18th annual Congress of the
EUROPEAN COLLEGE OF SPORT SCIENCE
UNIFYING SPORT SCIENCE
26th - 29th June 2013, Barcelona - Spain
Hosted by the National Institute of Physical Education of Catalonia (INEFC)

Sailing Symposium

Satellite to ECSS 2013 Barcelona

25th – 26th June

Registration via email required. Participation is on a "first come first served" principle.
Please book with Gisela Sjøgaard at gsjogaard@health.sdu.dk
Topic field must be: **Sailing ECSS**

25th Practice sailing at the Nautic Center in Barcelona

Chair: **Eduard Inglés Yuba** and **Feliu Funollet**, INEFC Barcelona, ESP
Costs may apply and will need to be met by the participant upon request.

26th Science in sailing at the ECSS conference center – room: Aula Magna 1

Chair: **Gisela Sjøgaard,** University of Southern Denmark, DEN
Program: 9.00 until 14.00 (break 12-13, lunches – pay by your own)

Opening: Learning to sail: the essentials
Speakers: **Josep Sarquella, Eduard Inglés Yuba,** and **Feliu Funollet,** ESP

Invited presentations:

Christian Gammelgaard Olesen, DEN: Grinding biomechanics

Narici Marco, GBR: "Neuromuscular performance in sailing"

Araujo Duarte, POR: "Decision making in team sport: relevance in sailing"

Giuseppe De Vito, ITA: Physiological assessment of Olympic Wind surfers

Jens Bojsen-Møller, NOR: Performance parameters/physical requirements in Olympic sailing

Marco Bernardi, ITA: Physiological characteristics of America's Cup sailors: evaluation and training

LEARNING TO SAIL: THE ESSENTIALS

Funollet, F.1,2; Inglés, E.1,2; Sarquella, J.3
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2: GISEAFE (Grup d'Investigació Social i Educativa de l'activitat Física i l'Esport)
3: Escola de Vela Fluvià-La Gola (Catalunya)

Introduction

The definition of sailing requires bringing together a broad and complex set of concepts. That creates the need to define the basic conceptual elements that may be involved in learning this sport. This is the precise aim of our presentation: to present the essentials of learning to sail. Our proposal comes up from the experience in our careers as outdoor sports formers (Funollet, Gomila, Inglés, forthcoming 2013). The general model has been mainly applied in the cross-country skiing learning process (Funollet, English, 2010) and supports this proposal.

A conceptual network for learning

We consider that the conceptual elements that make sailing up must be presented hierarchically and forming a network, where the apprentice can locate the learnings that he/she achieves. Learning is "to establish new and efficient relationships in an environment" (Riera, 1989; 2001). On the basis of this definition, we can say that the essence of any learning is the set of relationships established.

Our conceptual network is composed of six sections, where the concepts are presented hierarchically, so that each one serves supports a better achievement of the subsequent. Each concept can be applied to a set of tasks to develop certain skills that, in turn, can serve as support for the subsequent concept and its respective abilities.
The first section allows the apprentice to relate with the immediate environment of sailing. It is made up of the concepts: environment, equipment, facility and material. The second section is used to interact with the body self-conscience; it includes awareness and posture. The third section facilitates the connection with the basic skills of sailing needed to direct the boat; its concepts are: position, manoeuvres, sliding, transfer and discharge. The fourth section refers to the complementary technical skills that improve sailing performance. The fifth section relates to the strategic and tactical skills in sailing competition. Finally, the sixth section refers to the interpretive skills that allow sailors' independence in the natural marine environment.

Conclusion

Learning to sail needs a gradual achievement of autonomy from the environment, integrating the various essential elements introduced during the learning process.

References

Funollet, F., Gomila, B., Inglés, E. (forthcoming 2013). Aprender a aprender con el deporte. Libro-I ¡Sitúate! La esencia del aprendizaje.
Funollet, F. & Inglés, E. (2010). A conceptual net for the assisted learning of cross-country skiing. Revista portuguesa de ciências do desporto, 10(1 Supl), 96.
Riera, J. (1989). Fundamentos del Aprendizaje de la Técnica y la Táctica Deportivas. Barcelona: INDE.
Riera, J. (2001). Habilitats esportives, habilitats humanes. Apunts d'Educació Física i Esport. Dossier: Humanisme a l'Esport, 64, 46-53.

