JOURNAL of outdoor ...ies

Volume 7 Supl. No. 1/2013

6th International Mountain and Outdoor Sports Conference
November 22-25, 2012

Content

Introduction

Foreword to the publication of papers from the conference IMOSC

Greetings to authors and readers of this special edition of the magazine "Journal of outdoor activities". This is almost a ceremonial moment, when two faculties from different universities (Faculty of education of UJEP Ústí nad Labem and Faculty of physical education and sport of UK Praha) settled on cooperation and together they release monothematic edition of the magazine in English. This cooperation is not an accident. Both faculties have accreditation of study program called "Outdoor activities" and both faculties should work together at the scientific level and strive for continuity of bachelor's and master's degree programs.

Publication of scientific and research works in the field of educational applications of outdoor activities in English is a benefit to international cooperation. The most of magazines specialized in outdoor education and outdoor activities are in English as well as most scientific announcements, book publications and scientific conferences. We also want to inform the international community about the focus and the level of scientific work in Czech Republic. For us, authors, it is also a commitment for we try to improve the quality of research so we can join an international expert discussion. By publishing papers from the IMOSC conference we want to open an opportunity to cooperation within an international research projects.

The posts published in this edition of Journal of Outdoor Activities opens the door to an exploration of interesting and useful issues. Exploring of some questions related to "Outdoor activities and health" is becoming a dire need of all advanced countries. Likewise we can consult global issues such as "Environmental aspects of outdoor activities" and "Management of outdoor activities", which themselves calls for international cooperation and information exchange. We also need to explore the issue we called "Adventure activities and challenge sports in personal development" in detail for schools and organizations, for it may contribute to the all-rounded development of young generation. In the section "Performance in outdoor sports" we would like to develop specialized international cooperation, whose results may be applicable to sports and also to schools and free-time activities.

I thank to magazine publishers and authors and I also thank for attending the conference and I wish a successful cooperation to all who are interested in useful application of outdoor activities in education, sports and leisure.

I look forward to interesting discussions on our meetings at the conferences which will be organized under the name "International Mountain and Outdoor Sports Conference (IMOSC)"

With thanks to my colleagues Jiří Baláš, Lenka Nováková and Andy Martin, Jan Neumann.

Jan Neuman
Prague, june 2013

Editorial Board

address

Mgr. Martin Nosek, Ph.D.
Faculty of Education, University of Jan Evangelista Purkyně in Ústí nad Labem,
České mládeže 8, 400 96 Ústí nad Labem, Czech Republic
e-mail: martin.nosek@ujep.cz

Outdoor activities and health

Walking in nature

V. Bunc
Faculty of Physical Education and Sports Charles University, Prague, Czech Republic

Abstract
This study summarizes the possibilities of walking in nature as a toll influencing health, physical fitness, body composition and well-being and other psychological variables. Following the intervention program lasting 5 months with an energy content of 1000 kcal per week intensity in seniors, 1500 kcal in middle-aged men and 2000 kcal for children composed of at least 80% walking, pointing to significant changes in physical fitness and body composition parameters. Together with these variables were significantly improved the predispositions for physical and workload. It may be concluded that walking in the range of about 10 000 steps (7 000 in seniors and 12 000 in children) per day is able to remove the movement deficit, which is due to present lifestyle and may be used in majority population for improvement of health predispositions and for improved of physical fitness state.

Key words
walking, nature, movement intervention, physical fitness, body composition, children, adult men, seniors

Introduction

The fundamental problem today is steadily decreasing amount of physical activities regularly carried out, leading to a decline in fitness and subsequent manifestation of many health problems and working. Conversely rapidly increase the psychological stress. The aim of all interventions is a change in sedentary to an active lifestyle.

Physical activity can improve health state and predispositions for working and leisure time activities - active life style in subjects. However, despite these potential health benefits, the majority of nowadays individuals do not exercise regularly (Bond Brill, Perry, Parker 2002).

Important role in the implementation of physical activities play their availability, the location of and the ability to communicate with the surrounding nature (Tully et al. 2005).

Among people who do exercise, walking is the most popular form of physical activity. Walking is a weight-bearing form of aerobic exercise that can be easily integrated into one's daily life and it is frequently recommended as a way to help protect against health problems and low working and leisure capacity (Tully et al. 2005).

Major advantage with walking over running is that it has a lower frequency of injuries and that in a group of patients the probability of exceeding of security level is lower than in running. By application of walking like a group exercise form it is very important that exercised subjects are able to communicate during the exercise, what can contribute to the wellness of these subjects. Walking differs from a running gait in a number of ways. The most obvious is that during walking one leg always stays on the ground while the other is swinging. In running there is typically a ballistic phase where the runner is airborne with both feet in the air (for bipedals) (Biewer 2003; Bunc, Dlouhá 1997; Fenton 2001).

The course of energy cost coefficient c is presented in Figure 1.

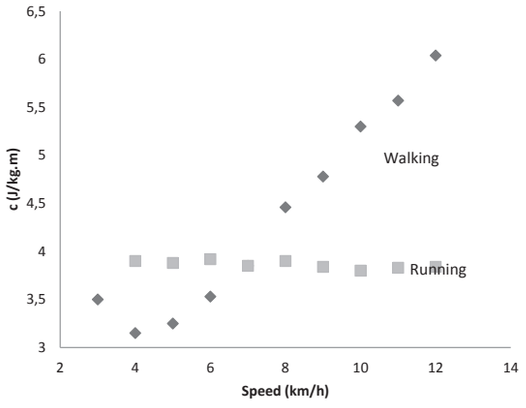


Figure 1 Course of walking and running energy cost coefficient c in dependence on speed of movement.

In the range of intensities lower than 7 km.h^{-1} the dependence of c on speed of walking has a minimum at a ground speed about 4 km.h^{-1}, increasing exponentially at speeds slower and at speeds greater than 7 km.h^{-1} the coefficient of walking energy cost increases practically linearly with increasing of moving speed. In the same Figure is presented the coefficient c for running. In the range from 4 to 12 km.h^{-1} this coefficient is practically constant (Bunc, Dlouhá 1997).

Human walking is accomplished with a strategy called the double pendulum. During forward motion, the leg that leaves the ground swings forward from the hip. This sweep is the first pendulum. Then the leg strikes the ground with the heel and rolls through to the toe in a motion described as an inverted pendulum. The motion of the two legs is coordinated so that one foot or the other is always in contact with the ground. The process of walking recovers approximately sixty per cent of the energy used due to pendulum dynamics and ground reaction force (Biewer 2003; Ogilvie et al. 2007; Stephen et al. 2011; Neptune, Sasaki, Kautz 2008).

Another difference concerns the movement of the center of mass of the body. In walking the body "vaults" over the leg on the ground, raising the center of mass to its highest point as the leg passes the vertical, and dropping it to the lowest as the legs are spread apart (Stephen et al. 2011).

Essentially kinetic energy of forward motion is constantly being traded for a rise in potential energy. This is reversed in running where the center of mass is at its lowest as the leg is vertical. This is because the impact of landing from the ballistic phase is absorbed by bending the leg and consequently storing energy in muscles and tendons. In running there is a conversion between kinetic, potential, and elastic energy (Neptune, Sasaki, Kautz 2008).

There is an absolute limit on an individual's speed of walking (without special techniques such as those employed in speed walking) due to the upwards acceleration of the center of mass during a stride - if it's greater than the acceleration due to gravity the person will become airborne as they vault over the leg on the ground. Typically however, animals switch to a run at a lower speed than this due to energy efficiencies (Biewer 2003).

Many people walk as a hobby, and in our post-industrial age it is often enjoyed as one of the best forms of exercise. The types of walking include bushwalking, racewalking, weight-walking, hillwalking, volksmarching, Nordic walking and hiking on long-distance paths (Fenton 2001). Sometimes people prefer to walk indoors using a treadmill. In some countries walking as a hobby is known as hiking (the typical North American term), rambling (a somewhat dated British expression, but remaining in use because it is enshrined in the title of the important Ramblers), or tramping. Hiking is a subtype of walking, generally used to mean walking in nature areas on specially designated routes or trails, as opposed to in urban environments; however, hiking can also refer to any long-distance walk. More obscure terms for walking include "to go by Marrow-bone stage", "to take one's daily constitutional", "to ride Shanks' pony", "to ride Shanks' mare", or "to go by Walker's bus". Among search and rescue responders, those responders who walk (rather than ride, drive, fly, climb, or sit in a communications trailer) often are known as "ground pounders" (Fenton 2001).

Professionals working to increase the number of people walking more usually come from 6 sectors: health, transport, environment, schools, sport & recreation and urban design.

Regular, brisk cycling or walking can improve confidence, stamina, energy, weight control, life expectancy and reduce stress. It can also reduce the risk of coronary heart disease, strokes, diabetes, high blood pressure, bowel cancer and osteoporosis. Modern scientific studies have shown that walking, besides its physical benefits, is also beneficial for the mind — improving memory skills, learning ability, concentration and abstract reasoning, as well as reducing stress and uplifting one's spirits (Haskell et al. 2007).

The health benefits of physical activity are well documented in relation to weight management and the prevention of chronic illnesses, as well as improving mental health and cognitive function (Nelson et al. 2007).

However, our knowledge of the benefits of physical activity is not matched by our
understanding of how to get people active and maintain activity.

There is a need for developing and trialing strategies for non-trained subjects to include physical activity into their lifestyle. These interventions need to be systematic, robust, and longer-term, incorporating different methods of engaging specific demands of intervened population groups (Rafferty et al. 2002).

Many factors influence physical activity behavior, yet there is limited evidence of the effectiveness of strategies to increase physical activity.' This is the case particularly in regard to booster programs, even though the little specific data available on physical activity booster programs are generally positive. Interestingly, lessons may be learned from the obesity treatment area, which has made significant gains in terms of promoting and improving
long-term behavior change (Haskell et al. 2007; Gordon et al. 2010).

The 10 000 steps per day physical activity prescripti-

on that has been suggested to meet
the minimum recommendation for physical activity in adult subjects. In seniors it is necessary to realize daily about 8 000 steps and oppositely in children about 12 000. Despite some research that supports walking regularly and completing 10 000 steps a day is enough activity to produce positive changes in lifestyle and certain aspects of fitness and cardiovascular health, other research has shown limited effectiveness of walking programs and the long term durability of any observed changes has recently been questioned (Choi et al. 2007; LeMasurier, Sidman, Corbin 2003; Schneider et al. 2006).

Walking is a viable form of physical activity that research has shown to be an effective intervention in the aging population, producing both physical and psychosocial benefits. However, there are many barriers to physical activity for the elderly, including safety issues, access, support, and health concerns. Community mall walking programs have the potential to address several of these barriers, particularly safety and social support needs (Ogilvie et al. 2007).

Effects of walking

Recent position statements have re-affirmed the benefits of an active lifestyle (Haskell et al. 2007; Nelson et al. 2007). The current physical activity recommendation for adults, aged between 18–65 years, to promote and maintain health is to accumulate at least 30 minutes of moderately intense physical activity on at least five days of the week. Promoting accumulative, lifestyle physical activity is an ideal approach to combat the high levels of inactivity evident in global populations (Scottisch Executive 2005; Macera et al. 2005).

Brisk walking has been suggested as the mode of physical activity most likely to increase physical activity at a population level (Hillsdon, Thorogood 1996) and is the most commonly reported mode of exercise amongst adults in many populations (Rafferty et al. 2002; Scottisch Executive 2005). It is available to almost all individuals with little risk of injury, is a no cost activity and it can be incorporated into peoples' daily routines (Morris, Hardman 1997). Researchers have identified that self determined brisk walking, even in short bouts of 10 minutes, for 30 minutes a day (including simple everyday walking activities such as walking a dog) produce moderate physical activity at the intensity required to achieve health benefits (Ainsworth et al. 200; Murtagh, Boreham, Murphy 2002).

Walking interventions can be effective in reducing body weight, waist and hip circumference, body fat, blood pressure and the cholesterol high density lipoprotein (HDL) ratio (Ainsworth et al. 200; Haines et a. 2007; Kelley, Kelley, Tran 2001; Kelley, Kelley, Tran 2004; 1Miyatake et al. 2003; Murphy et al. 2007; Murtagh, Boreham, Murphy 2002; Swartz et al. 2003) and may be effective in improving mood, affect (Kelley, Kelley, Tran 2001; Murphy et al. 2002; Tully et al. 2007) and quality of life (Fisher, Li 2004). Conversely, some studies have demonstrated that a walking intervention is not sufficient to affect any of these health-related outcomes (Coull et al. 2004; Gilson et al. 2007; Nies, Chruscial, Hepworth 2003; Stanton, Arroll 1996; Tudor et al. 2004). The reasons for such equivocal results are unclear, therefore determining the potential health benefits that can be achieved through walking are crucial to the public health message. One possible cause controversial results could be lack the intensity of load (walking speed), and insufficient duration and frequency of exercise.

Whilst several meta-analytical and systematic reviews exist that examine how best to promote physical activity (Hillsdon et al. 2005; Kahn et al. 2002) there is comparatively limited evidence on the most effective methods to specifically promote walking.

A recent systematic review from Ogilvie and colleagues (Ogilvie et al. 2007) examined the effectiveness of interventions aimed at increasing walking at both an individual and population level. The review concluded that the strongest evidence exists for tailored interventions that are targeted at individuals most motivated to change. The authors suggested that future studies should also attempt to examine whether walking interventions "are sufficiently frequent, intense, or sustained to produce measurable outcomes in anthropometric, physiological, biochemical or clinical outcomes".

A recent systematic review examined the association between pedometer use, physical activity levels and a variety of health related outcomes (Bravata et al. 2007). The authors concluded that pedometer use was significantly associated with increased physical activity levels and reductions in BMI and systolic blood pressure. In 2006 the National Institute for Health and Clinical Excellence (NICE) in the United Kingdom produced a review of pedometer--based intervention studies between 1990 and 2005 (NICE 2006). Due to stringent inclusion criteria, conclusions from this review were drawn from only four studies. Both reviews provide support for the suggestion that pedometers may be useful motivational tools for increasing walking. However, there are several limitations when considering the volume of published studies in this area highlighted by these reviews. Studies were predominantly of short duration (< 12 weeks) and based in the USA with small samples consisting mostly of clinical sub-populations. There is limited evidence regarding their effectiveness in non-clinical samples or in countries other than the USA. Additionally, few studies reported more than one outcome variable of interest.

There is a need for cross-cultural, sufficiently powered randomized controlled trials to further examine the effectiveness of pedometers in a community setting.

In practice, a provider's ability to promote physical activity has been limited by time constraints, lack of training in exercise prescription, concerns over monitoring patient safety, and lack of access to cost--effective resources that help patients remain active.

The goal of this study was to assess an effect of intervention program based on walking on physical fitness and body composition in groups without of regular physical training differing in age.

Subjects and methods

The groups of children (139 with normal mass, 95 overweight and 65 obesity – mean age 12.2±2.1 years), 68 middle age men (mean age 45.7±3.6 years), and 53 healthy senior women (68.7±5.0 years) were participated in this study. The research will be performing in subjects that are residing in area of Prague, without objective internal limitation, that participate on physical activity programs of Faculty of Physical Education and Sports Charles University Prague. Before the start of their participation in this study all absolved the medical evaluation together with dynamical assessment of ECG and blood pressure that was realized by physician one week before the start of the program.

Selected anthropometrical and maximal functional variables are collected in Tables 1-3.

Before the start of each movement diagnostics it is necessary to verify the movement ability of the subject that means if the subject is able to realize the movement activity that is assessed. This process could be divided in two parts (Bunc, 1990):

- skills – then means a level of movements skills, that will be decisive for diagnostics evaluation a that are a result of absolved training,
- muscles state (morphological, strength, etc) – these are strongly dependent on genetic predispositions but could be influent by the imposed training.

The maximal functional variables determined on a treadmill with slope of 5% during a progressive walking test until subjective exhaustion. The initial speed on the treadmill was in range of 3-5 $km.h^{-1}$ (in dependence on physical fitness state) and was increased each minute by 1 $km.h^{-1}$. The cardiorespiratory variables were measured in an open system using an on line method by TEEM 100 (Aerosport). All analyzers were checked before and after each test by a calibration gas of known concentration.

Time duration of intervention was 5 months and program was realized during the spring or autum.

The energy output on the level of 1000 kcal (4180 kJ) per week in seniors, 1500 kcal (6270 kJ) in adult and 2000 kcal (8360 kJ) in children were respected by construction of individual moving programs (Astrand, Rodahl 1986).

Age related changes in body composition (BC) have implications for physical function and health. The redistribution and increase of fat and the loss of muscle mass result in substantial decrease in functional capacity. Although BC, as well as the age-related changes in it, has a strong genetic component, it is also influenced by environmental factors. The primary influences are nutrition, disease, and physical activity (Blanchard, Conrad, Harrison 1990).

Clinically, BC is viewed in terms of two compartments: fat and fat-free mass (Blanchard, Conrad, Harrison 1990; Bunc et al. 2000). Fat mass (FM) plus fat-free mass (FFM) that are make of proteins, water, and minerals, equals to the total body mass.

Beginning in middle adulthood, FFM begins to decline gradually both in men and women, primarily due to the wasting of muscle tissue (Blanchard, Conrad, Harrison 1990). Similarly like FFM decreases with age the body cell mass (BCM) in subjects without of systematically physical training. This similarity is confirmed by a high significant positive correlation between these both variables (Bunc et al 2000). The BCM is the sum of oxygen-using, calcium rich, glucose-oxidising cells. This variable may indirectly characterize the ability of human to sustain a mechanical work.

Numerous tools and methodologies have been developed to measure various BC parameters. The bioelectrical impedance analysis (BIA) seems to be one of the most used methods in the field conditions (Roche, Heymsfields, Lohman 1996). Regardless of which instrument is chosen to assess BC, the method is only as good as the measurement technique and prediction or conversion formula applied. The conversion formulas and prediction equations selected use must be restricted to the populations from which they were derived to remain valid (Blanchard, Conrad, Harrison 1990; Bunc et al. 2000; Roche, Heymsfields, Lohman 1996).

One of the basic themes in exercise science research has focused on the relation of exercise on improvement of physical fitness, usually measured as maximal oxygen uptake (VO2max). Physical fitness is a broad concept, encompassing several specific types of fitness including strength, flexibility, and balance (Blair, Connelly 1996). The actual physical fitness state is not only the predisposition of better physical performance but it is the significant basis of their working capacity and in seniors of an independency. When evaluating the influence of physical activity on the human it is important to know its energy requirement (Bunc 1994). A positive influence is exerted only by those physical activities, when during their application a certain minimal threshold is exceeded. The level depends on the purpose for which these activities are performed.

The body cell mass is calculated using the FFM and phase angle between whole impedance vector and resistance α [44]. The extra cellular mass (ECM) is the difference between FFM and BCM - ECM = FFM - BCM. The FFM was calculated according to modified formula of Deurenberg et al. (1992).

Resistance and reactance were measured at four frequencies - 1, 5, 50 and 100 kHz (B.I.A. 2000M, Data Input, Germany) on the right side of the body by tetrapolar electrode configuration in accordance with manufacturer's specification. For the calculation of body fat content were used the prediction equation that were valid in senior women by DEXA method.

The energy demand of physical exercise was collected by Caltrac measurement together with assessment of energy cost of exercise from general relationship between the exercise intensity and energy that he or she needs for cover of this activity (Bunc 1994). The differences between both methods were lower than 12%.

According to our measurements in children (n=320), adult men (n=154), adult women (n=86), and senior women (n=106) the general dependence of oxygen consumption on walking speed on flat surface in range of intensities 3-9 km.h^{-1} was established in the form

$VO2.kg^{-1}(ml.kg^{-1}.min^{-1}) = 5.7488^{*} v (km.h^{-1}) - 6.0561$
$r=0.872, p<0.005, SEE=1.49\ ml.kg^{-1}.min^{-1}, TEE = 1.74\ ml.kg^{-1}.min^{-1}$

For calculation of energy cost from oxygen uptake was used mean energy equivalent for oxygen 4.83 kcal.min.l^{-1} (20.2 kJ. min.l^{-1}), neglecting the contribution of protein (about 15%) to the total metabolism (Astrand, Rodahl 1986).

