what if the "fastest" foil for one rider is actually slower for another?

Research Question: Is one foil kit universally faster, or does equipment performance depend on the individual rider? This question goes beyond preference. A foil's performance depends on how it interacts with the rider's weight, body position, and sailing technique. Our study tested this directly by having two world-class athletes swap equipment under statistically comparable conditions.



3D representation of hydrofoil glider types

So what !?

- **Fit over fame** – Champion gear won't suit everyone. Individual fit beats brand prestige.
- **Test head-to-head** – Swap equipment between two athletes under identical conditions to isolate real equipment effects.
- **Re-test regularly** – Athletes evolve. Technique and weight changes mean optimal equipment shifts over time.

What else do you need to know before deciding whether to switch equipment?

Method

Athletes: Two elite Formula Kite riders: Athlete A (total sailing weight: ~112 kg), Athlete B (total sailing weight: ~111 kg)
Equipment: Two foil masts from different manufacturers (identified here as **Foil X** and **Foil Y** for confidentiality).
What we measured: Over three days (November 2025), both riders sailed **side by side at the same time**, swapping foils between runs.
What we measured: Speed over ground for each rider on each foil, separated by sailing direction — **upwind** (against the wind) and **downwind** (with the wind).
Two ways we analyse the data:
Side-by-side comparison – We look at how much faster/slower each foil performs at the same time, under the statistically comparable conditions.
Rider-by-rider review – We check how each rider performs with each foil separately, to spot individual preferences.
How we test (for both): First, we compare averages with basic stats. Then, we use regression models to measure the foil's impact while accounting for wind, course, and setup.

Results

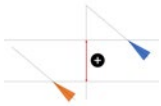
The headline finding: There is no universally faster foil. The best foil depends on who is riding it.

Upwind, neither athlete shows a meaningful difference (not statistically significant) between foils. In our research, the **downwind is where things differ**, Athlete A is significantly faster with Foil Y (+1.7 knots), while Athlete B gains a moderate edge with Foil X (+0.8 knots). In short, the optimal foil differs by rider—but primarily downwind; upwind, foil choice makes no significant difference.

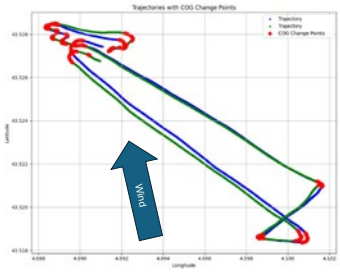
To put this in perspective: in Formula Kite, a 1.7-knot speed difference is substantial — roughly the margin between winning and losing a downwind leg in a race.

What this means:

- Athlete A was significantly faster downwind with Foil Y
- Athlete B was significantly faster downwind with Foil X
- Same wind, same day, same course — opposite conclusions
- Upwind, neither foil showed a clear advantage for either rider

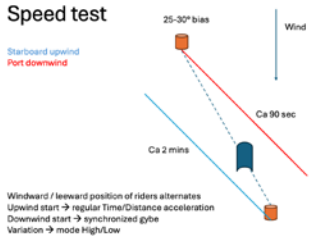


KPI for gain to the wind (VMG gain)



Example of GPS tracks collected while testing (North-up displayed)

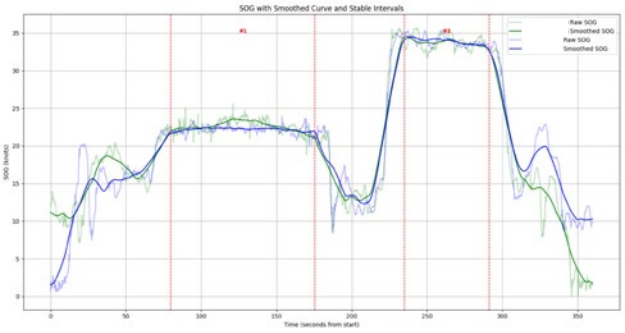
Two elite riders of the Swiss Sailing Team in testing configuration. Photo: Sailing Energy



Summary of the applied testing protocol

KPI for lateral gain

KPI for forward gain



Data filtering process; a parametric algorithm allowed using only consistent runs

Conclusions

Our findings challenge the assumption that a single "best" foil exists. Under statistically comparable conditions, two top elite riders showed opposite equipment performance gain downwind, with differences large enough to affect race outcomes. **The paired testing method we used is simple, robust, and applicable beyond Formula Kite.** Coaches should treat equipment selection as an ongoing, individualised process rather than a one-time decision based on external recommendations. In addition, **this testing process contributed to crucial decision-making in switching equipment** with positive impact in performance and results in competition.