DEVELOPMENT OF A MUSCULO-SKELETAL MODEL FOR GRINDER DESIGN PURPOSES

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Introduction

America's Cup is a prestigious boat race competition, which is held approximately every fourth year. The Competition changes from time to time, however ususally it is a matter of optimized engineered boats with world class crew on board. The crew is highly specialized, such as trimmers, helmsman, skipper and grinders. The grinders hold the job of operating the grinder pedistals when sails are adjusted, hoisted etc. Essentially the grinders are the engins onboard the boats, if they perform poorly, the boat will in general perform poorly. (Neville, V. 2008) In order to optimize the grinding performance, it is proposed to look at the grinding situation as a mechanical system including the mechanical parts as well as the human part. Therefore this study have the objective to develop a validated musculo-skeletal model of a person grinding.

Methods

The study can be divided into an experimental, computational and a validation part. The experimental part included one subject, an experienced professional Danish grinder (height: 194cm, weight: 120 kg). The grinding platform was a Harken (Harken Int. Milano, Italy) carbon grinder pedestal simulator, where the handled were custom made with force sensors built into the handles. On the floor two custom made force plates were mounted to measure reaction forces on the feet.
The experiment was conducted with a constant resistance on the grinder pedestal. The subject was asked to grind with a cadence between 80 and 110 rpm. A 8-camera motion capture system was used to measure the kinematics of 54 reflective markers attached to the grinder. The movement was measured with a 200 Hz sampling rate. The reaction forces from the hands and feets were sampled with 2000 Hz. Also EMG was measured for validation purposes for the m. biceps brachii, m.triceps brachii and m. deltoideus anterior for both arms. A subject specific 3D musculo-skeletal whole body model was made in the AnyBody modeling system. The kinematic recordings from the experiment was used to drive the model with the right motion and the kinetic measures were used as boundary conditions on the feet and hands.

Results

A model was developed and the calculated muscle activations were compared with the EMG measurements from the experiment, and the correspondence was good.

Discussion

It can be concluded that a musculo-skeletal model can predict muscle activations for a grinder setup that can be used to enhance design of boat equipment.

Acknowledgement

The author would like to acknowledge Harken Int. for supporting with equipment for the study.

Reference

Neville, Vernon. America's Cup Yacht Racing is Not Just About the Boat. The Sport and Exercise Scientist. March 2008.

NEUROMUSCULAR PERFORMANCE IN SAILING

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Introduction

The physiological demands in sailing can vary greatly depending on wind conditions, ambient temperature, effort intensity and duration and type of vessel. If the overall physiological demands are sufficiently high to affect 'the ability to generate the required or expected force' (Edwards, 1981), muscle fatigue will ensue. Since the generation of force or muscle power depends on a chain of events within the central nervous system and muscle, any of these can become impaired. Despite the extensive knowledge on the determinants of neuromuscular performance in laboratory conditions and in selected sports, the problem of neuromuscular fatigue in sailing has been scarcely studied. This presentation will address the limiting factors to neuromuscular performance of three principal sailing activities: dinghy sailing, windsurfing and yacht racing.

Fatigue in dinghy sailing

The greatest effort in dinghy sailing (DS) is experienced in sustaining hiking for prolonged periods with winds >12 knots, when forces can reach almost 500 N and with righting moments reaching 800 N. Because of the sustained isometric contractions, blood pressure shows peaks of 170-180/100 mmHg when sailing upwind. In on-water sailing, oxygen consumption averages 55-60% of VO2max and peak lactate concentrations around 2.5 mM/l, confirming that DS is mainly an aerobic activity. The increase in VO2 is a function of wind intensity and with winds peaking 25 knots, work intensity can reach 90% of VO2max. The hiking forces generated of 40-45% of the maximum voluntary contraction (MVC), are of sufficient intensity to induce muscle fatigue as contractions above 20% MVC induce muscle fatigue due to ischaemia (Sjogaard, 1990).