Results and discussion

All participants were able to realize the recommended content of intervention. The minimal volume of walking ranged from 82% in children to 88% in seniors.

The time spent at the exercise intensity in range of 80-90 %HRmax and in weekly volume ranged between 90-250 min. Walking time ranged between 80 and 220 min.

The time spent for other form of physical activities ranged between 10 and 30 min. Rest exercise was realized like home gymnastics, swimming, jogging or cycling.

The daily mean steps before intervention ranged from 5 800±280 in seniors to 9 200±430 in children. The mean volume of daily steps during intervention ranged from 8 700±310 steps.day^{-1} in seniors to 12 250±408 steps.day^{-1} in children with normal body mass.

Mean values of selected anthropometrical and functional variables are presented in Tables 1-4.The initially values of BC and aerobic fitness were practicalla the same like are the Czech population standards of this age. After the 5 months of aerobic training, both values of aerobic fitness and BC were significantly better than Czech population standards [46].

The energy output of realised moving activities in seniors ranged from 650 kcal (2675 kJ) to 1780 kcal (7740 kJ) (mean 950±230 kcal - 3970±960 kJ). The energy output in adults ranged from 1020 kcal (4264 kJ) to 2250 kcal (9045 kJ) (mean 1500±290 kcal - 6270±1212 kJ).

Results of the intervention with this energy content were collected in Tables 1-2.

Table 1 Selected anthropometric and functional variables collected before and after intervention in adults (n=68).

	Before	After
BH (cm)	175.3±2.6	175.4±2.5
BH (%)	100	100.0±0.1
BM (kg)	79.1±7.9	75.6±7.8*
BM (%)	100	95.6±4.6*
FFM (kg)	64.0±3.8	65.4±6.7*
FFM (%)	100	102.0±5.2*
BF_{abs} (%)	19.1±3.1	15.9±2.8**
BF_{rel} (%)	100	83.2±3.1**
BCM (kg)	35.2±3.7	37.0±2.8*
BCM (%)	100	105.1±2.7**
ECM/BCM	0.82±0.03	0.78±0.02**
ECM/BCM (%)	100	95.2±3.2**
HR_{max} (b.min^{-1})	178±7	176±6
VO_{2max}.kg^{-1} (ml)	33.1±5.3	38.7±4.8**
VO_{2max}.kg^{-1} (%)	100	117.0±3.3**
v_{max} (5%) (km.h^{-1})	6.8±1.1	7.8±0.9**
v_{max} (5%) (%)	100	115.0±1.5**

* p<0,05,
** p<0,01

Table 2 Selected anthropometric and functional variables collected before and after intervention in seniors (n=53).

	Before	After
BH (cm)	160.3±2.8	160.3±2.7
BH (%)	100	100.0±0.1
BM (kg)	69.9±7.9	70.4±7.8
BM (%)	100	100.7±5.9
FFM (kg)	43.7±6.8	45.9±6.7*
FFM (%)	100	05.0±5.2*
Fat_{abs} (%)	37.5±5.1	36.9±4.8
Fat_{rel} (%)	100	98.4±3.9
BCM (kg)	22.8±5.0	25.1±4.8**
BCM (%)	100	110.0±2.7**
ECM/BCM	0.92±0.03	0.82±0.02**
ECM/BCM (%)	100	89.2±3.6**
HR (b.min^{-1})	134±6	133±5
VO_2.kg^{-1} (ml)	17.5±3.0	19.0±3.2**
VO_2.kg^{-1} (%)	100	108.6±3.7**
%VO_{2max}.kg^{-1} (%)	67.4±3.2	67.8±3.0**
v_{max} (5%) (km.h^{-1})	4.4±3.1	4.7±3.4**
v_{max} (5%) (%)	100	106.8±3.3
%v_{max}	73.3±2.9	72.3±3.0

Majority of followed variables were after an intervention better than on the start of evaluation.

In children we assess the effect of walking intervention in subjects differing in body mass state. Movement program in children with normal body mass – energy content ranged from 1360 kcal (5685 kJ) to 2620 kcal (10952 kJ) (mean 1980±310 kcal - 8276±1296 kJ).

In overweight children – energy content ranged from 1650 kcal (6897 kJ) to 2310 kcal (9656 kJ) (mean 1920±230 kcal - 8026±960 kJ), and in children with obesity – energy content ranged from 1940 kcal (8109 kJ) to 2550 kcal (9045 kJ) (mean 2260±290 kcal - 9447±1212 kJ).

Results of these interventions are presented in Tables 3 and 4.

Table 3 Selected anthropometric variables collected before and after an intervention inchildren differing in body mass state.

	Before	After
n=139		
BH (cm)	150.8±2.0	153.4±2.2
BH (%)	100	153.4±2.2
BM (kg) (N)	44.0±3.8	45.4±3.7*
BM (%)	100	103.2±5.2*
BF_{abs} (%)	19.7±3.9	17.0±3.0**
BF_{rel} (%)	100	86.3±3.6**
n=95		
BH (cm)	151.6±2.2	154.1±2.4
BH (%)	100	101.6±2.2
BM (kg) (OV)	52.6±3.0	48.4±2.3**
BM (%)	100	92.1±2.0**
BF_{abs} (%)	24.6±3.1	20.8±2.5**
BF_{rel} (%)	100	84.6±2.4**
n=65		
BH (cm)	152.1±2.1	155.3±2.3
BH (%)	100	102.0±1.8
BM (kg) (OB)	63.2±3.6	54.3±2.8**
BM (%)	100	83.6±2.7**
BF_{abs} (%)	28.3±3.1	23.9±2.9**
BF_{rel} (%)	100	84.4±3.1**

* p<0.05,
** p<0.01,
N – normal body mass,
OV – overweight,
OB – obesity

Table 4 Selected anthropometric variables collected before and after an intervention in children differing in body mass state.

	Before	After
n=139		
v_{max} (km/h) (N)	12.5±1.8	13.9±1.7*
v_{max} (%)	100	111.2±4.2**
VO_{2max}/kg (ml)	44.6±3.9	51.2±3.0**
VO_{2max}/kg (%)	100	114.8±3.6**
n=95		
v_{max} (km/h) (OV)	11.8±1.1	12.8±0.9*
v_{max} (%)	100	108.5±0.9*
VO_{2max}/kg (ml)	33.1±5.3	38.7±4.8**
VO_{2max}/kg (%)	100	116.9±1.5**
n=65		
v_{max} (km/h) (OB)	9.8±0.3	10.4±0.4*
v_{max} (%)	100	106.1±2.2*
VO_{2max}/kg (ml)	24.5±3.2	27.7±3.3**
VO_{2max}/kg (%)	100	113.1±3.6**

* p<0.05, ** p<0.01,
N – normal body mass,
OV – overweight,
OB – obesity

The changes of majority variables are in relative description non-dependent on body mass state, it means that the walking program is able to realize practically the same changes in BC and physical fitness state. Of course the values that were recalculated on body mass were worse in subjects with higher body mass.

The proportion between the ECM and BCM ratio may be used to identify fluid imbalance or malnutrition and/or to assess the predispositions for muscular work. The term malnutrition refers to the loss of structural body components, which is most accurately reflected by the BCM and an increase of the ECM (Bunc et al. 2000).

The using of ECM/BCM for evaluation of physical exercise predispositions was confirmed by the significant dependence of VO2max on this variable. The relationship between VO2max and physical performance was often presented in literature (e.g. Bunc 1990). In our group of subjects this dependence was significant too (ranged from r=0.792, p<0.01 in seniors to r=0.720, p<0.01 in children). In practice this coefficient could be used like one of important criterion of exercise program efficiency.

The significant positive ECM/BCM dependence on age could be used for assessment of actual development state – biological age in seniors. In actual case we compare real value of ECM/BCM with value that was calculated according to general relationship that is true for senior women.

In normal subjects of middle age, ECM/BCM ratios are recorded between 0.75 and 1.00. Deviations from such figures toward higher values are due either to the erosion of BCM (catabolism) or to fluid expansion in extracellular spaces (edema). In the case of dehydration, we can observe the opposite phenomenon where the ECM/BCM ration is reduced (Bunc et al. 2000). Because the diet of followed subject was practically without significant alterations during whole 6 months, the significant increase in both FFM and BCM may be probably caused by imposed training program.

The changes in VO2max induced by endurance walking program are practically consistent with those found by Proper et al (2003), who found in group of senior men and women of similar age 14 % increase in aerobic fitness, and significant increase in FFM and significant decrease in BF and total body mass. These results were confirmed by our data but the changes in BC variables were not so high.

There is evidence to show that the magnitude of the increase in VO2max is dependent on total energy expenditure of exercise, and thus on frequency, and duration of exercise as a number of previous investigations have shown improvement to be in direct proportion to the number of weekly sessions (Astrand, Rodahl 1986; proper et al. 2003). According to the results of previous studies, VO2max as measured either in laboratory or in field has generally improved during the first months of conscription among non-trained subjects (Blair, Connelly 2005).

The minimum training energy expenditure required to maintain an elevated VO2max has not been clearly established. For example the most recent ACSM prescription guidelines (Haskell et al 2007) recommended minimal energy expenditure of 300 kcal per exercise session performed three days a week or 200 kcal per exercise session performed four days per week.

Adequate energy output has its effect both in the presence and in the absence of other influences, and the beneficial relationship continues with advancing age.

Physical activities that are based on walking can be implemented without having to visit special sports facilities and often expensive equipment. A major advantage is that it can be implemented in virtually any weather at the time that acceptable by the individual. Walking can be realized both as an individual activity as a group activity (Fujinami 2010). It is essential also that walking can be realized even within the family or as a joint activity of children of parents and grandparents. It should also be noted that walking at speeds higher than 6 km/h is already significant burden on the body and therefore it is necessary that intensive intervention programs before the individual was medically examined.

The condition required daily volume of physical activity - 10 000 steps - it can handle the full workload. Large margin today is the use of walking as a means of transfer in fulfilling everyday tasks such as working leisure time activities - regeneration. Another success is the regularity (at least three times a week, at least 30 minutes and more) is preferable 10 to 20 minutes daily.

In conclusion walking in energy expenditure ranged from 1000 kcal in seniors to 2000 kcal in children per week may significantly improve the physical fitness, body composition, and motor performance (speed of running) in non-trained groups of subject differing in age.

References

1. Ainsworth, B.E., Haskell, W.L., Whitt, M.C., Irwin, M.L., Swartz, A.M., Strath, S.J., et al. (2000). Compendium of physical activities: an update of aktivity codes and MET intensities. Medicine and Science in Sports and Exercise, 32: S498-504.
2. Astrand, P.O., & Rodahl, K. (1986). Textbook of Work Physiology. New York: McGraw Hill.
3. Biewener, A.A. (2003). Animal Locomotion. Oxford University Press.
4. Blair, S.N., & Connelly, J.C. (1996). How much physical activity should we do? The case for moderate amounts and Intensities of physical activity. Research Quarterly for Exercise, 67(2): 193-205.
5. Blanchard, J., Conrad, K.A., & Harrison, G.G. (1990). Comparison of methods for estimating body composition in young and elderly women. Journal Gerontology and Biological Sciences and Medical Sciences, 45: B119-B24.
6. Bond Brill, J., Perry, A.C., & Parker L. (2002). Dose-response effect of walking exercise on weight loss. How much is enough? International Journal of Obesity and Related Metabolic Disorders, 26(11): 1484-1493.
7. Bravata, D.M., Smith-Spangler, C., Sundaram, V., Geinger, A.L., Lin, N., Lewis, R., Stave, C.D., Olkin, I., & Sirard, J.R. (2007). Using Pedometers to Increase Physical Activity and Improve Health. Journal of the American Medical Association, 298: 2296-2304.
8. Bunc, V., & Dlouhá, R. (1997). Energy cost of treadmill walking. The Journal of Sports Medicine and Physical Fitness, 37: 103-109.
9. Bunc, V., Štilec, M., Moravcová, J., & Matouš, M. (2000). Body composition determination by whole body bioimpedance measurement in women seniors. Acta Universaitatis Carolinae Kinathropologica, 36(1):23-38.
10. Bunc V. (1994) A simple method for estimating aerobic fitness. Ergonomics; 37(1): 159-165.
11. Bunc, V. (1990). Biocybernetic approach to evaluation of organism response to physical load. Prague: UC.
12. Choi, B.C., Pak, A.W., Choi, J.C., et al. (2007). Daily step goal of 10,000 steps: a literature review. Clinical and Investigation Medicine, 30(3): E146-E15l.
13. Coull AJ, Taylor, V.H., Elton, R., Murdoch, P.S., & Hargreaves, A.D. (2004). A randomised controlled trial of senior Lay Health Mentoring in older people with ischaemic heart disease: The Braveheart Project. Age and Ageing, 33: 348-354.
14. Deurenberg, P., & Schouten, F.J.M. (1992). Loss of total body water and extracellular water assessed by multifrequency impedance. European Journal of Clinical Nutrition, 4: 247-255.
15. Fenton, M. (2001). Walking Magazine's The Complete Guide to Walking for Health, Weight Loss, and Fitness. Lyon: Lyons Press.
16. Fisher, K.J., & Li, F. (2004). A community-based walking trial to improve neighborhood quality of life in older adults: a multilevel analysis. Annals of Behavioral Medicine, 28: 186-194.
17. Fujinami, K. (2010). A Case Study on Information Presentation to Increase Awareness of Walking Exercise in Everyday Life. International Journal of Smart Home, 4(4): 11-26.
18. Gilson, N., McKenna, J., Cooke, C., & Brown, W. (2007). Walking towards health in a university commu-

nity: a feasibility study. Preventive Medicine, 44: 167-169.
19. Gordon, J.B., Harber, V., Murray, T., Courneya, K.S., & Rodgers, W. (2010). A Comparison of Fitness Training to a Pedometer-Based Walking Program Matched for Total Energy Cost. Journal of Physical Activity and Health, 7: 203-213.
20. Haines, D.J., Davis, L., Rancour, P., Robinson, M., Neel-Wilson, T., & Wagner. S. (2007). A pilot intervention to promote walking and wellness and to improve the health of college faculty and staff. Journal of American College Health, 55: 219-225.
21. Haskell, W., Lee, I.M., Pate, R.R., Powell, K.E., Blair, S.N., Franklin, B.A., Macera, C.A., Heath, G.W., Thompson, P.D., & Bauman, A. (2007). Physical activity and public health: updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. Medicine and Science in Sports and Exercise, 39: 1423-1434.
22. Haskell, W.L., Lee, I.M., Pate, R.R., et al. (2007). Physical activity and public health: updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. Circulation, 116:1081-1093.
23. Hillsdon, M., Foster, C., Cavill, N., Crombie, H., & Naidoo, B. (2005). The effectiveness of public health interventions for increasing physical activity among adults. A review of reviews. London: Health Development Agency 2nd edition.
24. Hillsdon, M., & Thorogood, M. (1996). A systematic review of physical activity promotion strategies. British Journal of Sports Medicine, 30: 84-89.
25. Kahn, E.B., Ramsey, L.T., Brownson, R.C., Heath, G.W., Howze, E.H., Powell, K.E., Stone, E.J., Rajab, M.W., & Corso, P. (2002). The effectiveness of interventions to increase physical activity. A systematic review. American Journal of Preventive Medicine, 22: 73-107.
26. Kelley, G.A., Kelley, K.S., & Tran, Z.V. (2001). Walking and resting blood pressure in adults: a meta-analysis. Preventive Medicine, 33:120-127.
27. Kelley, G.A., Kelley, K.S., Tran, Z.V. (2004). Walking, lipids, and lipoproteins: a meta-analysis of randomized controlled trials. Preventive Medicine, 38: 651-661.
28. LeMasurier, G.C., Sidman, C.L., & Corbin, C.B. (2003). Accumulating 10,000 steps: does this meet current physical aktivity guidelines? Research Quarterly for Exercise, 74(4): 389-394.
29. Macera, C.A., Ham, S.A., Yore, M.M., Jones, D.A., Ainsworth, B.E., Kimsey, C.D., & Kohl, H.W. (2005). Prevalence of physical activity in the United States: Behavioral Risk Factor Surveillance System, Preventing Chronic Disease, 2: A17.
30. Miyatake, N., Takahashi, K., Wada, J., Nishikawa, H., Morishita, A., Suzuki, H., Kunitomi, M., Makino, H., Kira, S., & Fujii, M. (2003). Daily exercise lowers blood pressure and reduces visceral adipose tissue areas in overweight Japanese men. Diabetes Research and Clinical Practice, 62:149-157.
31. Morris, J.N., & Hardman, A.E. (1997). Walking to health. Sports Medicine, 23: 306-332.
32. Murphy, M., Nevill, A.M., Neville, C., Biddle, S., & Hardman, A. (2002). Accumulating brisk walking for fitness, cardiovascular risk, and psychological health. Medicine and Science in Sports and Exercise, 34: 1468-1474.
33. Murphy, M.H., Nevill, A.M., Murtagh, E.M., & Holder, R.L. (2007). The effect of walking on fitness, fatness and resting blood pressure: a meta-analysis of randomised, controlled trials. Preventive Medicine, 44: 377-385.
34. Murtagh, E.M., Boreham, C.A., & Murphy, M.H. (2002). Speed and exercise intensity of recreational walkers. Preventive Medicine, 35:397-400.
35. National Institute for Health and Clinical Excellence (NICE) (2006). A rapid review of the effectiveness of pedometer interventions to promote physical activity in adults. London (UK): National Institute for Health and Clinical Excellence (NICE).
36. Nelson, M.E., Rejeski, W.J., Blair, S.N., Duncan, P.W., Judge, J.O., King, A.C., Macera, C.A., & Castaneda--Sceppa. C. (2007). American College of Sports M, American Heart A: Physical activity and public health in older adults: recommendation from the American College of Sports Medicine and the American Heart Association. Circulation, 116: 1094-1105.
37. Neptune, R.R., Sasaki, K., & Kautz, S.A. (2008). The effect of walking speed on muscle function and mechanical energetics. Gait Posture, 28: 135-143.
38. Nies, M.A., Chruscial, H.L., & Hepworth, J.T. (2003). An intervention to promote walking in sedentary women in the community. American Journal of Health Behavior, 27: 524-535.
39. Ogilvie, D., Foster, C.E., Rothnie, H., Cavill, N., Hamilton, V., Fitzsimons, C.F., & Mutrie, N. (2007). Interventions to promote walking: systematic review. BMJ: British Medical Journal (International Edition), 334: 1204-1207.
40. Proper, K.I., Koning, M., Beek, A.J., Hildebrandt, V.H., Bosscher, R.J., & van Mechelen, W. (2003). The effectiveness of worksite physical activity programs on physical activity, physical fitness, and health. Clinical Journal of Sports Medicine, 13(2): 106-117.
41. Rafferty, A.P., Reeves, M.J., McGee, H.B., & Pivarnik, J.M. (2002). Physical activity patterns among walkers and compliance with public health recommendations. Medicine and Science in Sports and Exercise, 34: 1255-1261.
42. Roche, A.F., Heymsfield, S.B., & Lohman, T.G. (1996). Human body composition. Champaign, Human Kinetics; 1996.
43. Schneider,P.L., Bassett, D.R., Jr., Thompson, D.L. et al. (2006). Effects of a 10,000 steps per day goal in overweight adults. American Journal of Health Promotion, 2l(2): 85-89.
44. Scottish Executive (2005). The Scottish Health Survey 2003. Edinburgh: Crown Copyright.
45. Stanton, J.M., & Arroll. B. (1996). The effect of moderate exercise on mood in mildly hypertensive volunteers: A randomized controlled trial. Journal of Psychosomatic Research, 40(6): 637-642.
46. Stephen, J., McGregor, M.A., Busa1, R.P., James, A.Y., & Erik, B. (2011). Control Entropy of Gait: Does Running Fitness Affect Complexity Of Walking? Clinical Kinesiology, 65(1): 9-17.
47. Swartz, A.M., Strath, S.J., Bassett, D.R., Moore, J.B., Redwine, B.A., Groer, M., & Thompson, D.L. (2003). Increasing daily walking improves glucose tolerance in overweight women. Preventive Medicine, 37: 356-362.
48. Tudor-Locke, C., Bell, R.C., Myers, A.M., Harris, S.B., Ecclestone, N.A., Lauzon, N., & Rodger, N.W. (2004). Controlled outcome evaluation of the First Step Program: a daily physical activity intervention for individuals with type II diabetes. International Journal of Obesity and Related Metabolic Disorders: Journal of the International Association for the Study of Obesity, 28: 113-119.
49. Tully, M.A., Cupples, M.E., Hart, N.D., McEneny, J., McGlade, K.J., Chan, W.S., & Young, I.S. (2007). Randomised controlled trial of home-based walking programmes at and below current recommended levels of exercise in sedentary adults. Journal of Epidemiology and Community Health, 61: 778-783.
50. Tully, M.A., Cupples, M.E., Chan, W.S., et al. (2007). Brisk walking fitness and cardiovascular risk: a randomized control trial in primary care. Preventive Medicine, 41: 622-628.