Authors

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Romain Corbel – EPFL Student

How to select supplied Olympic equipment in Sailing

Keyword : data-driven, equipment testing, sailing, performance

Fig.1 : Picture of Elia Colombo on the iQFoil - 2024 Olympics (the hydrofoil on top-left)

Introduction

Olympic sailing events either require athletes to bring their own gear or use **supplied equipment;** the iQFoil Windsurfing is in the second category.

Due to performance differences from **manufacturing variations**, suppliers gave athletes sets of **equipment to test** before the Paris 2024 Olympics. Swiss athlete Elia Colombo had to choose his equipment from 2 boards, 4 sail masts and sails, and **4 foil sets** (mast, front wing, rear wing, fuselage).

Elia Colombo received his equipment in week 17 of 2024 and had to finalize his selection by week 28. Since the gear must remain in top condition and **time for testing is limited**, it's not possible to try all parts in every weather condition. To address this, we supported Elia and his coach **with mechanical and numerical testing** to choose the best equipment. This poster details the process for testing the 4 foil sets (more equipment has been tested with other processes).

So what !?

- We tested hydrofoil gears using mechanical, 3D scanning, and CFD methods.
- Key differences were found in mast thickness and wing shapes, affecting performance.
- Selected: torsionally stiffest mast and thinnest rear wing. Front wing choice remained suboptimal.

Providing an accurate performance prediction within regulatory constraints

Method

The process was divided into three phases:

1) Mechanical Testing:
All parts were weighed. The foil mast and front wing underwent bench tests to estimate **flexion** and **torsion** properties.

2) 3D Scanning:
We used a Hexagon Absolute Arm 87 and Hexagon AS1 3D laser scanner, with Polyworks Inspector and Modeler software. Foils were scanned in two steps, aligned and meshed into **STL models**, then cleaned and refined. 3D markers ensured accurate comparisons. The scans were analyzed and compared using **Best Fit function**, and a final report was generated.

3) CFD Simulation:
3D scans were prepared for ANSYS Fluent, and high-quality meshes were created. Steady-state **RANS simulations** with the SST k-ω model were run to determine lift and drag. **Multiple angles of attack** were tested to compare the **hydrodynamic performance** of different foil configurations.

Result

The testing process revealed that the foil mast's **flexion** properties correlate strongly with its **weight**, while its **torsional properties** are closely **linked** to its **thickness**.

The **Best Fit** function **identified** notable **variations** in the sections and overall shapes of components that were expected to be identical. Specifically, one foil **mast** was significantly **thicker** than the others, and the radii and curvatures of the **front wing tips** also **varied** substantially.

Converting the 3D scan data into a format suitable for **CFD** analysis proved to be **resource-intensive**. Moreover, the simulation results remain somewhat **ambiguous** due to the challenge of **separating** shape reconstruction **approximations** from the actual **performance differences** observed in the analysis.

To ensure the athlete's perceptions remained **unbiased**, Elia Colombo **tested** all the equipment **on the water before reviewing** any of the results and **findings**. A closed feedback loop was established to share the test results and gather his subjective impressions in response.

The athlete progressed through iterative testing, based on a mix of data and experience.

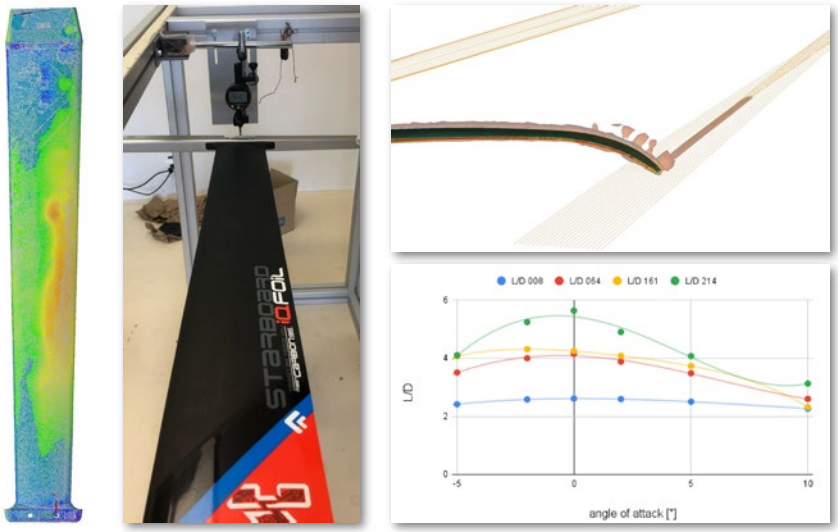

Fig.2-5: the mast foil during the bench test, one of the Best Fit outputs, a rendering of the CFD, the Lift/Drag ratio of the 4 front wings.