Windsurfing

As for DS, the metabolic profile of windsurfing (WS) is mainly aerobic. However, the intensity of the muscle contractions and number of simultaneously activated muscles (Dyson et al. 1996) are much higher than in dingy sailing and during beating tacks maximal activation of the arm muscles is attained (Buchanan et al 1996). The metabolic demands of WS increase dramatically (by 3-fold) when sail pumping (SP) is performed, as oxygen consumption can reach 100% of VO2max during the first few minutes of race starting (De Vito et al 1997; Vogiatzis et al 2002). As a consequence, much higher lactate levels are reached than dingy sailing, averaging to 8-9 mM/l. The available data predicts considerable levels of muscle fatigue as a main limiting factor to performance in WS.

Yacht racing

As the main strenuous activity in yacht racing is grinding, near-maximal VO2 levels are reached (up to 90%VO2max during grinding in gybes), muscle work of the upper limbs is extremely intensive, reaching some of the highest upper limb anaerobic power values ever recorded in athletes (Neville et al 2009), with an onset of blood lactate at about 60% of maximum aerobic power. Peripheral muscle fatigue must be one of the main limit to performance in grinders, while sleep deprivation (typically no more than 5.5 hours of sleep/night), state anxiety and perceived fatigue are recognized important causes of central fatigue in crew members in ocean sailing (Hagin et al 2010).

Conclusions

Neuromuscular performance in yacht racing, dingy sailing and in particular windsurfing can be extremely demanding in terms of muscle mechanical and metabolic requirements. Eventually, neuromuscular fatigue is likely to be a common limiting factor to performance in all three sailing activities.

References

Edwards RH. Human muscle function and fatigue. Ciba Found Symp. 1981;82:1-18.
Sjøgaard G. Exercise-induced muscle fatigue: the significance of potassium. Acta Physiol Scand Suppl. 1990;593:1-63.
Dyson RJ, Buchanan M, Farrington TA, Hurrion PD. Electromyographic activity during windsurfing on water. J Sports Sci. 1996 Apr;14(2):125-30.
Buchanan M, Cunningham P, Dyson RJ, Hurrion PD. Electromyographic activity of beating and reaching during simulated boardsailing. J Sports Sci. 1996 Apr;14(2):131-7.
De Vito G, Di Filippo L, Rodio A, Felici F, Madaffari A. Is the Olympic boardsailor an endurance athlete? Int J Sports Med. 1997 May;18(4):281-4
Vogiatzis I, De Vito G, Rodio A, Madaffari A, Marchetti M. The physiological demands of sail pumping in Olympic level windsurfers. Eur J Appl Physiol. 2002 Mar;86(5):450-4.
Neville V, Calefato J, Pérez-Encinas C, Rodilla-Sala E, Rada-Ruiz S, Dorochenko P, Folland JP. America's Cup yacht racing: race analysis and physical characteristics of the athletes. J Sports Sci. 2009 Jul;27(9):915-23.
Hagin V, Gonzales BR, Candau RB, Groslambert A. Influence of a conservative sleep management strategy during a solo Pacific Ocean crossing on anxiety and perceived fatigue: a case study. J Sports Sci. 2012;30(4):395-402.

TASK AND EXPERTISE EFFECTS ON TACTICAL BEHAVIOR IN SAILING

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Introduction

Performers' tactical behavior leaves much of the information out in the context. By carefully using continuous real-time performer-environment interactions, expert sailors solve tactical problems in a robust and flexible way. Changes in the macroscopic order of a dynamical system, such as changes in the course of action in the boat-environment system, are based on a phase transition process (Kelso, 1995).