Physiological responses to moderate and high arm work during walking with poles

J. Baláš[1], **M. Lušticky**[1], **A. J. Martin**[2]
[1]*Sport Research Centre Faculty of Physical Education and Sport, Charles University, Prague, Czech Republic;*
[2]*School of Sport & Exercise, Massey University, Palmerston North, New Zealand*

Abstract
Walking with poles or Nordic Walking (NW) is considered an activity with higher energy cost than simple walking (W). The aim of the study was to assess the effect of arm work intensity on energy expenditure during walking with poles in 14 active males. Oxygen consumption was used to assess energy cost during W and NW with moderate and high arm work intensity. NW with low arm work was only equal in demand as walking without poles. However, NW with high arm work or active propulsion produced large increases in the oxygen uptake of 5.4 and 4.1ml.min^{-1}.kg^{-1} at 0 % and 10% slope, respectively. The study showed that arm work intensity is one of the key factors influencing the energy cost of NW. The results may be considered by physical trainers or therapists in developing NW program prescription. The proper NW technique with active arm propulsion should be performed when seeking an increase in activity energy cost.

Key words
Nordic walking, energy expenditure

Introduction

The practice of regular physical activity (PA) is associated with improved mental and physical health (Garber et al., 2011). Walking is the most common PA in adults (Rafferty, Reeves, McGee, & Pivarnik, 2002) and the related health benefits have already been demonstrated (Boone-Heinonen, Evenson, Taber, & Gordon-Larsen, 2009). Walking is a natural locomotion, suitable for all age categories; it is materially not-demanding and easily practised outdoors and indoors. Walking with poles, or Nordic walking (NW), originated in Finland and its popularity has increased considerably over the past 20 years (INWA, 2010). Church et al. (2002) documented higher upper muscle limb activity when using poles, rather than simple walking, and therefore higher oxygen consumption without significantly increased perceived exertion (Porcari, Hendrickson, Walter, Terry, & Walsko, 1997). In this way, NW may represent an attractive activity especially for lower fitness or overweight persons who seek an increase of exercise intensity. The differences in energy cost between walking and NW mentioned in the literature vary between 7 - 23% (Church, et al., 2002; Dechman, Appleby, Carr, & Haire, 2012; Figard-Fabre, Fabre, Leonardi, & Schena, 2009; Hansen & Smith, 2009). This variability may be accounted for by the speed of locomotion, the pole length, the type or inclination of the terrain. The highest differences were stated during higher speeds of walking or field testing (Church, et al., 2002; Porcari, et al., 1997) where higher arm propulsion might have been expected. Our assumption was that the active propulsion or arm work during the locomotion will play a key role in energy cost of NW.

Aim

The aim of the study was to assess the effect of arm work on energy expenditure during NW.

Methods

Participants

The research sample consisted of 14 aerobically active males (24.1 ± 1.8 yrs, 74.3 ± 6.4 kg, 179.1 ± 5.4 cm). All participants were physical education students and familiar with Nordic walking. The study was approved by the local Human Ethics Board.

Procedure

For the test procedure, participants completed, after familiarisation, 2 x 3 (inclination x condition) different trials in one test session. The walking and NW was tested on a treadmill (Quasar, H/P/Cosmos, Germany) at 0 % and 10 % inclinations at a speed of 6 km.h^{-1}. The conditions represented walking, NW with moderate arm work and NW with high arm work. Each stage lasted for four minutes starting at 0 % by walking, followed by walking with moderate and then high arm work. The intensity of arm work was set on a subjective scale 1-5, where moderate arm work corresponded to 1-2 and high arm work to 4-5. All walkers received a 4 minute rest before undertaking the same procedure at 10 % inclination. The length of poles was adjusted specifically for each subject to an appropriate length in which the elbow was flexed at 90° while the pole was held in a vertical position and in contact with the ground.

Measurement of energy cost

Minute ventilation (V_E), oxygen uptake (VO_2) and carbon dioxide production (VCO_2) were measured during the treadmill tests by a portable breath-by--breath indirect calorimetry system (MetaLyzer, Cortex Biophysic, Germany). Before each test, gas and volume calibration was performed according to the manufacturer's guidelines. The volume calibration was performed using a known 3L syringe, and gas calibration was performed with a known gas mixture of 15% O_2 and 5% CO_2. Data was averaged over 20 s intervals; the mean of the last minute from each stage and the highest values from the maximal test were analysed. RER was computed by dividing measured CO_2 by measured O_2. HR was monitored by the MetaLyzer using a Polar heart transmitter belt (Polar Electro OY, Finland).

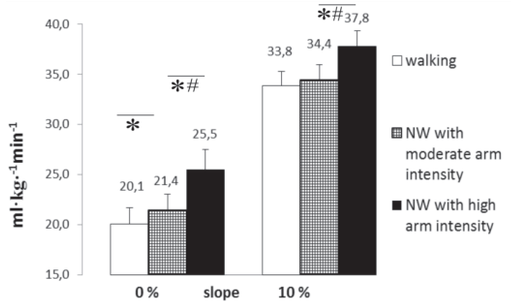
Statistical analysis

The normality for all variables was tested by one sample Kolmogorov-Smirnov goodness of fit. All data showed normal distribution. Descriptive statistics (means and standard deviations) were used to characterize the physiological responses during walking and NW. The differences between walking, NW with moderate and high arm work were assessed by repeated measure ANOVA and pairwise comparisons between walking and NW conditions. The statistical significant differences were considered at $P \leq 0.05$. 'Practical' differences in relative VO2 were set to at least 2 ml.min^{-1}.kg^{-1}.

Results

At 0 %, we observed statistically significant ($p < 0.001$) but 'practically' not significant increase (↑ 1.3 ml.min^{-1}.kg^{-1}) in the oxygen consumption between walking and NW with moderate arm work. On the other hand, we found significant ($p < 0.001$; ↑ 4.1 ml.min^{-1}.kg^{-1}) increase between NW with moderate and high arm work (Figure 1). At 10 %, we observed no significant ($p = 0.14$; ↑ 0.5 ml.min^{-1}.kg^{-1}) increase in the oxygen consumption between walking and NW with moderate arm work but significant ($p < 0.001$; ↑ 3.4 ml.min^{-1}.kg^{-1}) increase between NW with moderate and high arm work (Figure 1).

Figure 1. Oxygen consumption during walking (W), Nordic walking (NW) with moderate and high arm work in two inclinations (0°, 10°). * indicates statistically significant differences ($p < 0.001$) and # differences higher than 2 ml.min^{-1}.kg^{-1} .



There was a significant effect ($p < 0.001$) of inclination on VO2 but no significant interaction between the slope and walking conditions was found. The other physiological parameters are presented in Table 1. The data confirms physiological increases with the pole conditions and inclination, as described before.

Table I. Mean (± standard deviation) heart rate (HR), oxygen uptake (VO_2) and respiratory exchange ratio (RER) during walking (W), Nordic walking (NW) with moderate and high arm work in two inclinations (0°, 10°)

		HR (beats . min^{-1})	VO_2 (l . min^{-1})	V_E (l . min^{-1})	RER
0%	W	100 ± 10	1.49 ± 0.13	36.2 ± 4.8	0.91 ± 0.05
	NW moderate arm work	104 ± 10	1.59 ± 0.17	39.6 ± 4.3	0.93 ± 0.04
	NW high arm work	117 ± 11	1.89 ± 0.17	48.5 ± 4.9	0.94 ± 0.05
10%	W	131 ± 10	2.51 ± 0.18	55.0 ± 5.8	0.89 ± 0.04
	NW moderate arm work	137 ± 10	2.55 ± 0.23	58.7 ± 5.3	0.92 ± 0.03
	NW high arm work	149 ± 10	2.80 ± 0.22	68.6 ± 6.8	0.95 ± 0.04

Discussion

The purpose of the current study was to assess the effect of arm work during walking with poles on energy expenditure. The results were compared to walking without poles. The participants were recruited among physical education students which makes the results hard to generalizable for elderly and physically inactive populations. The testing procedure was performed on a treadmill which can decrease the measured values compared to over-ground walking (Dechman, et al., 2012). Nevertheless, the treadmill enabled the use of different intensities of arm work and the participants' NW technique was not compromised by the treadmill.

To our knowledge, only one previous study has compared different arm work in NW (Jensen et al., 2011). Jensen et al. (2011) investigated if an increase load transmitted through arms to the poles could reduce the knee joint compression force during level walking with poles. A force 2.4 higher than normal pole force did not lead to a reduction in the knee joint compressive force.

Our hypothesis was that the arm work intensity is the main contributor to the higher oxygen uptake in NW, as described in the literature (Church, et al., 2002; Porcari, et al., 1997; Rodgers, Vanheest, & Schachter, 1995; Schiffer et al., 2006). In the current study, the differences between walking and NW with moderate arm work during level walking were 6% and roughly corresponded to differences of 8% between walking and NW at a speed of 1.8 $m \cdot s^{-1}$ (6 $km \cdot h^{-1}$) in the Schiffer et al. study (2006). On the other hand, the differences between walking and NW with high arm work during level walking were 27% and were in line with the values reported by Church et al. (2002) who found a 20,6% difference between walking and NW at a speed of approx. 1.6 $m \cdot s^{-1}$ (5.8 $km \cdot h^{-1}$) and also Porcari et al.'s study (1997) who found a 23% difference between walking and NW at a speed of approx. 1.69 $m \cdot s^{-1}$ (6.1 $km \cdot h^{-1}$). This data shows that variances of higher oxygen uptake in NW may be explained by the intensity of arm work.

The speed of 6 $km \cdot h^{-1}$ was selected because the participants were unable to perform active propulsion with the poles at lower walking speeds. Therefore, with lower arm work, there may be not sufficient differences in oxygen consumption between walking and NW. This hypothesis is supported by the study of Schiffer et al. (2006) who stated non-significant difference in oxygen consumption between walking and NW at speeds lower than 6 $km \cdot h^{-1}$. Nevertheless, the speed of 6 $km \cdot h^{-1}$ may represent excessive intensity for middle aged, elderly or inactive populations, and this population would not benefit from using poles to increase energy cost of PA (Fritschi, Brown, Laukkanen, & van Uffelen, 2012; Kukkonen--Harjula et al., 2007). Figard-Fabre et al. (2009) found, in obese women, that the use of NW poles increased physiological responses at a speed of 4 $km \cdot h^{-1}$. However, although, the increase (12%) in VO_2 during level NW was found to be statistically significant it was smaller than 2 $ml \cdot min^{-1} \cdot kg^{-1}$ which represents only a normal fluctuation of oxygen uptake. The main limitation of the study is the choice of active male participants, which make the results difficult to generalize to a broader population. Inactive, elderly and overweight persons may not be able to achieve the speed of 6 $km \cdot h^{-1}$ where active arm propulsion can be performed.

Conclusions

The study showed that arm work intensity is one of the key factors influencing the energy cost of NW. NW with low arm work was only equal in demand as walking without poles. However, NW with high arm work or active propulsion produced large increases in the oxygen uptake of 5.4 and 4.1 $ml.min^{-1}.kg^{-1}$ at 0 % and 10% slope, respectively. The results have implications for trainers or therapists in prescribing NW programmes. The proper NW technique with active arm propulsion should be performed when seeking an increase in activity energy cost.

Acknowledgement

The study was supported by Ministry of Physical Education and Sport Czech Republic MSM 0021620864 and Specific University research SVV 2013 - 265603.

References

1. Boone-Heinonen, J., Evenson, K. R., Taber, D. R., & Gordon-Larsen, P. (2009). Walking for prevention of cardiovascular disease in men and women: a systematic review of observational studies. Obesity Reviews, 10(2), 204-217.
2. Church, T. S., Earnest, C. P., & Morss, G. M. (2002). Field testing of physiological responses associated with Nordic Walking. Research Quarterly for Exercise and Sport, 73(3), 296-300.
3. Dechman, G., Appleby, J., Carr, M., & Haire, M. (2012). Comparison of treadmill and over-ground Nordic walking. European Journal of Sport Science, 12(1), 36-42.
4. Figard-Fabre, H., Fabre, N., Leonardi, A., & Schena, F. (2009). Physiological and perceptual responses to Nordic walking in obese middle-aged women in comparison with the normal walk. European Journal of Applied Physiology, 108(6), 1141-1151.
5. Fritschi, J. O., Brown, W. J., Laukkanen, R., & van Uffelen, J. G. Z. (2012). The effects of pole walking on health in adults: A systematic review. Scandinavian Journal of Medicine & Science in Sports, 22(5), e70-e78.
6. Garber, C. E., Blissmer, B., Deschenes, M. R., Franklin, B. A., Lamonte, M. J., Lee, I. M., et al. (2011). Quantity and Quality of Exercise for Developing and Maintaining Cardiorespiratory, Musculoskeletal, and Neuromotor Fitness in Apparently Healthy Adults: Guidance for Prescribing Exercise. Medicine and Science in Sports and Exercise, 43(7), 1334-1359.
7. Hansen, E. A., & Smith, G. (2009). Energy Expenditure and Comfort During Nordic Walking with Different Pole Lengths. Journal of Strength and Conditioning Research, 23(4), 1187-1194.
8. INWA. (2010). International Nordic Walking Association history. Retrieved 12/12/2012, 2012, from http://inwa-nordicwalking.com/index.php?option=com_content&view=article&id=55&Itemid=127
9. Jensen, S. B., Henriksen, M., Aaboe, J., Hansen, L., Simonsen, E. B., & Alkjaer, T. (2011). Is it possible to reduce the knee joint compression force during level walking with hiking poles? Scandinavian Journal of Medicine & Science in Sports, 21(6), E195-E200.
10. Kukkonen-Harjula, K., Hiilloskorpi, H., MÄ¤nttÄ¤ri, A., Pasanen, M., Parkkari, J., Suni, J., et al. (2007). Self-guided brisk walking training with or without poles: a randomized-controlled trial in middle-aged women. Scandinavian Journal of Medicine & Science in Sports, 17(4), 316-323.
11. Porcari, J. P., Hendrickson, T. L., Walter, P. R., Terry, L., & Walsko, G. (1997). The physiological responses to walking with and without Power Poles(TM) on treadmill exercise. Research Quarterly for Exercise and Sport, 68(2), 161-166.
12. Rafferty, A. P., Reeves, M. J., McGee, H. B., & Pivarnik, J. M. (2002). Physical activity patterns among walkers and compliance with public health recommendations.. Medicine and Science in Sports and Exercise, 34(8), 1255-1261.
13. Rodgers, C. D., Vanheest, J. L., & Schachter, C. L. (1995). Energy expenditure during submaximal walking with Exerstriders. Medicine and Science in Sports and Exercise, 27(4), 607-611.
14. Schiffer, T., Knicker, A., Hoffman, U., Harwig, B., Hollmann, W., & Struder, H. K. (2006). Physiological responses to nordic walking, walking and jogging. European Journal of Applied Physiology, 98(1), 56-61.

Adventure activities and challenge sports in personal development

Enough about the outcomes ... what about the process: Personal development and experiential learning

P. Allison[1], K. Von Wald[2]
[1]The Institute for Sport, Physical Education and Health Sciences. Moray House School of Education, The University of Edinburgh, Scotland
[2]Learning and Change Consulting, Edinburgh, Scotland

Abstract
Most research in experiential learning has focused on outcomes. This has happened for good reason – not least to secure funding but also to understand the benefits that result from such experiences. However, this has resulted in limited work considering the process by which such outcomes are achieved. Some work has relied heavily on psychological constructs (e.g. Walsh and Golins, 1976) which have resulted in various rhetorical narratives (e.g. challenge by choice, project adventure inc., 2002). In the last decade (roughly speaking) there has been an increasing amount of work on process (eg McKenzie, 2000) and sociological conceptions of experiential learning (e.g. Brown & Fraser, 2009; Zink, 2010). While the former is needed to inform pedagogy the latter can provide some theoretical insights.
In this paper we outline some of the above issues and suggest the imbalance between research on outcomes over process needs to be addressed. We also argue that the claims of long term impact suggest that it will be valuable to undertake longitudinal and retrospective studies. We then focus on some of our own work which is concerned with both outcomes and processes. The example concentrates on Sail Training and presents a recently developed model to gain a conceptual understanding with a pedagogical focus.

Key words
personal development, outdoor

Introduction

The majority of research on experiential learning (used here as a general term to incorporate adventure sports, adventure education, outdoor education and related terms) has focused on outcomes. This has happened for good reasons, in part as a way of justifying expenditure but also because it has been important to gain understanding of the benefits of taking part in such activities. While the purpose of this paper is not to summarise this work it is worth noting that this past research can be understood as falling into categories of psychology, sociology and philosophy. Some work has also been undertaken in the natural sciences which, for the purposes of this paper, refers to biomechanics, physiology, health benefits and such like. What is clear at this stage is that there is a complex matrix of research in experiential learning which is further complicated by appearing in different books and journals and spanning across a multitude of disciplines and subject areas. While it is tempting to wish for clearer and more straightforward ways of categorising research in experiential learning we believe it is more useful to acknowledge and embrace this complexity. In this respect we are suggesting acceptance of 'what is' rather than 'what ought to be'. We are simply suggesting use of the is/ought distinction to deal with this complexity and recognition that change is unlikely given the growing proliferation of publication outlets and the wide variety of contexts in which experiential approaches to learning are utilised.
When attempting to take a meta view of research in experiential learning it becomes evident quickly that there is a plethora of research which focuses on the outcomes of participation in experiential learning. As noted above this seems reasonable given that such research is often needed to secure funding. In this paper we suggest that this trend now needs to be balanced by encouraging research which is focused on the processes associated with experiential learning. This point was made by Allison and Pomeroy (2000) and more recently by Baldwin, Persing and Magnusun (2004, p. 168),
There are philosophical ideas, programming principles, and a "folk pedagogy" of practitioners beliefs about how "adventure" works, but few explicit theoretical models, testable hypotheses, and little empirical evidence of specific adventure mechanisms that affect processes of individual change.
We argue here that a focus on process is essential if we are to develop meaningful conceptual understandings of experiential learning across a range of different disciplines. Though this short discussion will leave inevitable gaps and places where readers may want more, our hope is that in time others will begin to look at the details and that, most importantly, researchers will begin to consider these arguments as they plan and undertake various research projects.