Conclusion

This process proved highly valuable, enhancing mutual understanding among the athlete, coach, and technicians regarding equipment characteristics. Elia chose the thickest mast for its superior reactivity (minimal torsion) and the thinnest rear wing to minimize drag. The front wing selection was more complex, and current data has yet to provide a definitive answer on the best option for the athlete. The process was reassessed after the Olympics and improved for future use.

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VELOCITY-BASED STRENGTH TRAINING – DATA DRIVEN RESISTANCE TRAINING

Velocity-based strength training in Team Sports

A minimalist, velocity-guided strength program, built strength into a full competitive season.
Plus, the same data can flag athletes who aren't responding.

Achermann B.B.[1 2], Regazzi N.[1 3], Heynen R.[4], Lüdin D.[4], Suter J.[1], Drewek A.[1], Lorenzetti S.R.[1 3]
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+15.2% SQUAT (EST. 1RM)

+5.9% Trap Bar DEADLIFT (EST. 1RM)

IMPROVED STRENGTH

17 athletes significantly improved their estimated[1] squat and trap bar deadlift one-rep maximum (1RM) inside the competitive season. They used VBT Measurement Devices and the presented velocity framework to train efficient and to keep the motivation high. The training load wasn't guessed: a simple velocity-zone framework set and auto-adjusted it, session by session, with no maximal-strength testing required.

[1]Estimated one-repetition maximum relative to body weight, from load–velocity profiling. Pre- vs. post 6-week intervention, n = 17, both $p \leq 0.006$. Complete results of the intervention can be found in the study Achermann et. Al. 2025 linked in the footer of the poster.

METHOD

The intervention

The athletes completed a 30-minute strength session in the gym immediately before their regular floorball training. They worked in 4 groups of 3 (2 back squat, 2 trap bar deadlift), each station equipped with its own iPad and GymAware unit to track every repetition in real time.

After warm-up, they performed 3 sets per exercise (5 repetition strength block / 8 repetition power block). Loads were adjusted based on the velocity framework to keep bar speed within the target zone for each block.

The velocity framework (aiming to stay in the target zone) and real-time feedback boosted motivation, with athletes pushing each other to move every rep with maximal intent. To ensure a high data quality, two experienced coaches supervised technique at each session, while athletes recorded their own data.

The velocity framework

Concentric bar velocity was measured in real time for every repetition, and reps falling outside the target velocity zone were counted. Load was then auto-regulated based on the number of out-of-zone repetitions. By holding velocity constant, the athletes only way to remain within the prescribed zones was to adjust the load. This framework requires athletes to be experienced in resistance training and to perform each repetition with maximal intent to move the bar as fast as possible[2].

Figure 1: Visualization of the velocity profile proposed in Achermann et al., 2025.

MONITORING VALUE

From a coach's eye

The relationship is clear: as external load increases, movement velocity decreases. The target velocity zone determines whether athletes have more room to modulate velocity or load, which in turn depends on the adaptation the coach aims to target. **Hence, the simple framework enabels a visual assessment which builds trust in the approach among coaches and athletes.**

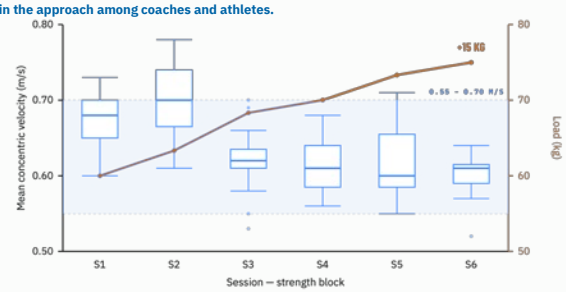

Figure 2: Visualization of an example of an athlete profile of the strength block (adapted from Achermann et al. 2025, Fig 1.