Revisited studies

Transitions in the boat path are an emergent process, which can be intentionally constrained but cannot be specified completely in advance. In manipulating the angle between the wind direction and the starting line, it was observed a sudden jump in the decision "where to start". The boat's position on the starting line tends to be on the extremities with the higher |angle| values (>±10º). When the wind is favouring one of the extremities of the starting line, the nearer to that extremity the boat is positioned, the more direct is the required trajectory to the 1st mark of a regatta. However, in the zone where the wind is neutral (between about –10º and +10º) there is higher variability, because there is no advantage from a boat's position for the required trajectory (Araújo et al., 2006). Modelling of decision-making in sailing is revealing that this is not a conscious process accounted for by traditional, normative, rationality-based models.. In these models, tactical positioning and displacement over a course in match race sailing emerges as a function of interacting task (e.g., regatta leg), individual (e.g., expertise level) and environmental constraints (e.g., wind direction, tide, manoeuvres and adversary position). Computer simulated sailing regattas performed by sailors with different expertise levels revealed specific patterns of information utilisation, and performed actions (Araújo et al., 2005).

Conclusions

Phase transitions (i.e., decisions) in sailing emerge from the interaction of multiple factors (e.g., memories, speed, morphology and space constraints). This interplay of forces eliminates the need to posit any inordinate role for a single controlling factor (e.g., the mind). Decision-making in sailing is characterized by non-linear accumulated effects of exploring and using informational constraints in a regatta, which are dependent on the level of individual perceptual attunement to specific information. It can be developed through the active exploration of situational constraints

References

Araújo, D., Davids, K, Hristovski, R.(2006). *Psy Sport Exerc*, *7*, 653-676.
Araújo, D., Davids, K., Serpa, S. (2005). *Psy Sport Exerc*, *6*, 671-692.
Kelso, JAS. (1995). *Dynamic Patterns*.Cambridge: MIT

PHYSIOLOGICAL ASSESSMENT OF OLYMPIC WIND-SURFING

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Introduction

Olympic boardsailing is a very demanding endurance activity. The main reason for this phenomenon is ascribable to the fact that elite windsurfers use pumping for propulsion during sailing. Pumping is a manoeuvre in which the athlete pulls the sail rhythmically so that it acts as a wing, thus providing the board with additional forward motion especially in light and moderate wind conditions.

Methods

De Vito et al (1,2) were the first to demonstrate, by using portable metabolimeters in actual sailing conditions, that Olympic boardsailing (Mistral board; sail surface 7.4 m2) was indeed a very demanding activity entailing high energy and cardiorespiratory costs. In moderate wind velocity conditions (4-5 m/s), the average oxygen uptake and heart rate they recorded corresponded to more than 70% VO2 max and 92% of HRmax. These results were confirmed and expanded later by Vogiatsis et al (5) who measured, in elite Olympic board-sailors, energy costs and cardiorespiratory responses during both pumping and non-pumping boardsailing. They found that (wind velocity between 4 and 15 m/s) pumping, compared to non-pumping sailing, induced a significant increase in VO2 and HR values (from 19.2 to 48.4 ml/min/kg and from 110 to 165 beats/min, respectively). These observations have not substantially changed after the introduction in 2006 of a new board (Neil Pryde RS:X; 9.5 m2 Men & 8.5 m2 Women) equipped with a larger sail (3). Across studies the aerobic demands (1-4), recorded on various windsurf boards (expressed as % VO2max), was higher than 75% of VO2max whilst HR values were higher than 85% of HRmax.

Discussion

In conclusion, Olympic wind-surfing can be considered as a high intensity endurance type of sport comparable to other aerobic sporting activities (i.e. rowing). It is similarly clear that pumping is the crucial factor determining this high intensity aerobic demand and this irrespective of the sailing board adopted.

References

1.De Vito G, Di Filippo L, Felici F, Gallozzi C, Madffari A, Marino S, Rodio A (1996) Int J Sport Cardiol 5:55-59.
2.De Vito G, Di Filippo L, Rodio A, Felici F, Madaffari A (1997) Int J Sports Med 18:281-284.
3.O. Castagna, C. Vaz Pardal, J. Brisswalter. Eur J Appl Physiol (2007) 100:247-252.
4.Shephard RJ (1997) Sports Med 23: 350-356.
5.Vogiatzis I, De Vito G, Rodio A, Madaffari A, Marchetti M (2002) Eur J Appl Physiol 86:450-454.