Declaration of Interests and Frustrations

We believe it is important to give some context to this paper and also to declare our own interests and frustrations. This paper is based upon a presentation at the International Mountain and Outdoor Sports Conference (IMOSC) at Charles University in Prague in November 2012. This conference brings together a collection of people from across Europe who are committed to thinking and practicing in the area of experiential learning with a specific focus on values. At the conference one of us was asked to speak about 'Adventure Activities and Challenge Sports in Personal Development'.
Our own interests in experiential learning are in the area of education outdoors and particularly in the value of wilderness experiences for personal development. This is a result of our own experiences and subsequent studies on the influence of such experiences on values development and exploration. Parallel to these experiences and interests we have an ongoing interest and commitment to philosophy as a way of knowing and are sceptical of the evidence based practice movement (see Harper, 2010) which relies almost exclusively on empirical evidence.
One of us has been somewhat disillusioned by experiences of working in outdoor education due to the often unexamined assumptions and beliefs and by moves since the turn of the century (approximately) to an emphasis on environmental education and sustainability which often seems to overshadow personal development and values education in a wider context. This has led to frustrations as practices are often incongruent with espoused experiential principles and begin to take a more values training than values education approach – although such a critique is, admittedly, fiercely contested. However, this is not the focus of this paper but something for subsequent writing.
In this paper we use two examples to illustrate challenges for research in the area of experiential learning but before doing so it is useful to consider a phrase that is commonly associated with experiential learning.

Life Changing Experiences

Browsing through literature on experiential learning, looking at organisations' web sites and speaking to people who have been involved in experiential learning the phrase 'life changing' is often used. Our understanding of this term is that it indicates that people are trying to articulate something for which they do not have sufficient vocabulary to adequately express themselves. We believe this to be understandable given that such experiences often take people to places – literally and metaphorically speaking – from which they step outside their everyday life and look in on themselves and their lives as an observer.
'Life changing experiences' is a term that can be found in many places, but a recent example is present in the Outward Bound Social Impact report (2012, p. 3) which states, The purpose is not to paint a glossy picture of one life-changing experience after another, but to give an open and honest account of how young people benefit from our courses and of the challenges we continue to face in measuring that consistently.

Similarly,
I've often heard people talk about life changing experiences and have dismissed this as hyperbole, I can honestly say however, that Outward Bound is a life changing experience and one I think everyone should have at least once in their lives. (Jarvie, 2008)
Use of this term is certainly not restricted to experiential learning. The front cover of an Education Scotland document published in the autumn of 2012 titled Career Long Professional Learning included the phrase "Transforming lives through learning".
These examples are not cited to criticise the use of the term but more to highlight the prevalence of its use and to make a further observation. The majority

of research in experiential learning takes a black box approach (Howe, 2004, p. 47), considering input and output but not process. Furthermore, the majority of research considers the 'output' or outcomes of such experiences in the short term. Research that considers outcomes for anything more than 24 months post experience is very difficult to find. This seems somewhat ironic given that such experiences are repeatedly reported and claimed to be 'life changing'. If indeed such experiences are life changing then one might expect to see much more long term research, such as looking at the lives of people who took part in specific experiential learning events 50 years ago for example. There is a small amount of research which takes this kind of approach (e.g. Davis-Berman & Berman, 2012) but it is remarkably rare.

It may be useful to point out at this stage that the idea of life changing experiences may be somewhat problematic in a number of ways. For example, for organisations to advertise that they offer 'life changing experiences' raises expectations to a level which then places pressure on staff to 'provide' life changing experiences. In turn, this assumes that there is a common understanding of what the term means and what it might be like to have a life changing experience! It also assumes that life changing experiences are positive, desirable or good. One might also question whether an organisation or other person (such as a wilderness leader) is in an appropriate position to offer or facilitate a life changing experience. Another analysis might suggest that the kind of people who are attracted to partake in experiential learning experiences might do so at a stage when they are looking for a life changing experience, at a stage in their life when they are looking for change of some kind. If this is the case then it is perhaps not surprising that they find such experiences in experiential learning participation. This argument suggests that life changing experiences may be a self-fulfilling prophecy in many contexts. Needless to say there are a whole host of further issues that could be considered – most of which raise interesting ethical considerations – but for the purposes of this paper the above is sufficient to make the point that claims of life changing experiences through experiential learning might wisely be treated with some caution.

In order to progress further and offer some more specific examples we are going to focus on some research that we have undertaken over recent years. This is certainly not intended to be self-indulgent or to suggest that this work is somehow exemplary but rather to illustrate our own approaches and the difficulty of moving away from outcomes focused research. We are in the process of developing longer term research which aims to address the second critique outlined above.

Research on Sailing

Between 2005 and 2007 one of us worked with colleagues on a relatively large research project on 'the characteristics and value of sail training'. The work involved tall ships (of varying sizes) across the world to explore the research questions presented in table 1.

Table 1. Research Questions from The Characteristics and Value of Sail Training (Allison, McCulloch, McLaughlin, Edwards & Tett, 2007, p. 11).

1. What benefits and effects do participants anticipate from their experience and what influences those expectations?
2. To what extent do participants experience these benefits and effects as being achieved?
3. To what extent do participants experience unanticipated benefits and effects?
4. What, if any, specific identifiable changes in participants' views of themselves are evident between the beginning of a voyage and two to three months after the voyage?
5. What are the key differences between sail training programmes? Do differences such as type of vessel used, voyage characteristics, ideology and programme characteristics lead to differing purposes and outcomes? If so what are the significant differences?

To answer these questions 17 different vessels from 13 different countries were involved in the study, 34 voyage reports, 155 observations, 306 interviews early in the voyage and after three months 173 of these people were interviewed again. Further details of the study can be found in the report but at the time this was the largest study of sail training ever undertaken. The two year project concluded that sail training does pretty much what sail training operators claim. Participants reported overwhelmingly positive experiences, developed confidence, teamwork and technical skills and there was very little difference between different vessels, sex, age and countries of origin.

Having undertaken this research which was, not surprisingly, well received by the sail training community, Allison was left with a sense of missing some depth. While the findings were useful for pragmatic reasons (and have since assisted various sail training operators in securing grant funding for their ongoing work) the work will not make much, if any, difference to young people joining a voyage. There was nothing in the research that helped to inform someone working on board on how to do a better job – how to ensure that youth development outcomes were achieved, enhanced or how to understand their work in a meaningful way. These were not the aims of the research but upon reflection led to a search beyond the study for something else, something more. A brief summary of Aristotle's concept of phronesis is useful at this stage.

Aristotle and Phronesis

Among the many concerns and interests of the ancient Greek philosopher Aristotle was a concern with developing a theory of moral life. Indeed, developing a theory of moral life is one way of summarising Aristotle's work throughout his own life. He was concerned with enhancing human well being or human flourishing (e.g. Aristotle, trans. 1999, I 4§2). To do so he believed that moral wisdom is required and to develop his arguments he needed to consider different ways of knowing (epistemology). Specifically, he maintained that certain dispositions of character seemed to consistently promote a flourishing life, and these dispositions were called virtues. If one wanted to live well, it was then sensible to live a life of virtue. Judgments were informed not by what one ought to do, but by what kind of person, namely virtuous, one wanted to be. Aristotle considered there to be three forms of knowledge (Techne, Episteme and phronesis) all of which contributed to human flourishing which, for the purposes of this paper, need very brief summary (Allison, Carr & Meldrum, 2012; Thorburn & Allison, 2010).

Techne refers to what might often be referred to now as technical skills (skills and techniques or instrumental knowledge). In the case of outdoor experiential learning this might refer to things like erecting tents, hoisting sails, lighting stoves and cooking, tying knots and such like. These are sometimes referred to as "hard skills" but we prefer the term technical skills.

Episteme is concerned with theoretical knowledge often associated with academic institutions (Saugstad, 2013). Examples of episteme are the content specific learning of subjects like glaciology, Geology, botany, meteorology and physics. This can also include learning about individual and small group dynamics, and techniques for facilitating individual and small group reflection.

Phronesis is normally translated as practical wisdom or good judgement. This comes from having the ability to do the right thing at the right time in the right amount. For Aristotle this 'mean' varies between both individuals and contexts and is something that ought to develop through one's life – it is a never ending project. Terms such as integrity, sympathy, compassion, empathy and tolerance are often associated with phronesis which is a 'way of being' rather than a technical skill or theoretical knowledge. Someone with phronesis knows how to exercise judgement, which is context sensitive. Aristotle considers phronesis to be the intellectual virtue which allows all other virtues of character to be exercised.

Most people involved in experiential learning can see how these three categories emerge in different contexts and often suggest that they cannot be separated out in practice. While this seems to be reasonable to a point, we believe that these three forms of knowledge are useful as ways of considering and understanding different approaches to experiential learning, especially outdoors. (It is useful here to note of the importance of well being in current contexts. In Scotland and beyond the focus on well being politically with associated 'trickle down' to research, curriculum and policy at all levels is significant. It is not particularly controversial to say that health and well being is 'in vogue'. The conception of well being and human flourishing that Aristotle offers is interesting in this current landscape as it is broad and expansive rather than instrumental (e.g. physical health to reduce medical costs) or binary (e.g. physical vs mental health).

Purposes Practices and Outcomes

In 2009 we undertook some work for Sail Training International to develop a practical toolkit to assist sail training practitioners to improve their practice and impact (Von Wald & Allison 2010, 2011). In order to undertake this work we developed a model of youth development through sail training (Figure 1). This model is based on literature in the areas of youth development, adventure education and experiential learning.

The purposes of Sail Training are summarised drawing upon the three Aristotelian categories outlined above (techne – skill acquisition; episteme – curriculum based education and Phronesis – personal and social development). Two things are important to note at this stage. First, most sail training operators aim at some combination of these three purposes. The categories may be useful for clarifying approaches to setting programme purposes and

then subsequently aligning systems and practices to achieve those purposes. Second, curriculum based education can encompass two different meanings – a curriculum that is part of broader experiences (such as schools) or a curriculum which is developed on board and is independent of other institutions.

Youth development through sail training

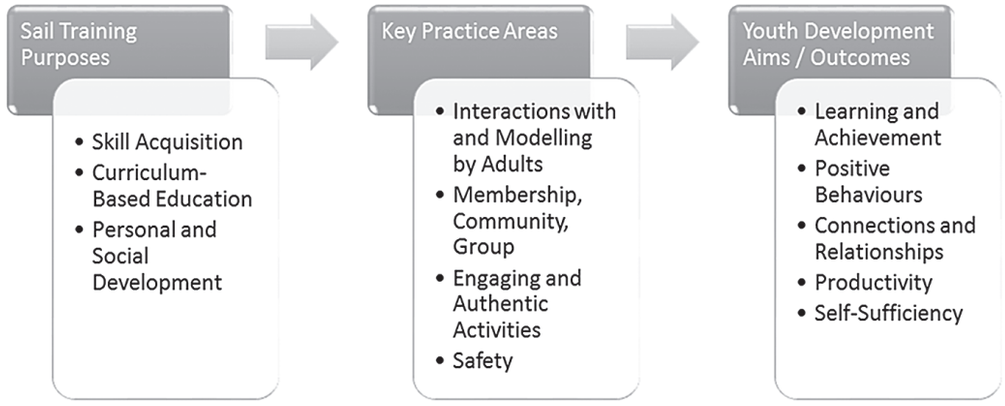


Figure 1. The Sail Training International Model

In developing this model we identified these five different outcomes of youth development. These outcomes are summarised (Von Wald and Allison, 2011, p. 6) as

- *Learning and Achievement*: including progressive mastery of new skills and/or discipline-based content, confidence
- *Positive Behaviours*: concerned with virtue and character, practical wisdom (judgment), respect for self and others, teamwork, leadership
- *Connections and Relationships*: between people – peers and adults; between the sailing experience and other experiences – past, present and future
- *Productivity*: participating, taking action to contribute to individual and group goals
- *Self-sufficiency*: to be self-reliant and appropriately confident, self-aware

These outcomes were derived from the main themes in relevant literature that suggest the impact and outcomes of youth development in order that we could concentrate on identifying the processes that contribute to achieving the outcomes. This was useful for developing the practices that were the focus of the sail training programme evaluation self-assessment toolkit. The toolkit that we developed breaks down each of the key practice areas into further detail in the form of questions which are aimed to promote reflection and discussion.

As discussed here, the focus in the literature seems to stem from an interest in providing evidence that youth development produces positive benefits (outcomes). By setting these evident outcomes as the aim of youth development through sail training, we could then focus on the practices that are linked with the outcomes so that operators could gain an understanding about elements of accepted practice to increase the likelihood that participants in their programmes would experience the desired outcomes. With the outcomes in mind, we can focus on the process and thus help youth development operators achieve better results from their engagement with young people.

Reflection and Perspective – Life Changing?

In this paper we have suggested that a shift in focus of research in adventure education from outcomes to process will be beneficial in improving practice and therefore enhancing the experiences and outcomes of those engaged in adventure education. In doing so we have taken a broad and general perspective which attempts to identify the key arguments and issues at stake. There are elements of the arguments that need to be explored further and we welcome work which does this.

It is important to point out that we are not suggesting that outcomes research is bad and process research is good - such a binary conception is inevitably problematic. We are suggesting that research that considers process is important in developing the current literature to take a more holistic perspective.

The second observation we have made is concerned with the short term nature of research on outcomes and the value of experiential learning. We are struck by the short term nature of the outcomes research that has been undertaken which is ironic given the 'life changing' claims so often associated with, and espoused for, experiential learning. While such experiences may be 'life changing' there may be aspects of this somewhat rhetorical polemic (some of which are noted above) which require careful consideration and articulation.

References

1. Allison, P. & Pomeroy, E. (2000). How shall we ‚know?': Epistemological concerns in research in experiential education. Journal of Experiential Education, 23(2), 91–97.
2. Allison, P., Carr, D., & Meldrum, G. (2012). Potential for excellence: interdisciplinary learning outdoors as a moral enterprise. Curriculum Journal, 23(1), 43–58. doi:10.1080/09585176.2012.650469
3. Allison, P., McCulloch, K., McLaughlin, P., Edwards, V. & Tett, L. (2007). The characteristics and value of the sail training experience. Edinburgh: Research report, The University of Edinburgh.
4. Aristotle (1999). Nicomachean ethics (2nd ed.). (T. Irwin, Trans.). Indianapolis, IN: Hackett.
5. Baldwin, C., Persing, J., & Magnuson, D. (2004). The role of theory, research, and evaluation in adventure education. Journal of Experiential Education, 26(3), 167-183.
6. Brown, M., & Fraser, D. (2009). Re-evaluating risk and exploring educational alternatives. Journal of Adventure Education & Outdoor Learning, 9(1), 61–77. doi:10.1080/14729670902789529
7. Davis-Berman, J., & Berman, D. (2012). Reflections on a Trip: Two Decades Later. Journal of Experiential Education, 35(2), 326–340. doi:10.5193/JEE35.2.326
8. Harper, N. J. (2010). Future paradigm or false idol: A cautionary tale of evidence-based practice for adventure education and therapy. Journal of Experiential Education, 33(1), 38-55.
9. Howe, K. R. (2004). A Critique of Experimentalism. Qualitative Inquiry, 10(1), 42–61. doi:10.1177/1077800403259491
10. Jarvie, D. (2008). The Outward Bound Trust. Retreived January 17, 2013 from http://www.outwardboundgenerations.org.uk/story/deborah-jarvie
11. McKenzie, M. (2000). How are adventure education program outcomes achieved? A review of the literature. Australian Journal of Outdoor Education, 5(1), 19–28.
12. Project Adventure Inc. (2002). Adventure programming workshop manual (2nd ed.). Beverly, MA: Project Adventure Inc.
13. Saugstad, T. (2013). The importance of being experienced : An Aristotelian perspective on experience and experience-based learning, Studies in Philosophy and Education, 32, 7–23. doi:10.1007/s11217-012-9329-0
14. Thorburn, M., & Allison, P. (2010). Are we ready to go outdoors now? The prospects for outdoor education during a period of curriculum renewal in Scotland. Curriculum Journal, 21(1), 97–108. doi:10.1080/09585170903560824
15. Von Wald, K. & Allison, P. (2010). Sail training programme evaluation: Self-assessment toolkit. Gosport: Sail Training International.
16. Von Wald, K. & Allison, P. (2011). Sail training programme evaluation: Self-assessment toolkit (Second edition). Gosport: Sail Training International.
17. Walsh, V., & Golins, G. (1976). The exploration of the Outward Bound process. Unpublished manuscript.
18. Zink, R. (2010). Coming to know oneself through experiential education. Discourse: Studies in the Cultural Politics of Education, 31(2), 209–219. doi:10.1080/01596301003679727

Performance in outdoor sports

Injury Prevention in Marathon Runners

J. Nathan
Royal Blackburn Hospital, England

Abstract
More people run today than ever before with participation in marathons becoming increasingly popular. Injury rates in those training for a marathon can be as high as 90%. 89 individuals running for Arthritis Research UK were followed up before and after running the London Marathon. All were asked to complete two online questionnaires, one before the marathon asking for demographic information, previous history of running injury and training habits and one after regarding how the run went and recovery time. The mean response rate across both surveys was 62%. There is a significant association between time and injury whilst running the London Marathon (p = 0.003). This is supported by the fewest percentage of runners who sustained an injury are those who ran the marathon in less than 4 hours (13%). This report indicates how difficult it is to determine who will sustain an injury whilst running a marathon. It highlights that they are many risk factors for incurring injury but few proven by scientific research. It does suggest a relationship between marathon time and injury.
There is a need for guidelines for all marathon runners to help reduce injury

Key words
marathon, run, prevention

Introduction

Growth in non-elite marathon runners

Since the 1980s marathon running has ceased to be a sport only for elite athletes and began to attract mass participation by non-elite 'fun runners'(Satterthwaite et al., 1996). The big city marathons in London, New York and Boston attract tens of thousands of runners. These courses also stage a main race where elite athletes compete.(Spellman, 1996) Over the last 10 – 15 years there has been a dramatic increase in popularity and participation in marathons.(Fredericson and Misra, 2007) It would be interesting to consider what the reason for this increase may be.

Increase In health consciousness

Medical advice recommends a healthy running distance of 10 – 25km per week or 1 – 2 hours of endurance exercise. In the last 10 – 15 years there has been a greater emphasis on balanced diets and choosing running programmes which lead up to marathon distances.(Nicholl et al., 1995) One may expect that the increase in individuals taking up running may impact the rates of injuries, a factor that needs to be further investigated.

Impact in growth of marathon running on rates of injury

During the course of a year two thirds of long distance runners sustain an injury that interrupts their training programme.(Lysholm and Wiklander, 1987) In this study long distance runners were defined as those who trained for at least one hour for 21 days of the month. Among this group of runners lower extremity injuries are particularly common. (Lysholm and Wiklander, 1987) Unfortunately this data is limited; as it considers runners by the amount of time they spend running per month, not by distance covered, such as marathon runners.
Although this connection seems relatively sensible it still does not explain why some individuals are more prone to injuries than others. It also does not explain why a correlation between distance covered in training and rates of injury has been found.