Results from Achermann et al. 2025
During the Strength block, athletes primarily showed an increase in load while maintaining velocity within the target zone.
During the Power block, load remained relatively constant while athletes aimed to reach the required velocities.

Results / Conclusion of the Intervention

Improved Strength

The minimalist resistance training intervention produced clear strength improvements during a competitive season. The approach is time-efficient and simple for coaches to implement, even within the tight schedules of elite team sport. However, neuromuscular gains did not consistently transfer to sport-specific tasks, so additional task-specific training may be needed.

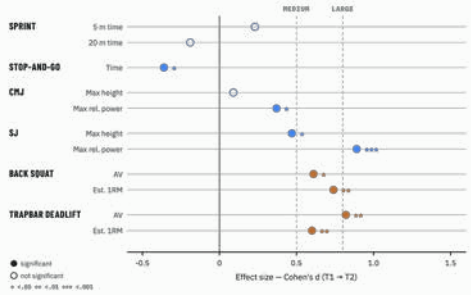

Figure 3: Visualization of the change in performance between T1 and T2. CMJ: Counter Movement Jump, SJ: Squat Jump. (adapted from Achermann et al., 2025, Table 3).

Who was studied

Top-level Swiss floorball club. One of few VBT studies in *female* team-sport athletes

17 ♀
completed (23 enrolled)

22.0 ± 3.7
years old (18+)

≥ 1 yr
strength-training experience required

back squats & trap bar deadlifts

12 training sessions
2 sessions per week for 6 weeks

Further use of the recorded data for statistical models (and AI?)

Next to the positive effects of the velocity framework the recorded parameters are valuable for statistical models.

As a proof of concept, we used the recorded velocity parameters, combined with load, body mass, and initial performance values, to predict improvements in velocity and estimated 1RM (squat and deadlift) over the 12-session program. A prediction power between adjusted R^2 = 0.786 and 0.544 was found. Details on the model can be found in Achermann (2025).

These findings lay the foundation for the development of more robust predictive models to support training decisions, using larger datasets. While based on a small sample, they highlight patterns that may assist in individualizing load progression.

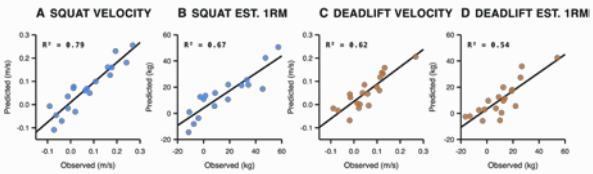

Figure 4: Visualization of model performance in predicting the average differences in velocity and estimated 1RM (adapted from Achermann et al., 2025, Fig. 4).

PUBLISHED AS
Achermann, B.B. et al. (2025). From Monitoring to Prediction: Velocity-Based Strength Training in Female Floorball Athletes. Sports, 13, 175. doi.org/10.3390/sports13060175

READ WITH CAUTION
Small sample (n=17), no control group, no long-term follow-up, findings are promising but preliminary and should be confirmed in larger trials.

DATA, CODE & CONTACT
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Funded by the Swiss National Science Foundation (200021_192289/1)

Row to Run

One cue, +357 m in the Cooper Test, lower perceived exertion.

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Università della Svizzera italiana

Università della Svizzera italiana

THE CUE

"Use your lower limbs like oars in the water: row backward."
A short, memorable image athletes could feel immediately.

SO WHAT?

Same training. Different instruction. Better outcome. This study shows that performance gains can come not only from adding workload, but from making the task clearer.

WHY?

In running, forward motion does not depend only on the visible form of the movement, but on the ability to transform ground contact into a finalized propulsive action. The "rowing" cue shifts the athlete's focus toward the biomechanical cause of propulsion: feeling the support, pushing the ground backward, and directing force in the useful direction for forward motion. For coaches, the rowing cue is a simple instruction to guide the athlete toward a less dispersive movement organization: not simply "running harder", but organizing propulsion more effectively, reducing actions that do not directly contribute to forward motion, and supporting a more efficient propulsive pattern[3].

METHODS

29 adolescent female athletes were included in two groups: a Intervention Group (n = 14) and a Control Group (n = 15). Both groups completed the same 5-week motor programme; the only experimental difference was the instructional cue. Endurance running performance was assessed using Cooper Test[1], while perceived exertion was measured immediately after the test using the Borg CR10 scale[2].