PERFORMANCE PARAMETERS/PHYSICAL REQUIREMENTS IN OLYMPIC SAILING

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Introduction

Physical fitness and muscular strength are generally considered relevant for performance in Olympic sailing. However, in contrast to most other sports, sailing is highly influenced by wind velocity, to the extent that when breeze is light to moderate, the physical requirements are limited, and sailing even at elite level becomes rather effortless.

Sailing Classes

Sailing consists of 10 separate so called 'events' or yacht classes, that all are handled in a different manner, and require different body weight, muscular strength, aerobic capacity, agility, and even teamwork ability in yachts with more than one sailor on board. It follows that sailing is a complex sport, and that the physical demands remain heterogeneous due to weather conditions and as a result of differing events and yacht types.

Sailors performance

Previous studies have examined dinghy sailors with respect to more general physiological performance parameters such as muscle strength, endurance and aerobic capacity. Moreover, more sailing specific assessments such as hiking endurance (hiking is the ability to provide righting moment to the yacht by leaning over the side of the yacht by use of sustained isometric muscle effort) have been reported. Limited information exists about absolute elite sailors, and moreover the profile of the Olympic events has changed over the last decade to represent more agile, fast, spectacular yachts with supposedly higher physical demands. The change of events have likely added to physical requirements and it seems plausible that the sailors that participate in the Rio games in 2016 may likely have kept an increased focus on physical preparation in prior years compared to sailors of previous Olympic games.

Conclusion

The present paper reviews existing data on physical requirements in Olympic sailing with specific focus on the current type of Olympic events.

PHYSIOLOGICAL CHARACTERISTICS OF AMERICA'S CUP SAILOR EVALUATION AND TRAINING

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Introduction

Previous studies on America's Cup mastmen and grinders have verified the hypothesis that their optimal physical performance requires high anaerobic capacity and high aerobic fitness to tolerate acidosis and to allow fast recovery from repeated grinding activities. Athletic training programs therefore should include upper limb aerobic exercise. This study aims at validating a training protocol targeted for these sailor's characteristic effort.

Methods

Six America's Cup grinders and mastmen, trained for 8 weeks, two times a week, at the arm cranking ergometer (ACE). Each training session lasted for 30 minutes and replaced the regular aerobic exercise that usually consisted of a running activity outdoor or at the treadmill. The ACE exercise was set at an intensity corresponding to a power half way between ventilatory (anaerobic) threshold and respiratory compensation threshold of a preliminary incremental maximal cardiopulmonary exercise test (CPET) carried out to assess also oxygen uptake peak (VO2peak). An all-out test (A-OT), simulating grinding activity, was also performed and both measurements were repeated after the training program.

Results

There was a significant increase in lactate threshold that increase from 29.80±3.82 ml/kg/min to 36.58±2.17 ml/kg/min, power peak levels increasing from 356±30 watt to 393±33 watt in pre training and post training tests respectively. VO2 peak did not show a significant difference pre and post training, increasing from 42.27±3.84 ml/kg/min to 45.34±3.51 ml/kg/min. AO-T mechanical work also increased significantly after training changing from 29±3 kJ to 38±4 kJ.

Conclusion

This study shows that tailored aerobic training program for America's Cup sailors is effective in improving anaerobic threshold and the mechanical work carried out in a A-OT. An ACE exercise for his similarity with the on board grinding activity should always be implemented in the gym training of these athletes.

References

Bernardi M, Quattrini FM, Rodio A, Fontana G, Madaffari A, Brugnoli M, Marchetti M. (2007). J Sport Sci, 25(10), 1141-1152.
Bernardi E, Delussu SA, Quattrini FM, Rodio A, Bernardi M. (2007). J Sport Sci, 25(10) 1153-1160.