Injuries Associated With Marathon Running

Common injuries

The most common overuse injury is patellofemoral pain syndrome.(Ballas et al., 1997, Pinshaw et al., 1984) Iliotibial band friction syndrome, plantar fasciitis, meniscal injuries and patellar tendinopathy are the other common acute injuries experienced by runners.(Taunton et al., 2002)
The knee is the most common site of both acute and overuse injury. Other injury sites include the foot/ankle, lower leg, hip/pelvis, achilles/calf, upper leg and lower back.(Pinshaw et al., 1984) It is unsurprising that the knee is most commonly associated with injuries as it is the main joint taking the impact whilst running.
Additional acute complaints include thigh muscle soreness, blistered feet, chaffing, malaise, ankle sprains and extreme exhaustion.
Non-musculoskeletal injuries including light-headedness, nausea, stomach upsets, headaches and diarrhoea will not be considered in the study. These are commonly due to dehydration.(Fredericson and Misra, 2007)

Long-term complications

One of the most common associations is between marathon running and predisposition to osteoarthritis (OA) later in life but the connection is still unknown.
Reports have shown that the type of sport has a significant impact on the degree of risk. The sports that have a high recognised risk are those that involve repetitive, high intensity, high impact forces through the affected joint(Conaghan, 2002). One Finnish study found that the prevalence of radiographic osteoarthritis in long distance running, football, weightlifting and shooters were 14%, 29%, 31% and 3% respectively(Kujala et al., 1995). This study did not state the distance covered by long distance runners and whether they were marathon runners or not. In addition it did not state whether the radiographic findings correlated to symptoms of pain.
One retrospective cohort study in 1973 and 1988 examined former athletes of whom 27 were long distance runners who averaged 60 miles per week. Radiographic evidence of OA of the hip was found in 19% of runners.(Marti et al., 1989) A conflicting study by Lane and colleagues presented a series of reports from a prospective cohort of subjects from a long distance recreational running club.(Lane et al., 1986, Lane et al., 1993, Lane et al., 1998) The report concluded that there were no differences in clinical or radiographical findings of OA after five years compared with nine years follow up. The mechanism of repetitive, high weight-loading exercise causing OA is still unclear. It is surprising that the link is so well known despite there being insufficient evidence to support it.(Spector et al., 1996)

Risk Factors Predisposing Marathon Runners to Injury

These can be categorised into four groups; demographic, systemic, training / running related factors and health and lifestyle factors.

Demographic Factors:

Gender and Age - Patterns of injuries have been assumed to be more sport specific than gender specific and previous studies have found similar overall injury rates in men and women. (Lanese et al., 1990) These studies do not specify what proportions of these include marathon runners compared to other sports and therefore no significant conclusion can be made. Conn et al assessed sports related injuries in a population of ages 5 – 24 years old in the United States. They found that injuries were twice more common in males than females. (Conn et al., 2003)
As the anatomy of males and females differ it is unsurprising that sites of acute injury may vary. In females hip, lower leg and shoulder related injuries are more common (Satterthwaite et al., 1999). Whilst thigh related injuries have been found to have a higher incidence amongst males compared with females.(Sallis et al., 2001) Again these studies were not exclusive to marathon runners. Satterthwaite et al found that specifically amongst male marathon runners there was a greater risk of hamstring and calf injuries than in females (Satterthwaite et al., 1999).
Taunton et al found that an age less than 34 years old was a risk factor for developing pattelofemoral pain in both sexes. In addition it showed that young age is a protective factor against meniscal injuries(Taunton et al., 2002). Conflicting reports by Jacobs and Berson (Jacobs and Berson, 1986), Macera et al (Macera et al., 1989) and Walter et al (Walter et al., 1989) reported that age was not significantly related to incidence of running injuries although one study of military recruits with a uniform training regime showed a positive correlation of injury with increasing age.(Neely, 1998) Therefore it is difficult to conclude whether age has an impact upon rates of injury, as reports seem to contradict one another.

Height and Weight – As mentioned previously, there are contradictions in conclusions drawn by different studies and equally there does not seem to be any consistency proving that height or weight significantly impacted incidence of injury in marathon runners.
Although BMI has shown to be a valid estimate of body composition for the general public it is uncertain whether a relationship can be found on its im-

pact on rates of injuries in runners.
The limitations and inconsistency of the above reports suggest that it may be difficult to determine whether simple demographics impact injury rates. In addition the lack of inclusion of marathon runners makes it hard to draw any significant conclusion or association. It may be useful to investigate other factors that could predispose a marathon runner to injury.

Systemic Factors:
Anatomical Factors - Certain anatomical factors have been associated with running injuries. These can be separated into congenital factors and those that result from biomechanical, postural or gait abnormalities.
Individuals born with cavus feet have biomechanically shown to be more rigid and sustain a higher impact.(Hespanhol Junior et al., 2012). The population involved in this study were recreational runners who were not training for a marathon distance. In a population of athletes leg length inequality has also been suspected as a factor in hip, pelvis, iliotibial band syndrome (ITB) and lower back injury. This study found a specific association of leg length discrepancy and recurrent stress fractures of the lower limb in all groups (Korpelainen et al., 2001).
Hip muscle weakness is suggestive of overall injury risk in the lower extremity, particularly ITB where vastus medialis has been the key deficit area. (Niemuth et al., 2005)

Running / Training Related Factors
Certain factors associated with training have been indicated to affect incidence of injury. However, rapid increase in mileage covered was the only factor shown to significantly affect injury incidence.
Macera et al and Walter et al support that training in excess of 40 miles per week is a significant risk factor for injury in males(Macera et al., 1989, Walter et al., 1989), whilst only one study supports this association in females (Walter et al., 1989). It is still unknown whether inexperience predisposes an individual to hamstring, knee or foot injuries (Satterthwaite et al., 1999). There is no association between the use of warm up and prevention of lower extremity injuries. (Macera et al., 1989) Training terrain has not shown to affect incidence of injury (Wen et al., 1998).

Health and Lifestyle Factors
History of a previous lower extremity running injury is a significant risk factor for a recurrence(Wen et al., 1998, Macera et al., 1991, Macera, 1992, Walter et al., 1989). It has been suggested that this is because the original cause of injury may be unknown and repaired tissue may function less well as a protective barrier.

Summary of Introduction
More people run today than ever before and the participation in marathons is becoming increasingly popular. Injury rates in those training for a marathon can be as high as 90%.(Satterthwaite et al., 1996)
With increasing participation there is an ever-increasing need for knowledge for both the runner and the health care profession into factors that predispose runners to injuries. The literature research presented above shows a variable, although somewhat contradictory range of opinions regarding factors that may contribute to injury.
There is also a need to exclusively investigate injuries in marathon runners and factors associated. Different studies define long distance runners differently and this project will only investigate individuals training for and competing in the London marathon (26.2 miles)

Aims
To investigate the factors that may predispose marathon runners to injury. These will be; number of marathons completed in the past, time taken to complete the London Marathon, previous history of injury, following a marathon training plan, experience of pain whilst running during training, age, sex and number of training runs per week. Each factor will be compared with injury sustained whilst running the London Marathon.

Method
Survey Monkey, an online survey website was used to generate each questionnaire which then produced a unique link which was sent out to all runners via email. Survey Monkey limited each questionnaire to ten questions. The first questionnaire consisted of more than ten questions and was separated into two parts, generating two separate links to be sent out. Thus requiring both parts to be completed to fully answer the first survey. Runners were asked demographic information regarding their year of birth and sex. They were then asked about previous history of running injury and if so, which part of there body was affected. Individuals were asked how many marathons they have completed in the past and what distance they have covered / intended to cover in their training in March and April. This survey then asked whether individuals follow a training plan and if they take any medication for pain experienced whilst running.
An employee of ARUK sent out the first survey via email on Tuesday 10th April, before the London Marathon, which occurred on Sunday 22nd April 2012. All 89 ARUK runners were emailed. Two follow up emails were sent and individuals were then telephoned from the office. All individuals were given the opportunity to opt out of the survey.
The same person then sent out a second survey on Monday 28th May via the same method as the first. This consisted of fewer questions and only required one link.
The second questionnaire asked about the runners experience on the day of the marathon and whether there was any time during the run that they had to stop due to an injury. They were then asked for the time they completed the marathon and whether they thought their training was sufficient. If they did not they were asked why and if they had any advice to give future marathon runners. Runners were then asked how long it took them to feel free of any aches or pains and how long it took them to return to running.

Results

Response rate
Below is a table that shows the number of individuals who completed each survey. This has also been represented as a percentage of the total number of runners. As the first survey was spread over two parts these have been represented by 1A and 1B, whilst the second questionnaire 2.

Survey	Total Number of runners (n)	Total Completed (% of total runners)	Males Completed (% of total males)	Females Completed (% of total females)
1A	89	53 (60)	36 (65)	17 (50)
1B	89	56 (63)	36 (65)	17 (50)
2	89	55 (62)	33 (60)	22 (65)

Figure 1 - Table representing total number of questionnaires completed

This data shows that 15% more males completed the first survey compared with females. However 5% more females completed the second survey compared with men. Despite the first survey being online for a month longer than the second it does not seem to have had an effect on the response rate.

Statistical analysis plan
Chi squared was chosen, as it is best suited for analysis of data where sample size is relatively small
Using the described analytical technique this study will determine whether there is any statistical significance between selected factors and suffering an injury on the day of the London Marathon. The second questionnaire asked participants whether they endured an injury on the day of the marathon. This was defined as any time during the run that an individual needed to stop. This did not include toilet breaks.
As mentioned in the methodological limitations section, some individuals completed the first questionnaire and not the second or visa versa. Therefore if a category from the first questionnaire is being compared to injury on the day of the marathon (questionnaire 2) only the individuals who filled out the both questionnaires can be included.

First time runners and Injury during the London Marathon
No statistical significance was found between individuals running the marathon for the first time and incidence of injury ($p = 0.688$).

Previous running injury and injury during the London Marathon
In this study, 'previous injury' was defined as any injury whilst training or running a marathon, which was sufficient enough to stop training and seek medical advice. There was no statistical significance found between previous injury and injury endured on the day. ($p = 0.947$)
Out of the 54 individuals that completed the first survey 33 had sustained an injury.

Marathon time and injury whilst running the London Marathon
A p value of 0.003 suggests a statistical significance between running time and injury on the day. This is supported by only 13% of runners who completed the marathon in less than 4 hours sustaining an injury. Whilst this was significantly higher in those who finished between 4 - 5 hours and over 5 hours at 70% and 47% respectively; their mean time was

4hrs and 36 minutes.

Following a training plan and sustaining an injury during the London Marathon
Training plans are often known to be essential preparation for individuals training to run a marathon. It is unsurprising that they help individuals to cover the necessary distance however one might suggest that following a training plan may help prevention of injury. There was no statistical significance to support this ($p = 0.601$). 68% of runners in this survey followed a training plan and 43% of those sustained an injury.

Pain whilst training and injury during the London Marathon
No statistical significance was found ($p = 0.204$) between injury during the London Marathon and runners who suffered from pain whilst training. Runners who experienced pain whilst training were asked if they took anti-inflammatory medication, paracetamol or both to help regulate the pain. Out of 56 runners who completed the question 32 (57%) stated that they regularly suffered from pain whilst running. Of that total 27 (84%) took anti-inflammatories, paracetamol or both.

Age and injury whilst running the London Marathon
Again only individuals who completed both surveys could be included. No significance was found between age and injury sustained whilst running the London Marathon ($p = 0.376$). The average age for males was 40 and females 42.

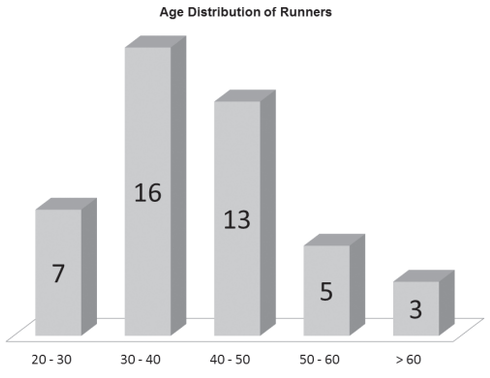


Figure 2- age distribution of runners

Male or Female sex and injury whilst running the London Marathon
There is no statistically significant correlation between gender and injuries incurred in males and females ($p = 0{,}138$).

Number of running sessions per week and injury during London Marathon
Participants were asked how many times per week they trained. The answers ranged from one to six runs per week. This factor was not found to affect the number of runners who sustained an injury ($p = 0.770$).
The graph below shows the range in number of times individuals ran per week.

Discussion
Running injuries are frequently experienced when training for a marathon. Prevention of these running injuries would allow the positive benefits of running to be enjoyed. This report systematically investigates possible factors that may be implicated in predisposing marathon runners to injury. It investigates whether there is any relationship between these factors and injuries sustained whilst running the London Marathon.

Summary of main findings
There is a significant relationship found between time and injury whilst running the London Marathon ($p = 0.003$). This is supported by the fewest percentage of runners who sustained an injury ran the marathon in less than 4 hours (13%).
There was no association found between; previous history of injury and reoccurrence ($p = 0.947$), number of marathons previously run ($p = 0.688$), following a training plan ($p = 0.601$), pain whilst running during training ($p = 0.204$), age ($p = 0.376$), gender ($p = 0.138$) and number of training runs per week ($p = 0.770$) and injury whilst running the London Marathon.

Response rates of runners
Although the first survey was online for one month more than the second, response rates were almost equal. One may suggest this is because people intend to complete the survey or not and trying to chase an individual to do so is futile. However it may be that some individuals have every intention to complete the survey but simply forget to. Therefore sending another email or telephoning the individuals may be beneficial but doing this more than once is often not, and can lead to people becoming irritated.
The average response rate in males is slightly higher than females. One suggestion for this difference could be that male marathon runners more frequently experience injury over females and are therefore more likely to take part in a questionnaire aiming to prevent injury in marathon runners. However this association is not supported by the report ($p = 0.138$). Another reason could be that as more men ran for ARUK word of mouth between male runners could have lead to more completing the survey. However as the difference is only by 5% it is difficult to make any significant conclusion.

Interpretation of results

Previous injury and reoccurrence whilst running the London Marathon
The relationship between past history of injury in marathon runners and reoccurrence is well recognised by Ballas et al(Ballas et al., 1997), Macera et al (Macera et al., 1991), Wen et al (Wen et al., 1998) and Machera et al(Macera, 1992). However this is not consistent with the results found in this study. The most likely explanation for the literature written is previous injury results in a weakness of the area that makes the runner more prone to a second injury. One could also consider that it is a result of an underlying anatomical problem predisposing the individual to injury. If an individual is following an incorrect training method i.e. a rapid increase in mileage over a short space of time it could be the cause.(Walter et al., 1989) Although this study does not support the associated made it did find that the knee is the most common anatomical site of injury, a result that is consistent with previous literature. This supports the idea that during running the majority of force passes through the knee and it is subsequently more prone to injury than other areas. (Pinshaw et al., 1984)

Marathon time, previous number of marathons ran and relationship with injury whilst running the London Marathon
Participants completing the marathon in less than four hours are less likely to sustain an injury ($p = 0.003$) and the lowest incidence of injury (13%) is in runners who completed the marathon in less than 4 hours.
There are fewest novices present in the group of runners who complete the marathon in under 4 hours. In addition fewest novices were present in this group. Experienced level has been identified as a risk factor for injury. In first time marathon runners, hamstring and knee injuries were more common.(van Gent et al., 2007) Machera et al reported that runners with an experience fewer than 3 years had an odds ratio of 2.2 for injury (Macera, 1992).

Other Determinants of Injury
Various papers support the findings of this study that there is no relationship between age and sex with incidence on injury whilst running a marathon. (Lanese et al., 1990, Satterthwaite et al., 1999)
It is interesting to consider why this may be. Although Conn et al found an overall increase in injuries in males compared to females this was not exclusive to marathon runners and therefore most likely to be determined by the different sports that males and females participate in.
There is no relationship between following a training plan and injury whilst running the London Marathon. However training plans have been shown to, if designed effectively help to prevent a new injury or prevent reoccurrence.(Hespanhol Junior et al., 2012)
Self-reported pain is not considered as an actual injury in this study, or in other literature as pain is a subjective phenomenon that is difficult to measure and compare between individuals, this makes it an unspecific and unreliable factor to consider when considering marathon injuries, (Borg, 1998)

Other findings
The majority of individuals ran a total of 100 – 150 miles in March (n=23), the month preceding the London Marathon. An even distribution was found in the other ranges, 50 – 100 (n=10), 150 – 200 (n=8) and over 200 miles (n=11). This is interesting as it shows the variation in distance covered by people training for a marathon. It is also interesting to note that two people were injured and did not run at all during March but were still able to complete the marathon.
All individuals tapered down their distances in April, the month of the London Marathon, and this is recommended by most training plans and experienced runners. Mujika et al found that a 6-day tapering down period in 800 metre runners where their intensity was decreased by 80% showed significant performance gains.(Mujika et al., 2002) It would be interesting to also test this in marathon runners exclusively.
The longest runs completed by trainees were between 15 and 23 miles and the mean run was 20.5 miles. Most runners stated that their longest run was 20 miles (n=21) and few ran distances less or more that 20 miles. This is interesting as most training for a marathon are aware of the length that their longest run should be. Although this varied in runners it did not have an impact on them completing the marathon or sustaining an injury. This highlights that most training is specific to the individual and that it is difficult to generate a gold standard.
It is somewhat concerning that a third of runners felt their training was not sufficient and most mentioned that next time they would complete more longer runs. This highlights the need for training guidelines by organisations that have individuals running for them in a marathon. These should aim to provide all

runners with information regarding injury prevention, the common injuries and what to do if one feels they have sustained an injury.

Evidence found in this study would suggest that most runners are able to return to running shortly after the marathon demonstrating that the acute after effects on physical health are minimal. The mean time that runners took to feel ache or pain free was three days, and most returned to running in a week. This suggests that injuries sustained by most runners during a marathon are not serious enough to cause significant long-term complications.

Anecdotal evidence suggests that many marathon runners have always aimed to complete a marathon, but that one marathon is sufficient to achieve this goal. Only 10 out of 55 people who completed the questionnaire said they do not intend to run another marathon. This reinforces the idea that marathon running is "a bug" and runners are keen to continue once they have completed a marathon, perhaps to improve on their completion time.

Conclusion

This report finds that there is a connection between running a marathon in less than 4 hours and reduced rates of injury. This report investigates various factors that may contribute to an individual experiencing injury during running a marathon but none are found to have a significant effect on injury.

These results highlight how difficult it is to determine who gets an injury whilst training for or running a marathon and there is a lot of uncertainty regarding factors that affect injuries. There is also a lack of scientific evidence for many anecdotal associations between marathon running and injury such as early onset of Osteoarthritis and more frequent lower limb injuries. Therefore there is increased need for scientific evidence proving or disproving these theories.

It is important to consider and further to understand factors contributing to injury and if these are identifiable to provide guidelines to those training for a marathon to help prevention and improve enjoyment.