DESIGN

A controlled three-time-point design (T1, T2, T3) with a 5-week intervention and follow-up was adopted. Both groups completed the same training programme; the only experimental difference was the coaching instruction.

RESEARCH QUESTION

Can a simple propulsion-focused coaching cue improve running performance and reduce perceived exertion in youth female athletes?

KEYWORDS

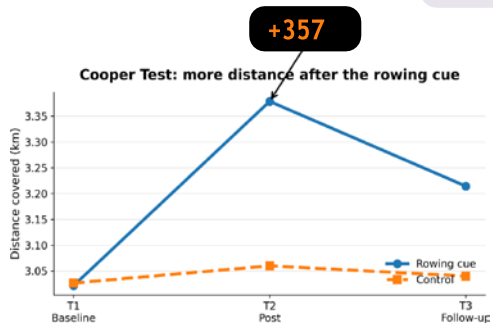
Youth athletes; coaching cue; running propulsion; Cooper Test; perceived exertion; Borg CR10.

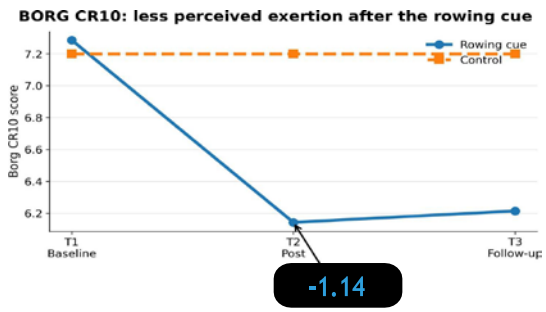
RESULTS

After 5 weeks, the rowing-cue group improved **Cooper Test** distance by 357 m, compared with 33 m in the control group, corresponding to a between-group difference in **change of 324 m**. The between-group difference was statistically **significant (p < 0.001)** and showed a large **effect size (Hedges' g = 1.60).**

Perceived exertion **decreased by 1.14 Borg CR10** points in the rowing-cue group, while remaining essentially unchanged in the control group. The between-group difference was statistically **significant (p < 0.001)** and showed a large effect in favour of the rowing-cue group (Hedges' g = −2.41).

At the five-week follow-up, the rowing-cue group maintained a **greater improvement in Cooper Test performance than the control group** (p = 0.008; Hedges' g = 0.86). The reduction in perceived exertion was also largely maintained (p < 0.001; Hedges' g = −1.81).





CONCLUSION

Running is not only a matter of legs. It is also a matter of intention. The rowing cue gave athletes a clear task: use the ground to move forward. With the same training, changing the instruction was associated with a different performance outcome. This is the practical strength of the study: a coach's words can become a performance tool.

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The Impact of blood sugar regulation on competitive golf

Raphael Albrecht, Marc Chatelain

NUTRIPERFORMX

Key words: continuous glucose monitoring, cognitive performance, athletic performance, golf, sports nutrition

Swiss Golf

Introduction:

Continuous glucose monitoring (CGM) enables real-time assessment of glucose dynamics during exercise. In golf, stable glucose availability may support concentration, decision-making, neuromuscular coordination, and fatigue management, providing opportunities to optimize nutritional strategies and performance.

Research question:

How does consumption of a high-carbohydrate meals and snacks (Day 1), compared to a balanced meal and snacks (Day 2), affect postprandial blood glucose levels, muscular performance, and cognitive performance in professional golfers?

So what!?

1. Revision of the dietary recommendations issued by national tournament organizations
2. Development of a nutrition guide for national team players
3. Development of a nutrition checklist for travel

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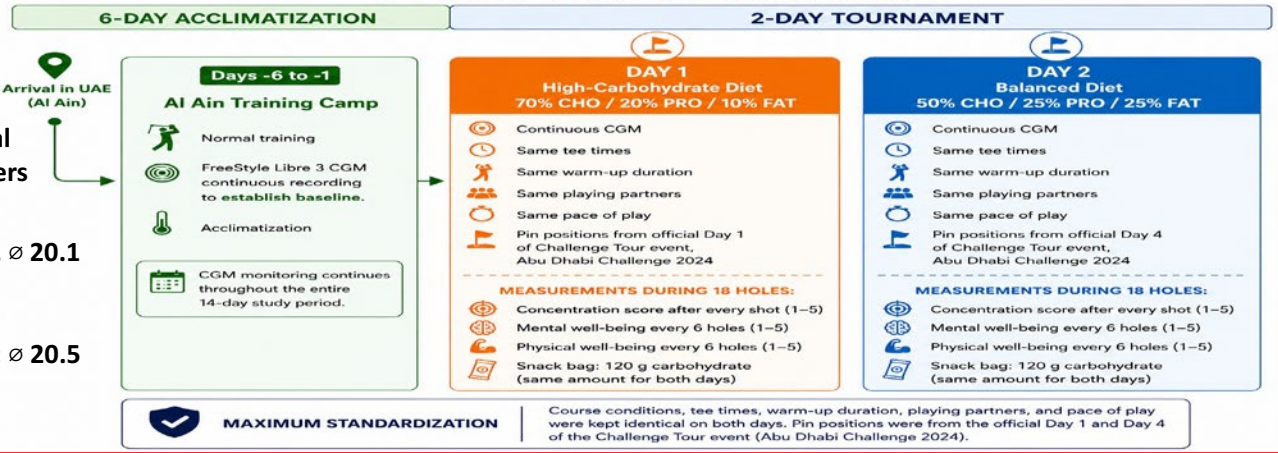
Methods:

Subjects:

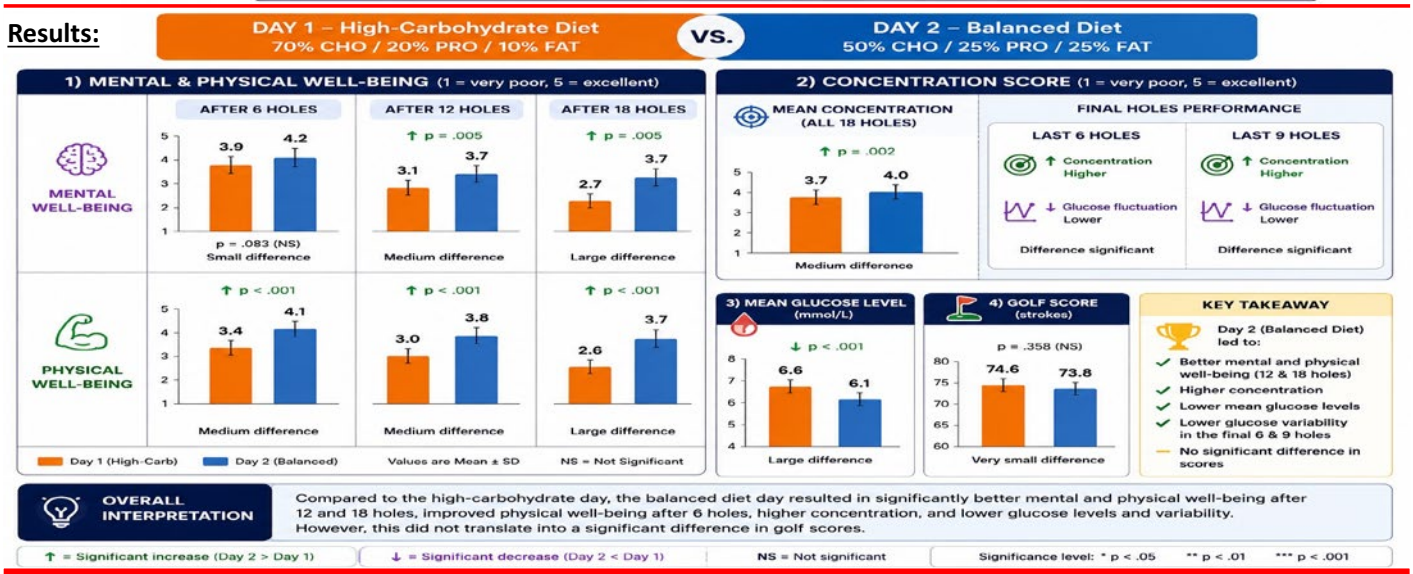
31 National Team Players

16
Age 17-27, ⌀ 20.1

17
Age 17-35; ⌀ 20.5



Results:



Conclusion:

A balanced dietary strategy resulted in more stable glucose levels and improved concentration, mental well-being, and physical well-being during tournament play. The findings suggest that optimizing nutritional strategies and glucose regulation may support performance-related factors important for elite golf.

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