References

1. Ballas, M. T., Tytko, J. & Cookson, D. (1997). Common overuse running injuries: diagnosis and management. Am Fam Physician, 55, 2473-84.
2. Borg, G. (1998). Borg's Perceived Exertion and Pain Scale. United States: Human Kinetics.
3. Bovens, A. M., Janssen, G. M., Vermeer, H. G., Hoeberigs, J. H., Janssen, M. P. & Verstappen, F. T. (1989). Occurrence of running injuries in adults following a supervised training program. Int J Sports Med, 10 Suppl 3, S186-90.
4. Conanghan, P. G. (2002). Update on osteoarthritis part 1: current concepts and the relation to exercise. Br J Sports Med, 36, 330-3.
5. Conn, J. M., Annest, J. L. & Gilchrist, J. (2003). Sports and recreation related injury episodes in the US population, 1997-99. Inj Prev, 9, 117-23.
6. Duffey, M. J., Martin, D. F., Cannon, D. W., Craven, T. & Messier, S. P. (2000). Etiologic factors associated with anterior knee pain in distance runners. Med Sci Sports Exerc, 32, 1825-32.
7. Frederison, M. & Misra, A. K. (2007). Epidemiology and aetiology of marathon running injuries. Sports Med, 37, 437-9.
8. Hespanhol Junior, L. C., Costa, L. O., Carvalho, A. C. & Lopes, A. D. (2012). A description of training characteristics and its association with previous musculoskeletal injuries in recreational runners: a cross-sectional study. Rev Bras Fisioter, 16, 46-53.
9. Jacobs, S. J. & Berson, B. L. (1986). Injuries to runners: a study of entrants to a 10,000 meter race. Am J Sports Med, 14, 151-5.
10. Kettunen, J. A., Kujala, U. M., Kaprio, J., Koskenvuo, M. & Sarna, S. (2001). Lower-limb function among former elite male athletes. Am J Sports Med, 29, 2-8.
11. Kohl, H. W., Laporte, R. E. & Blair, S. N. (1988). Physical activity and cancer. An epidemiological perspective. Sports Med, 6, 222-37.
12. Korpelainen, R., Orava, S., Karpakka, J., Siira, P. & Hulkko, A. (2001). Risk factors for recurrent stress fractures in athletes. Am J Sports Med, 29, 304-10.
13. Kretsch, A., Grogan, R., Duras, P., Allen, F., Summer, J. & Gilliam, I. (1984). 1980 Melbourne marathon study. Med J Aust, 141, 809-14.
14. Krivickas, L. S. (1997). Anatomical factors associated with overuse sports injuries. Sports Med, 24, 132-46.
15. Kujala, U. M., Kettunen, J., Paananen, H., Aalto, T., Battié, M. C., Impivaara, O., Videman, T. & Sarna, S. (1995). Knee osteoarthritis in former runners, soccer players, weight lifters, and shooters. Arthritis Rheum, 38, 539-46.
16. Lane, N. E., Bloch, D. A., Jones, H. H., Marshall, W. H., Wood, P. D. & Fries, J. F. (1986). Long-distance running, bone density, and osteoarthritis. JAMA, 255, 1147-51.
17. Lana, N. E., Michel, B., Bjorkengren, A., Oehlert, J., Shi, H., Bloch, D. A. & Fries, J. F. (1993). The risk of osteoarthritis with running and aging: a 5-year longitudinal study. J Rheumatol, 20, 461-8.
18. Lane, N. E., Oehlert, J. W., Bloch, D. A. & Fries, J. F. (1998). The relationship of running to osteoarthritis of the knee and hip and bone mineral density of the lumbar spine: a 9 year longitudinal study. J Rheumatol, 25, 334-41.
19. Lanese, R. R., Strauss, R. H., Leizman, D. J. & Rotondi, A. M. (1990). Injury and disability in matched men's and women's intercollegiate sports. Am J Public Health, 80, 1459-62.
20. Lysholm, J. & Wiklander, J. (1987). Injuries in runners. Am J Sports Med, 15, 168-71.
21. Macera, C. A. (1992). Lower extremity injuries in runners. Advances in prediction. Sports Med, 13, 50-7.
22. Macera, C. A., Pate, R. R., Powell, K. E., Jackson, K. L., Kendrick, J. S. & Craven, T. E. (1989). Predicting lower-extremity injuries among habitual runners. Arch Intern Med, 149, 2565-8.
23. Macera, C. A., Pate, R. R., Woods, J., Davis, D. R. & Jackson, K. L. (1991). Postrace morbidity among runners. Am J Prev Med, 7, 194-8.
24. Marti, B., Knobloch, M., Tschopp, A., Jucker, A. & Howald, H. (1989). Is excessive running predictive of degenerative hip disease? Controlled study of former elite athletes. BMJ, 299, 91-3.
25. Mujika, I., Goya, A., Ruiz, E., Grijalba, A., Santisteban, J. & Padilla, S. (2002). Physiological and performance responses to a 6-day taper in middle-distance runners: influence of training frequency. Int J Sports Med, 23, 367-73.
26. Nely, F. G. (1998). Intrinsic risk factors for exercise-related lower limb injuries. Sports Med, 26, 253-63.
27. Nicholl, J. P., Coleman, P. & Williams, B. T. (1995). The epidemiology of sports and exercise related injury in the United Kingdom. Br J Sports Med, 29, 232-8.
28. Niemuth, P. E., Johnson, R. J., Myers, M. J. & Thieman, T. J. (2005). Hip muscle weakness and overuse injuries in recreational runners. Clin J Sport Med, 15, 14-21.
29. Pinshaw, R., Atlas, V. & Noakes, T. D. (1984). The nature and response to therapy of 196 consecutive injuries seen at a runners' clinic. S Afr Med J, 65, 291-8.
30. Ristolainen, L., Heinonen, A., Turunen, H., Mannström, H., Waller, B., Kettunen, J. A. & Kujala, U. M. (2010). Type of sport is related to injury profile: a study on cross country skiers, swimmers, long-distance runners and soccer players. A retrospective 12-month study. Scand J Med Sci Sports, 20, 384-93.
31. Sallis, R. E., Jones, K., Sunshine, S., Smith, G. & Simon, L. (2001). Comparing sports injuries in men and women. Int J Sports Med, 22, 420-3.
32. Satterthwaite, P., Larmer, P., Gardiner, J. & Norton, R. (1996). Incidence of injuries and other health problems in the Auckland Citibank marathon, Br J Sports Med, 30, 324-6.
33. Satterthwaite, P., Norton, R., Larmer, P. & Robinson, E. (1999). Risk factors for injuries and other health problems sustained in a marathon. Br J Sports Med, 33, 22-6.
34. Spector, T. D., Harris, P. A., Hart, D. J., Cicuttini, F. M., Nanadra, D., Etherington, J., Wolman, R. L. & Doyle, D. V. (1996). Risk of osteoarthritis associated with long-term weight-bearing sports: a radiologic survey of the hips and knees in female ex-athletes and population controls. Arthritis Rheum, 39, 988-95.
35. Spellman, G. (1996). Marathon Running - an all-weather sport? Northampton: Royal Meteorological Society.
36. Taunton, J. E., Ryan, M. B., Clement, D. B., McKenzie, D. C., Lloyd-Smith, D. R. & Zumbo, B. D. (2002). A retrospective case-control analysis of 2002 running injuries. Br J Sports Med, 36, 95-101.
37. Thijs, Y., Van Tiggelen, D., Roosen, P., De Clercq, D. & Witvrouw, E. (2007). A prospective study on gait-related intrinsic risk factors for patellofemoral pain. Clin J Sport Med, 17, 437-45.
38. Van Gent, R. N., Siem, D., Van Middelkoop, M., Van Os, A. G., Bierma-Zeinstra, S. M. & Koes, B. W. (2007). Incidence and determinants of lower extremity running injuries in long distance runners: a systematic review. Br J Sports Med, 41, 469-80; discussion 480.
39. Van Mechelen, W. (1992). Running injuries. A review of the epidemiological literature. Sports Med, 14, 320-35.
40. Walter, S. D., Hart, L. E., McIntosh, J. M. & Sutton, J. R. (1989). The Ontario cohort study of running-related injuries. Arch Intern Med, 149, 2561-4.
41. Wen, D. Y., Puffer, J. C. & Schmalzried, T. P. (1997). Lower extremity alignment and risk of overuse injuries in runners. Med Sci Sports Exerc, 29, 1291-8.
42. Wen, D. Y., Puffer, J. C. & Schmalzried, T. P. (1998). Injuries in runners: a prospective study of alignment. Clin J Sport Med, 8, 187-94.

The association between ankle strength, postural stability and regular slacklining

B. Strejcová, L. Šimková and J. Baláš
Sport Research Centre, Faculty of Physical education and Sport, Charles University in Prague, Czech Republic

Abstract
The aim of the study was to assess ankle strength during plantar and dorsal flexion, and the postural stability in slackliners. The slackliners (n=9) were matched according to age, body mass and height to physical education students (n=9) with no slackline experience. The results showed significantly higher relative ankle strength during plantar flexion (angular velocity 30°.s-1) in the slackline group than in the control group (left: 1.51 ± 0.31 vs. 1.20 ± 0.30 N.m.kg-1, p<0.05, ηp2=0.21; right: 1.55 ± 0.34 vs. 1.21 ± 0.34 N.m.kg-1, p<0.05, ηp2=0.22). There were no significant differences between the groups in other tested variables. The results might be considered in the injury prevention and rehabilitation of the ankle joint.

Key words
slackline, isokinetic strength, ankle joint, postural stability

Introduction

Postural stability is simultaneously influenced by visual control, vestibular apparatus, and proprioception (Giagazoglou, Amiridis, Zafeiridis, Thimara, Kouvelioti, & Kellis, 2009). Training on unstable surfaces (Laudner & Koschnitzky, 2010; McKnight & Armstrong, 1997) and vibrating supports (Evangelos, Georgios, Konstantinos, Gissis, Papadopoulos, & Aristomenis, 2012) has been found to increase the proprioception and functional capacity of the lower joints. Several studies (Aydin, Yildiz, Yildiz, Atesalp, & Kalyon, 2002; Horvat, Ray, Croce, & Blasch, 2004; Maki, Holliday, & Topper, 1994) have stated that lower limb strength is a determining factor of good postural stability. Poor postural stability is associated with lower ankle strength (Maki, Holliday, & Topper, 1994; Perry, Carville, Smith, Rutherford, & Newham, 2007) and knee strength (Jadelis, Miller, Ettinger Jr, & Messier, 2001; Messier, Glasser, Ettinger Jr, Craven, & Miller, 2002).
Walking on a slackline is a rapidly expanding physical activity. A slackline is a webbing 2-5 cm wide, usually 5-25 meters long, stretched tight between two anchor points. The basic skill on the slackline is to keep balance on one leg. Other exercises include walking, jumping and balance movements. A good level of postural stability has been associated with slackline practice (Granacher, Gollhofer, & Kriemler, 2010). Pfusterschmied, Buchecker, Keller, Wagner, Taube, & Muller (2013) showed better postural stability after 4 weeks slackline training in young adults. However, Granacher, Iten, Roth, & Gollhofer (2010) did not support the relationship between postural stability and slackine practice.
Therefore, the aim of this study was to compare postural stability and ankle strength in slackliners to that of other physically active individuals.

Methods

Subjects

Eighteen participants, divided into 2 groups, volunteered for the study. The first group was formed by "slackliners" (1 female and 8 male, 25.0 ± 0.9 years, 73.3 ± 8.9 kg and 181.0 ± 8.0 cm). To be placed into the slackline group, individuals had to walk on 2.5 cm wide webbing for 10.2 meters and perform the following exercises: standing on the right and left leg, move back and forward with a vertical turn, jump from the ground onto the slackline, walk with hands on hips. The control group of physical education students with no slackline experience was matched according to age, body mass and height (1 female and 8 male, 22.9 ± 0.8 years, 73.3 ± 8.9 kg and 181.0 ± 8.0 cm). The research was approved by the local Ethics Board.

The ankle strength measurement

Ankle strength was tested by the isokinetic dynamometer (Cybex NORM ®, Humac, CA, USA). Strength testing was performed in a lying position where the tested limb was supported by a stabilizer with the knee at an angle of 90°. The second leg was supported on a stable adapter. The test protocol consisted of two angular velocities (30°.s-1 and 120°.s-1) with 5 respective 15 repetitions of plantar and dorsal flexion. The range of motion was set to 90°.
The ankle strength was assessed by the peak torque (PT) related to the body mass and the time to achieve peak strength (TP).

Postural stability

The postural stability was tested by one leg stance (Flamingo) for 63 s on a pressure plate (FootScan ®, Belgium). The total trajectory way (TTW) of the centre of pressure (COP) was used to evaluate the level of postural stability. Both right and left leg were tested. The free leg was bent at the knee at approximately 120°. The reliability of the TTW of COP in the Flamingo test was found to be satisfactory with an intra-class correlation coefficient ranging from 0.87 to 0.90 (Baláš & Zahálka, 2011).

Statistical analyses

Means and standard deviations were used to characterise the groups tested variables. Differences between the groups were assessed by a simple analysis of variance. Statistically significant differences were considered at the level $p < 0.05$. Partial coefficient eta squared ηp2 was used to assess the effect size. All statistics were computed by SPSS for Windows Version 11.0 (Chicago, IL, USA).

Results

The results of the postural stability and the isokinetic ankle strength are summarized in table 1.

Table 1:
Postural stability and isokinetic ankle strength in dorsal and plantar flexion (mean±SD) in slackline and control group

Variables		Slackline group (n=9)	Control group (n=9)
Postural stability	COP TTW L (mm)	900±199	867±421
	COP TTW R (mm)	797.2±134.1	793.3±161.8
Isokinetic ankle strength 30°.s^{-1}	PF PTrel. L (N.m.kg^{-1})*	1.51±0.31	1.20±0.30
	PF PTrel. R (N.m.kg^{-1})†	1.55±0.34	1.21±0.34
	DF PTrel. L (N.m.kg^{-1})	0.50±0.11	0.41±0.07
	DF PTrel. R (N.m.kg-^{1})	0.47±0.07	0.45±0.11
	PF TP L (s)	0.46±0.08	0.48±0.08
	PF TP R (s)	0.49±0.06	0.48±0.11
	DF TP L (s)	0.48±0.13	0.53±0.22
	DF TP R (s)	0.48±0.16	0.53±0.16
Isokinetic ankle strength 120°.s^{-1}	PF PTrel. R (N.m.kg^{-1})	0.8±0.15	0.71±0.16
	DF PTrel. L (N.m.kg^{-1})	0.79±0.21	0.75±0.2
	DF PTrel. R (N.m.kg^{-1})	0.28±0.09	0.24±0.05
	PF TPrel. L (N.m.kg^{-1})	0.27±0.08	0.21±0.06
	PF TP L (s)	0.25±0.04	0.23±0.05
	PF TP R (s)	0.24±0.03	0.22±0.03
	DF TP L (s)	0.16±0.02	0.12±0.07
	DF TP R (s)	0.14±0.02	0.13±0.04

* $p<0.05$, ηp2=0.21; † $p<0.05$, η_p^2=0.22.

Parameters: COP-Centre of pressure, TTW- Total trajectory way, L- left ankle, R- right ankle, PF- plantar flexion, DF- dorsal flexion, PT- peak torque, rel.- relative value, related to body weight, TP-time to peak.

There was significantly higher ankle strength in plantar flexion (30°.s^{-1}) in slackliners than in the control group for both ankles (left: 1.51 ± 0.31 vs. 1.20 ± 0.30 N.m.kg^{-1}, $p < 0.05$, $\eta_p^2 = 0.21$, right: 1.55 ± 0.34 vs. 1.21 ± 0.34 N.m.kg^{-1}, $p<0.05$, $\eta_p^2 = 0.22$). We did not find significant differences for other parameters (Table 1). We can only state higher, but not significant, relative strength at 120°.s^{-1} in the slackline group.

Discussion

In the current study, we found that the slackliners had significantly higher relative ankle strength for plantar flexion than the control group at angular velocity 30°.s^{-1}. At higher angular velocity (120°.s^{-1}), there were no significant changes. Granacher, Muehlbauer, Maestrini, Zahner, & Gollhofer (2011) used the vertical jump to assess ankle strength after slackline training, but did not found any improvements, which might have been associated with the strength testing eliciting high speed contractions.

Schweizer, Bircher, Kaelin, & Ochsner (2005) reported high ankle strength and postural stability in climbers. The climbers were characterized by a significantly higher relative ankle peak torque of plantar flexion than soccer players (1.85 ± 0.2 vs. 1.52 ± 0.3 N.m.kg^{-1}, p <0.05). There were no differences for the plantar extension (0.52 ± 0.07 vs. 0.53 ± 0.07 N.m.kg^{-1}). The current study stated similar results for ankle strength. Both slacklining and climbing are characterized by precise and slow movements in order to stabilize the body position. Therefore, the stabilizing movements on a small support area might be associated with higher ankle strength. Contrary to Schweizer, Bircher, Kaelin, & Ochsner (2005) study, we could not confirm better postural stability in slackliners.

There are contradictory results in postural stability in slackliners among published research studies (Granacher, Iten, Roth, & Gollhofer, 2010; Granacher, Muehlbauer, Maestrini, Zahner, & Gollhofer, 2011; Pfusterschmied, Buchecker, Keller, Wagner, Taube, & Muller, 2013). Granacher, Iten, Roth, & Gollhofer and Granacher, Muehlbauer, Maestrini, Zahner, & Gollhofer (2010; 2011) reported no improvements in postural control after slackline training sessions. The authors used the trajectory of COP on a pressure or force plate to evaluate the changes in postural stability. Pfusterschmied, Buchecker, Keller, Wagner, Taube, & Muller (2013) found significant improvement in postural stability using 3D motion analysis to assess the trajectory of centre of gravity. The different methods might be the reason for the results' discrepancies. As already stated by Ruhe, Fejer and Walker (2011), the measurement of COP is not a true record of body sway but rather a measure of the motor system activity in moving the COP. In the current study, we used the trajectory of COP and could not confirm better postural stability in slackliners. It corresponds to the hypothesis that the COP measurement might not be a suitable means to assess postural stability in slackliners.

The main limitation of the study is the small sample.

Conclusion

We found that the slackliners had significantly higher isokinetic ankle strength during slow speed than the control group. There were no significant differences in postural stability and higher speed isokinetic strength. The results might be considered in the injury prevention and rehabilitation of the ankle joint.

Acknowledgement

The study was supported by Ministry of Physical Education and Sport Czech Republic MSM 0021620864, Grant of Czech Republic GAČR P407/12/0166.

References

1. Aydin, T., Yildiz, Y., Yildiz, C., Atesalp, S., & Kalyon, T. A. (2002). Proprioception of the ankle: A comparison between female teenaged gymnasts and controls. Foot and Ankle International, 23(2), 123-129.
2. Baláš, J., & Zahálka, F. (2011). Reliabilita testování stoje na jedné noze při opakovaném měření. Česká kinantropologie, 15(3), 165-171.
3. Evangelos, B., Georgios, K., Konstantinos, A., Gissis, I., Papadopoulos, C., & Aristomenis, S. (2012). Proprioception and balance training can improve amateur soccer players' technical skills. Journal of Physical Education and Sport, 12(1), 81-89.
4. Giagazoglou, P., Amiridis, I. G., Zafeiridis, A., Thimara, M., Kouvelioti, V., & Kellis, E. (2009). Static balance control and lower limb strength in blind and sighted women. European Journal of Applied Physiology, 107(5), 571-579.
5. Granacher, U., Gollhofer, A., & Kriemler, S. (2010). Effects of balance training on postural sway, leg extensor strength, and jumping height in adolescents. Research Quarterly for Exercise and Sport, 81(3), 245-251.
6. Granacher, U., Iten, N., Roth, R., & Gollhofer, A. (2010). Slackline training for balance and strength promotion. International Journal of Sports Medicine, 31(10), 717-723.
7. Granacher, U., Muehlbauer, T., Maestrini, L., Zahner, L., & Gollhofer, A. (2011). Can balance training promote balance and strength in prepubertal children? Journal of Strength and Conditioning Research, 25(6), 1759-1766.
8. Horvat, M., Ray, C., Croce, R., & Blasch, B. (2004). A comparison of isokinetic muscle strength and power in visually impaired and sighted individuals. Isokinetics and Exercise Science, 12(3), 179-183.
9. Jadelis, K., Miller, M. E., Ettinger Jr, W. H., & Messier, S. P. (2001). Strength, balance, and the modifying effects of obesity and knee pain: Results from the observational arthritis study in seniors (OASIS). Journal of the American Geriatrics Society, 49(7), 884-891.
10. Laudner, K. G., & Koschnitzky, M. M. (2010). Ankle muscle activation when using the both sides utilized (bosu) balance trainer. Journal of Strength and Conditioning Research, 24(1), 218-222.
11. Maki, B. E., Holliday, P. J., & Topper, A. K. (1994). A prospective study of postural balance and risk of falling in an ambulatory and independent elderly population. Journals of Gerontology, 49(2), M72-M84.
12. McKnight, C. M., & Armstrong, C. W. (1997). The role of ankle strength in functional ankle instability. Journal of Sport Rehabilitation, 6(1), 21-29.
13. Messier, S. P., Glasser, J. L., Ettinger Jr, W. H., Craven, T. E., & Miller, M. E. (2002). Declines in strength and balance in older adults with chronic knee pain: A 30-month longitudinal, observational study. Arthritis Care and Research, 47(2), 141-148.
14. Perry, M. C., Carville, S. F., Smith, I. C. H., Rutherford, O. M., & Newham, D. J. (2007). Strength, power output and symmetry of leg muscles: Effect of age and history of falling. European Journal of Applied Physiology, 100(5), 553-561.
15. Pfusterschmied, J., Buchecker, M., Keller, M., Wagner, H., Taube, W., & Muller, E. (2013). Supervised slackline training improves postural stability. European Journal of Sport Science, 13(1), 49-57.
16. Ruhe, A., Fejer, R., & Walker, B. (2011). Center of pressure excursion as a measure of balance performance in patients with non-specific low back pain compared to healthy controls: A systematic review of the literature. European Spine Journal, 20(3), 358-368.
17. Schweizer, A., Bircher, H. P., Kaelin, X., & Ochsner, P. E. (2005). Functional ankle control of rock climbers. British Journal of Sports Medicine, 39, 429-431.

Determinants of a simulated cross-country skiing sprint competition using skating technique on roller skis by junior XC skier

M. Nosek[1], V. Haman[2]
[1]Physical education and sports department, Pedagogical faculty, University J. E. Purkyně in Ústí nad Labem
[2]Gymnasium and High School Jilemnice

Abstract
The present study analyses the main factors determining the performance in simulated sprint race on roller skis for junior XC skiers. At the same time it is trying to check a hypothesis whether the performance in simulated freestyle sprint race and the time spending in each section of racetrack have close continuity with performance in maximum muscle performance test on ski simulator.
Eight czech male junior XC skiers performed a simulated freestyle sprint race (4x1600 metres and 20 minutes rest) on the racetrack of the World Championship in Liberec – Vesec. We looked into their performance in simulated freestyle sprint race and the performance in each section of the racetrack. We measured the total time and the time measured in five different sections of the racetrack. The total time, time and speed measured in different sections were taken by using sport tester Polar RS800CX with GPS navigation and Google Earth. In addition, the athletes underwent the laboratory test of spiroergometry on the treadmill and maximum power performance test on Skierg. The test on the treadmill was performed with increasing load until athletes' exhaustion and during this we measured the maximal aerobic capacity (VO_{2max}), blood lactate concentrations (LA) and maximum heart rate (HR_{max}). In the examination of the maximum power performance by using ski simulator -Skierg we investigated the maximal power performance and blood lactate concentrations.
We discovered that the final time in simulated race correlates with two measured sections in the ascent and one measured section in flat terrain ($r_{uphill1}$= 0,89; r_{flat}= 0,73; $r_{uphill2}$= 0,70, p<0,05). A correlation has been shown in dependence of measured section of downhill and total time (r= 0,54; p<0,05) and between both measured sections in the ascent (r= 0,69; p<0,05) .The correlation has been found also between the maximal aerobic capacity VO_2 and final time in simulated race (r= -0,79, p<0,05). When we were analysing a connection among the performance in simulated freestyle sprint race, time spent in each sections of the racetrack and results from maximum power performance test on Skierg we found out a correlation between results from the maximum power performance test and the final time in race (r= - 0,91, p<0,05) and contemporaneously the correlation has been also established between results from maximum power performance test and the time of the first measured section in the ascent ($r_{uphill1}$= -0,69).

Key words
performance, roller ski, cross country skiing

Introduction

Sprint cross-country skiing is a physiologically and technically complex discipline, performed as a time-trial qualification race and three subsequent knock-out heats. The racing time in a single heat is 2-4 min and is comparable to other middle-distance sports. However, sprint skiing is performed in varied terrain at constantly changing intensities using multiple techniques involving the arms and the legs to various degrees (Sandbakk, 2011). Sprint skiing was increasingly accepted as a discipline in cross-country skiing and included in the World Cup in the late 1990s. The first World Championship in sprint skiing was performed in Lahti, Finland in 2001 and the first Olympic event in Salt Lake City, USA in 2002 (FIS, 2012).

Since then the ski sprint has changed a lot. The performances are better and better. The speed of skate ski sprint has been increasing in last 10 years from 6,5-8,8 to 7,0-10,05 m/s (23,4-36,1 km/h (Stöggl,Stöggl, & Müller,2009). It is caused by many reasons. One of the reasons is using new materials and technical elements as are ski wax, ski, poles, but also ski bindings. The skating technique develops thank these factors. Of course, the performance is influenced by other factors. Many studies tried to find an answer to the question which other factors are participating in increasing speed and performance in ski sprint.
Zory, Millet, Schena, Bortolan & Rouard (2006) investigated a classical sprint simulation on snow for the effects of fatigue on kinematic parameters (cycle, phases, and joints angles) in the double poling technique. This study showed that the mean heat speed remained the same over the heats. However, the final sprint speed ("spurt") was significantly lower in the third heat compared to the first.
Stöggl, Lindinger & Müller (2007) showed peak values of 90-95% of VO2max and 95-100% of maximal heart rate (HRmax) during a simulated classical sprint race on the treadmill. This study demonstrated that sprint performance strongly correlated to maximal speed, and that the fastest skiers produced longer cykle lenght in all techniques at equal cycle rate.
The determinants, which influence the performance in simulated cross-country skiing sprint competition, were recognized by Mikkola, Laaksonen, Holmberg, Vesterinen, & Nummela (2010). Sixteen elite male XC skiers performed a simulated sprint competition (4 x 850 m heat with a 20-minute recovery) using V2 skating technique on an indoor tartan track. Heat velocities, oxygen consumption, and peak lactate were measured during or after the heats. Maximal skiing velocity was measured by performing a 30-m speed test. Explosive and maximal force production in the upper body was determined by bench press. Subjects also performed maximal anaerobic skiing test and the 2 x 2 km double poling test. The results show that faster skiers in sprint simulation had a higher absolute VO2 during sprint heats, and higher anaerobic skiing power and better anaerobic skiing economy than slower skiers. Faster skiers were also stronger in bench press, with regard to both absolute and relative values.
The last research, which deals with this problem is work Sandbakk, Ettema, Leirdal, & Jakobsen (2011), which found out the physiological and biomechanical aspects of sprint skiing. They worked with 33 men and 8 women in their research. All subjects were categorized as world-class or national level skiers. The world-class skiers were all national team skiers in Norway and Sweden and included five World Champions and three Olympic Champions. All of the national level skiers ranked among the 10-30 best in the Norwegian or Swedish Cup Series. The results show, that maximal aerobic capacity, gross efficiency and high speed capacity differentiate world-class from national level sprint skiers, and these variables seem to determine sprint skiing performance. World-class skiers include more low and moderate-intensity endurance training and maximal speed training in their conditioning, which indicates that these training methods are important to achieve an international level in sprint skiing. Performance on uphill and flat terrain has the greatest impact on sprint time-trial performance, and the last part of a sprint race contains the greatest differential among skiers. Performance on the uphill sections correlates to overall sprint time-trial performance, particular because the better skiers used the V2 skating and double dance technique to a greater extent and the slower skiers used V2 skating. The maximal speed tests in double poling and V2 skating and double dance technique correlated to the percentage of racing time using V2 skating and double dance technique, indicating the significance of the upper body and movement specific power in uphill terrain. VO-2max correlates to the ability to maintain uphill racing speed from the first lap to the second lap.
From these letters it is clear that performance improvement is associated with changes in the development of physiological conditions and important physical abilities. The recent studies (Holmberg, Lindinger, Stöggl, Eitzlmair, & Müller, 2005; Smith & Holmberg, 2010; Stöggl, Müller, Ainegren, & Holmberg, 2011; Stöggl, Lindinger, & Müller,2007; Zory, Vuillerme, Pellegrini, Schena, & Rouard, 2009) show that the level of power abilities and their development is a major cause of performance improvement, especially for athletes in sprint disciplines. This is exactly the reason why our article is specialized in analyses of the determinants, which influence the performance in ski sprint. It tries to find the relationship between performance in simulated cross-country skiing sprint and the time spent in different sections of the racetrack. In the same time we try to find a correlation between performance in a simulated race in sprint and in the test of maximum muscle performance on the ski simulator.

Subjects and methods

Eight czech male junior XC skiers performed a simulated freestyle sprint race (4x1600 metres and 20

minutes rest) on the racetrack of the World Championship in Liberec – Vesec. We looked into their performance in simulated freestyle sprint race and the performance in each section of the racetrack. We measured the sprint time-trial (STT) and the time measured in five different sections of the racetrack (S1-S5). The total time, time and speed measured in different sections were taken by using sport tester Polar RS800CX with GPS navigation and Google Earth (Fig. 1). In addition, the athletes underwent the laboratory test of spiroergometry on the treadmill and maximum power performance test on Skierg. The test on the treadmill was performed with increasing load until athletes' exhaustion and during this we measured the maximal aerobic capacity (VO2max), blood lactate concentrations (LA) and maximum heart rate (HR max). In the examination of the maximum power performance by using ski simulator -Skierg we investigated the maximal power performance (Watt) and blood lactate concentrations. Table 1 shows the basic parameters.

Statistical analyses

All data were shown to be normaly distributed and are presented as means and standard deviation (SD). Correlations between the various parameters were analyzed using Pearson's product–moment correlation coefficient test and simple linear regression was used to draw trend lines. Repeated measurements of the physiological and kinematic parameters on the treadmill demonstrated intraclass correlation coefficients of >0,60. The corresponding coefficients for repeated determinations of STT performance and the relative contribution of section times during pilot testing were 0,90 - 0,95. Statistical significance was set at α value of $p<0,05$.

Table 1 Antropometric, physiological and performance characteristic of the 8 male XC skiers

Parameter	Mean ± SD
Age (years)	17,3 ±0,4
Body weight (kg)	68,2 ±3,5
Body height (cm)	178,7 ±4,7
Body fat (%)	9,5 ±3,0
VO^2 max (ml min^{-1} kg^{-1})	65,3 ±3,5
HR max (min)	195 ±5,5
SKIERG (watt)	275,0 ±8,8
LA (mmol l^{-1})	10,8 ±2,5

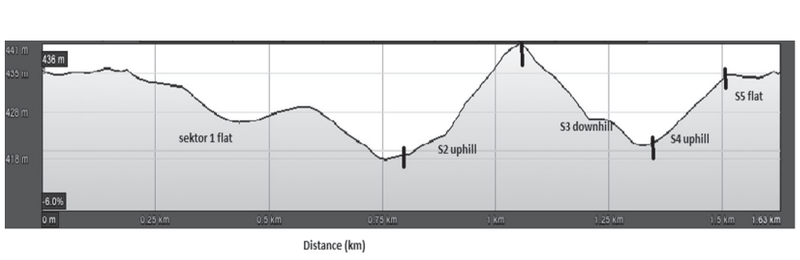


Fig. 1 The lenghts and inclines of the track sections (with Google Earth)

Results

In the first result part we compare speed in every single section of the racetrack in relationship with time achieved in sprint section (Table 2).

Table 2 The time spent in the 5 different section of the track during the sprint time trial

Terrain	Track section	Section lenght (m)	Time in section (s)	Correlation (r) of the section time to STT*
Flat	S1	807	102,5 ± 3,8	0,73
	S5	102	11,0 ± 1,3	0,38
Uphill	S2	259	61,0 ± 3,2	0,89
	S4	204	42,2 ± 3,1	0,70
Downhill	S3	258	20 ± 1,1	0,54
STT		1600	236,5± 5,9	-

*$p<0,05$

We found out that total racing time strongly correlates with two measured uphill sections and with one flat section ($rS2= 0,89$; $rS4= 0,70$; $rS1= 0,73$; $p<0,05$). The strong correlation was also identified by downhill section and total racing time ($rS3= 0,54$, $p<0,05$). But we didn't discover the correlation between total racing time (STT) and time in the last flat section (S5) ($rS5= 0,38$, $p<0,05$) (Fig.2).

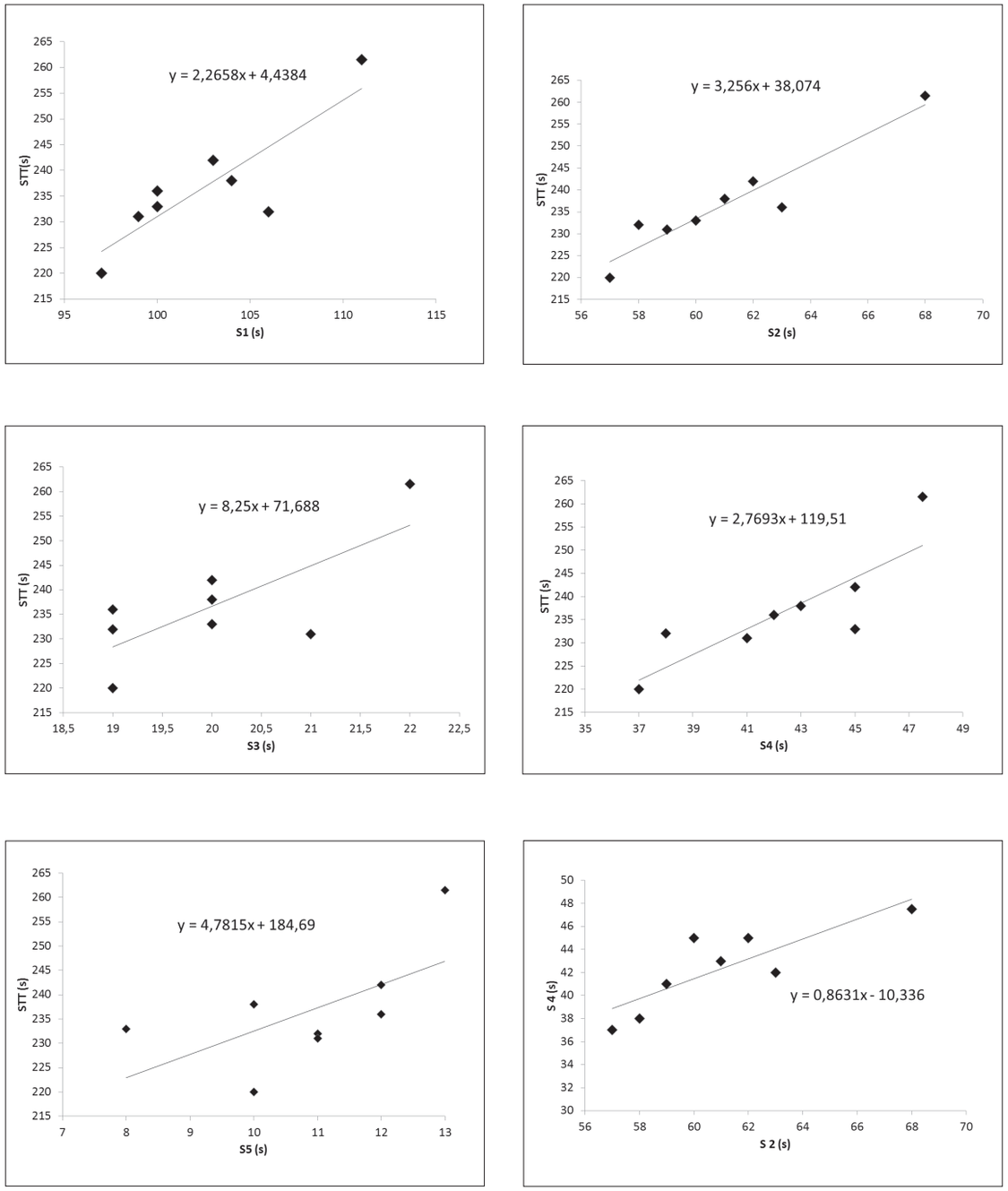
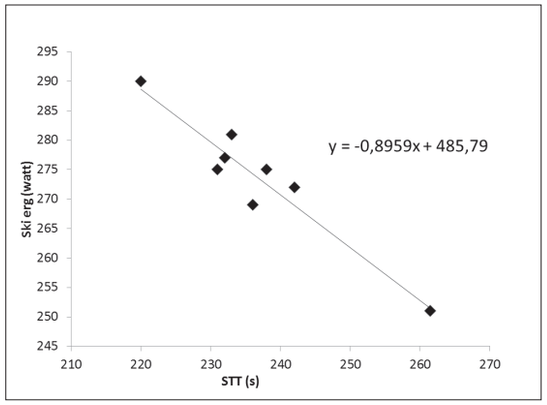
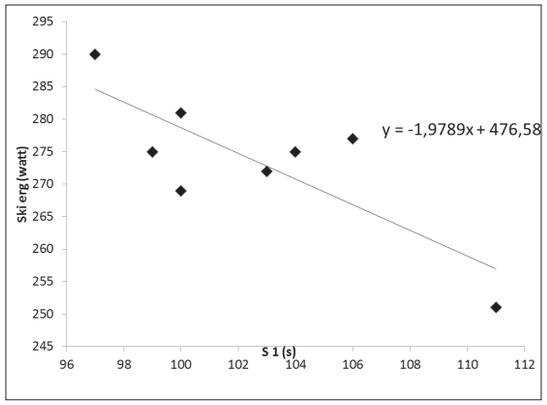


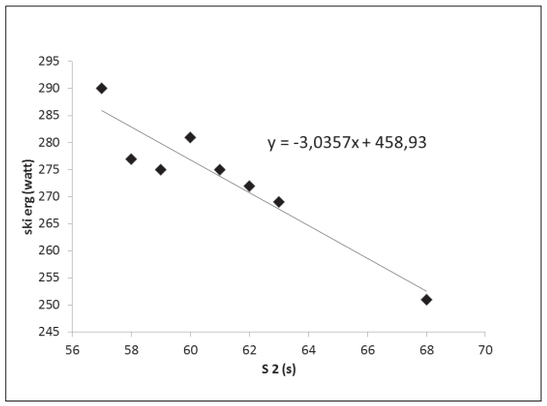
Fig. 2. Sprint time-trial performance in relationship to the time spent in different section of terrain

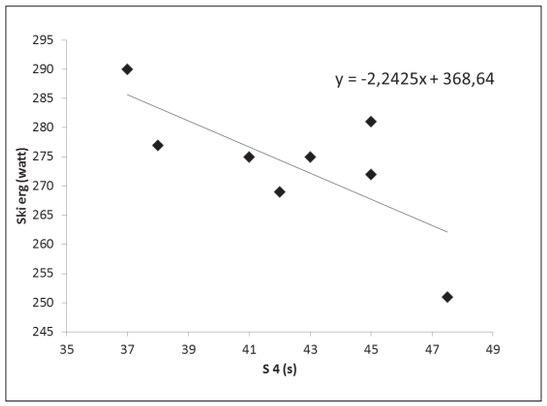
We figured out that measured (uphill) sections S2 and S4 are also strongly correlated ($r= 0,69$, $p<0,05$) (Fig. 2).

In the same time we tried to confirm if performance in simulated sprint race has connection with results in test of maximum muscle performance on the ski simulator. We found out that total time STT, results in test of maximum muscle performance (Skierg) ($r= -0,91$; $p<0,05$) and first uphill section S2 ($r= - 0,88$; $p<0,05$) have strong correlation. The level of muscle strength was approved in other sections of the racetrack. We discovered good correlation between first flat section (S1) ($r= - 0,63$; $p<0,05$) , second uphill section (S4) ($r= - 0,52$; $p<0,05$) and also final flat section (S5) ($r= - 0,56$; $p<0,05$) (Fig. 3 and Table 3).









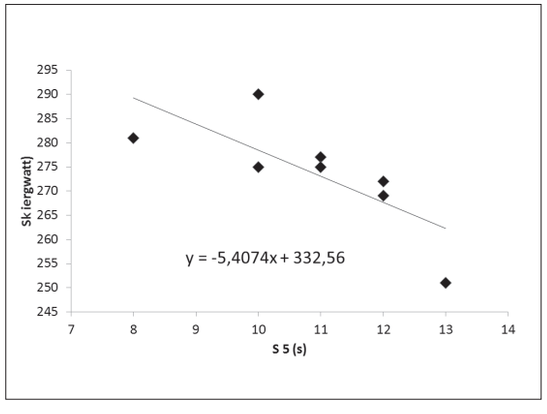


Fig. 3 Sprint time-trial performance and time the section in relationship to the maximum power performance test SKIERG

At comparison of the results which were ascertained by functional investigation we can submit that we find a significant dependence among pursued parameters (Table 3).

Table 3 The correlations (r-values) between physiological and kinematical parameters versus sprint time-trial (STT) performance and time spent in the different sections of terrain and Skiergometry (Skierg) for the 8 male cross-country skiers

Correlations (r)*						
Section	STT	Flat		Uphill		Downhill
Parameters	S1-S5	S1	S5	S2	S4	S3
Skierg (watt max)	-0,91	-0,63	-0,56	-0,88	-0,52	-0,49
VO_2max (ml min^{-1} kg^{-1})	-0,79	-0,69	-0,64	-0,85	-0,81	-0,56
Peak BLa (mmol l^{-1})	0,04	0,05	0,05	0,03	0,03	0,06

*p<0,05

Treadmill performance (VO_2max) was strongly negatively correlated to overall STT performance (r = -0,79, p<0,05), as well as to the time spent on the uphill (r = -0,85 and -0,81; p<0,05) and flat sections of the STT (r = -0,69 and -0,64; p<0,05). Significant dependence, but not such in case as other sections of the racetrack, is also found between treadmill performance (VO_2max) and downhill section (r = -0,56; p<0,05). At comparison with level of Peak BLa and time in every single section of the racetrack, we figured out very small correlation (r= -0,03 to - 0,06, p<0,05).

Discussion

According to an analysis of the sprint competition on roller ski we tried to make conditions as with competition on cross-country ski. We chose the racetrack where was the world cup in cross – country skiing in 2009 and also where is organized the world cup in sprint every year (Liberec). During the simulated race we were measuring total time but also we were finding times in every single section of the racetrack. We ascertained that total time of simulated race (STT) is strongly correlated with two measured uphill sections and one flat section of the racetrack (r_{S2}= 0,89; r_{S4}= 0,70; r_{S1}= 0,73; p<0,05). It's acknowledged by many authors (Mikkola, Laaksonen, Holmberg, Vesterinen, & Nummela, 2010; Sandbakk, Ettema, Leirdal, & Jakobsen, 2011) that speed, achieved in uphill, participates in final overall race in ski sprint. It's interesting that higher dependence in STT was shown in the first uphill section, but not in final uphill section, where we expected final acceleration of skiers (follow Sandbakk, Ettema, Leirdal, & Jakobsen, 2011). Perhaps it was caused by lenght and height profile of these sections. First uphill was 55 meters longer than second uphill, but the second uphill had higher absolute slope, which reached to 14%.

During the analysis we found out very strong correlation between the performance in simulated sprint race and results from test of maximum muscle performance on Skierg (r= - 0,91; p<0,05). Also negative correlative dependence was established between first uphill section (S2) (r= - 0,88; p<0,05) and result in test of maximum muscle performance on Skierg. A good correlation was discovered between Skierg test and first flat section (S1) of the racetrack (S1) (r= - 0,63; p<0,05) (Fig. 3). It's confirmed that level of muscle strength participates in total result of performance in sprint on roller ski, which is followed by many authors (Mikkola, Laaksonen, Holmberg, Vesterinen, & Nummela, 2010; Zory, Millet, Schena, Bortolan, & Rouard, 2006). The results show that faster skiers in STT were also stronger (f.e. bench-press).

By many studies, the level of VO_2max is the most important factor of the performance in ski sprint (Hoffman & Clifford, 1992; Holmberg, Lindinger, Stöggl, Eitzlmair, & Müller, 2005; Mahood, Kenefick, Kertzer, & Quinn, 2001; Mikkola, Laaksonen, Holmberg, Vesterinen, & Nummela, 2010; Sandbakk, Ettema, Leirdal, & Jakobsen, 2011; Stöggl, Lindinger, & Müller, 2007). But also in our study were established significant dependence between VO_2max and performance in simulated sprint race on roller ski (r = -0,79, p<0,05). We discovered a strong correlation between VO2max and performance in uphill sections (S2 and S4) (r=0,85 and r=0,81, p<0,05). The strong negative correlation between VO_2max and STT performance, which is reported here, illustrates the general importance of high-speed ability for sprint time-trial performance.

Conclusions

The results show that the time spent in the ascent, in the flat terrain and especially during the second part of the racetrack correlate with total output in the race. It means that the crucial factor of performance is an ability to keep the average speed for the entire length of the race. Other important factors of skiers' performance are physiological conditions which are correlated both the final time at the finish line and measured sections in the ascent. At the same time we discovered that the strength abilities of athletes are participating for total output in run on roller skis. It follows that the modern cross country skiing is increasing demands on strength-endurance capability for the classical technique cross country skiing and skating.

References

1. FIS (2012). History International ski federation. Retrieved , 12.9.2012 from International ski federation: http://history.fis-ski.com/
2. Hoffman, M., & Clifford, P. (1992). Physiological aspect of competitive cross-country skiing. J.Sport Sci, 10, pp. 3-27.
3. Holmberg, H.-C., Lindinger, S., Stöggl, T., Eitzlmair, E., & Müller, E. (2005). Biomechanical Analysis of

Double Poling in Elite Cross-Country Skiers. Medicine & Science in Sports & Exercise, 5,(37), pp. 807-818.
4. Mahood, N., Kenefick, R., Kertzer, R., & Quinn, T. (2001). Physiological determinants of cross-country skiing performance. Med.Sci.Sports Exerc., 8 (33),pp. 1379-1384.
5. Mikkola, J., Laaksonen, M., Holmberg, H., Vesterinen, V., & Nummela, A. (2010). Determinants of a simulated cross-country skiing sprint competition using V2 skating technique on roller skis. JStrength Cond Res., April 24(4), pp. 920-928.
6. Sandbakk, Ø. (2011). Physiological and Biomechanical - Thesis for the degree of Philosophiae Doctor. Trondheim: Norwegian University of Science and Technology.
7. Sandbakk, Ø., Ettema, G., Leirdal, S., & Jakobsen, V. (2011). Analysis of a sprint ski race and associated laboratory. Eur J Appl Physiol, pp. 947–957.
8. Stöggl, T., Lindinger, S., & Müller, E. (2007). Analysis of a simulated sprint competition in classical cross country skiing. Scand J. Med.Sci. Sports, August 17(4), pp. 362-372.
9. Stöggl, T., Müller, E., Ainegren, M., & Holmberg, H. C. (2011). General strength and kinetics: fundamental to sprinting faster in cross country skiing? Scandinavian Journal of Medicine & Science in Sport, December, 21, 6, pp. 791-803.
10. Stöggl, T., Stöggl, J., & Müller, E. (2009). Competition analysis of the last decade (1996 – 2008) in cross-country skiing. In E. L. Müller, Science and Skiing IV (pp. 657-667). Oxford: Meyer & Meyer Sport.
11. Zory, R., Millet, G., Schena, F., Bortolan, L., & Rouard, A. (2006). Fatigue induced by a cross-country skiing. Med Sci Sports Exerc, pp. 38/12, 2144-2155.
12. Zory, R., Vuillerme, N., Pellegrini, B., Schena, F., & Rouard, A. (2009, 1). Effect of fatigue on double pole kinematics in sprint cross-country skiing. Hum Mov Sci(28), pp. 85-98.

Environmental aspect of outdoor activities

Outdoor activities and natural environment: a resilience metaphor bridging the human-natural interface

J. Dlouhá
Charles University Environment Center, Charles University in Prague

Abstract
Sport is perceived as a source of harmony that contributes to a balance between the mental and physical elements of a human being, or as a continuous attempt to surpass the physical limits posed by the body. In the context of a more performance oriented approach some 'limits to growth' of individual performance could be defined that should not be exceeded without risk to human health. On the other hand, these limits are constantly shifting due to growing pool of experience and technical knowledge in the sports field. The aim of developing this know-how is to maintain a certain resilience a 'capacity of a system to maintain and renew itself particularly in the presence of stressors'. The term acquires similar meaning in the field of medicine, psychology, ecology or the social and cultural sciences and could be used as a metaphor that enables the interrelation of these fields and the bridging of the gap in their practical applications. Based on the resilience concept, a better reflection of physical load and its proper management to enhance the positive experience of training is possible. As a metaphor it can also contribute to reducing the tension between the relationship between human beings and the environment. This dimension is an important aspect of outdoor education but has recently been neglected which has had a twofold impact: the changing nature of outdoor activities and environmental degradation as a result of this modified character.

Key words
sports, nature, environment, ecology, resilience, sport values, education, Olympic movement

Introduction

This article explores diverse perspectives from which sports are viewed: on a systemic level, they are mostly seen currently as part of a high performance-oriented economic sector where their attraction for potential spectators viewing media broadcasts is considered to be a success factor (Billings, 2011), as compared with the traditional educational perspective that values sport for its contribution to healthy life style, resistance and fitness of the organism, as well as more complex personal development and other important social phenomena that sport helps to form. (Neuman, 2011). The economic perspective and its contradictions have already been discussed many times without any definitive conclusion: success is part of the game and easily translated into economic terms – intrinsic values should then only be protected against some violation for profit. On an individual level, the Cartesian, mechanistic point of view perceives the human body as a mechanism that can be technologically 'improved', thus increasing its performance. In this context, the dualistic concept of 'mind and body' and the dichotomy between mental and physical phenomena prevents a holistic understanding of the human being (Hunter and Csikszentmihalyi, 2000).

We will experiment with changes to these perspectives and develop an 'ecological point of view' that enables a holistic experience of the body and mind, and connects sports to its social context, especially to education and the values inherent within the social sphere. We should try to identify relationships between the human body and natural systems, identify various interconnections, their role and how we perceive them (from other perspectives) and derive a message or some form of wisdom that could potentially enrich these prevailing perspectives.

Ecological perspective

From an ecological point of view, humans are organisms that have a close relationship to their environment: their growth and development is based on interactions with other organisms and the outside world, and are limited by their own capacities as well as by the availability and quality of environmental resources.

In contrast to the above, the ecological perspective stresses the importance of interactions with the surrounding environment. The human body from this viewpoint is no longer an isolated entity that can be manipulated to achieve some desired state, but a kind of system that is interconnected with other systems and shares some of the processes that are under way within them. If a certain desired state can be achieved (in our case, a trained sportsman), it should not be described as a triumph over nature; some other metaphor should be used – triumphs of this kind are (from an ecological viewpoint) are devastating for natural systems, including the human body. We consider the ecological perspective useful because it is closely related to sustainability over time it highlights limits (of the body and system) and shows what the possibilities are for the best management of it are to prevent some breakdown from overwork. In the case of sports, the ecological viewpoint shows that bodily limits represent boundaries that should be constantly challenged; this struggle supports the development of certain values on an individual level, and opens up a debate about either successfully overcoming them or failure to do so, and ways how to avoid these failures especially at the societal level. This perspective abandons the highly individualistic approach and takes into account important (environmental and social) factors that play a role in the development of a person and social structures; it also helps to view sports from more of a process (not outcome) point of view. It also supports a diversity of dialogue and the actors involved, and generates new associated narratives which appear within the context of this perspective. Environmental factors that influence an individual and his or her performance (for example, different types of interactions generated between sportspeople and the environment in which their sports occur) are discussed. As a result, environment is perceived as a shared responsibility in a situation where the ecological footprint or impact of sport activities on the environment is increasingly visible (cf. Horká, 2011).

Because life itself is understood metaphorically, through analogies and based on one's own experience (cf. Michálek, 2000), the ecological perspective offers different metaphors that are applied in different, ecologically relevant contexts – for example, an understanding of the Earth as a 'superorganism' is elaborated in the Gaia theory where the sensitivity of highly complex systems and their relationships is essential to ensuring the conditions of life (Lovelock, 1994). The human body is often considered to be part of the planetary ecosystem that ensures energy and material flows, as well as the necessary environment (homeostasis and related health conditions, aesthetical conditions – cf. (Millenium Ecosystem Assessment, 2005)). From the point of view of ecodynamics (Goldsmith, 1978), living things seek to 'preserve their structure, … survive and flourish through spontaneous, adaptive self-regulation' – life systems are thus substantially different from the non-living world and its laws of thermodynamics. The ecological perspective operates especially in outdoor education where the Biophilia hypothesis (Wilson and Kellert, 1993) or Psycho-evolutionary theory (Neill et al., 2004) are sometimes applied. According to the latter, outdoor education is a 'form of ritualistic or compensatory cultural adaptation to deal with the recent, rapid divorcing of nature from daily life'.

Limits to individual growth and development

One of the most influential metaphors applied in the context of the environmental or sustainability discourse is limits to growth. A study with this name was published under the auspices of the Club of Rome in 1972 and concentrated on economic and population growth in a world of finite resources (cf. Meadows, D.H. et al., 1972). But the limits metaphor is also applicable elsewhere in relation tovarious types of human or social development: for example, at the level of the human body, increasing its (physical, mental) potential would collide at a certain point with boundaries that limit further growth and depend on external as well as the internal resources and capacities of the body. These limits consequently represent a challenge that is dealt with differently in different areas of human activities - specifically in sports where training is appropriate strategy to modify them. They represent here an important impetus for personal development around which sports values are concentrated, and thus they are a factor in sports education where personal growth is emphasised.

From the ecological perspective, the struggle to extend personal limits should contribute to individual welfare (developing fitness, immunity etc.) and support social welfare through opening up a dialogue with different actors on the necessary resources (material, aesthetic, psychological etc.) and especially the results of personal growth. Sports values are also extensively discussed within other (non-ecological) viewpoints, especially in education, and

they are highly relevant for the Olympic movement's mission, which is to preserve a certain tradition. It should be noted here that this is not self-evident as the Olympic movement has recently faced an 'increasing separation between high performance sport and the interests of the population as a whole' which is leading to 'a marginalization of organized sport as a social phenomenon in which the public participates at its own level' (Pound, 2008). Personal limits are also dealt with from a purely performance-oriented perspective and the represent a driving force for technological progress, the development of new sports sectors, and also play an important role in the public perception of sports – but very often prohibited interventions such as use of drugs also play a role here.

The role of different approaches in dealing with personal limits

Obviously different approaches also differ in the ways how personal limits should be managed. Where the major question is about sports performance – in an outcome oriented approach – management concentrates on artificial intervention (technology, and even drugs) in situations where potential for growth has already been reached, and its success is reflected mechanistically (upgrading the body without paying attention to its social context, interactions etc.). In the educational sphere, attention is paid to progress on an individual level and its benefits to sport as a value-and-practice system. Attention is also paid to the health and well-being of the body and in this regard the ecological viewpoint is often promoted – regeneration of human capacities is stressed (Dohnal, 2010) and the link between the state of the natural environment and the general physical, mental and social welfare of a person has been confirmed by research (Horká, 2011). For educational purposes, learning environments play an important role, especially if they are challenging: obstacles are an inevitable part of the development process (Franklin, 2012).

Different perspectives are also important for the type of questions that are posed with regard to desired (sports) outcomes, and for the ways these questions are answered. What are the possibilities for overcoming limits to growth? What is – in this regard – being developed most dynamically? And finally, how successful have such developments been, in which respect (what did it deliver) and what are the indicators through which these deliverables are perceived or assessed? These questions could be analysed through the narratives that are characteristic of the outlined approaches – relevant to success, technical progress, the wellbeing of an individual and society, or a value system and other educational goals etc.

For example, from the educational perspective, increasing human capacities are stressed together with resulting values, and the questions and narratives associated with such growth are specific. How do people change as a result of sport? What impact on their life does sport have? From this perspective, an analysis of failure is important – e.g. the reasons for not succeeding on a personal, institutional or systemic level, attention to the life cycle of the sportspeople, and other possible examples of unanticipated outcomes. What is important is what the sportspeople themselves say and how they perceive their situation.

Method – resilience metaphor

Paradigms in ecology change over time. While in the mid-19th century the central concept in this science was that of an ideal natural equilibrium where any disturbance damages natural systems, from the 1990s the paradigm of a new, unstable ecology is gradually being developed. Within this new framework, ecosystems are considered to be open, unbalanced systems where an equilibrium exists but often not from a long-term perspective and is not pre-defined (there is no desirable 'stable' ecosystem state). Disturbances are common components of natural processes and ecosystems are even dependent upon them. While in the first paradigm, the resistance of the ecosystem is most important to preserve its stability, the second paradigm counts on the resilience that permits an ecosystem's structure to be maintained after disturbances that upset its equilibrium (cf. Plesník, 2012). If we consider the human being as a 'natural system' interacting with its surroundings, being part of it, sharing some of the processes etc., then overcoming personal limits might be dealt with as facing up to such a disturbance and taking adaptive measures with the aim of preserving its resilience, i.e. new and unbalanced stability. This metaphor is also useful for sports where harmony of human the body is attained through a series of unbalanced states (the training load) that are absorbed by the body.

Definition

Resilience, however, has been defined in a range of contexts (describes elasticity of materials, is applied in computer networking, in psychology, ecology, management etc.).

On a general systemic level, it is defined as: 'Resilience provides the capacity to absorb shocks while maintaining function. When change occurs, resilience provides the components for renewal and reorganisation. Vulnerability is the flip side of resilience: when a social or ecological system loses resilience it becomes vulnerable to change that previously could be absorbed. In a resilient system, change has the potential to create opportunity for development, novelty and innovation. In a vulnerable system even small changes may be devastating.' (Folke et al., 2002)

The Resilience Alliance (which is also a highly interdisciplinary organization with the aim of exploring the dynamics of social-ecological systems www.resalliance.org) defines resilience – a concept applied to the integrated systems of people and nature – as:

(a) the amount of disturbance a system can absorb and still remain within the same state or domain of attraction (b) the degree to which the system is capable of self-organization (versus a lack of organization, or organization forced by external factors) and c) the degree to which the system can build and increase the capacity for learning and adaptation (Carpenter et al., 2001).

In psychology, resilience is considered to be 'an individual's ability to generate biological, psychological and social factors to resist, adapt and strengthen himself when faced with an environment of risk, generating individual, social and moral success.' It could be described (on the individual level from a psychological point of view) with regards to:

- Good outcomes despite high-risk status,
- Steady competence under stress,
- Recovery from trauma,
- Using challenges for growth that make future hardships more tolerable.

The opposite of resilience is often defined as vulnerability. Vulnerability refers to the propensity of a social and ecological system to suffer harm from exposure to external stresses and shocks. It involves exposure to events and stresses, sensitivity to such exposures (which may result in adverse effects and consequences), and resilience owing to adaptive measures to anticipate and reduce future harm. The coping capacity is important, at all stages, to alter these major dimensions.

Application of the resilience metaphor

By providing insight into the 'limits of growth' both within the human organism and its surrounding environment, the resilience metaphor might help to incorporate the ecological viewpoint within the sports discourse; it may thus also highlight the risks and benefits of sport activities for all 'actors' involved (sportsmen and the environment).

The concept of resilience is relevant for systems thinking and applicable to different types of systems; it is well understood within different discourses and thus could serve as a 'boundary object' for developing dialogue and mutual understanding (cf. Star and Griesemer, 1989; Carlile, 2004). In the context of sports, it can bridge different perspectives from which sports are viewed (economic, educational, and ecological) while recognizing the important role of environment and relationships developed within it. However, there are some differences within these relationships: within the 'performance perspective', there are no limits perceived from the outside, and the impact on the environment is also believed to be unimportant – resilience is not considered although on the other hand it manifests itself in failure. From the educational point of view, resilience might play a role in understanding the limits of the body and support the development of methods to extend them. The ecological viewpoint then bridges the gap between environmental and human concerns and demonstrates their mutual interdependence. In this regard, sports should no longer be considered an individualistic exercise environmental and social factors have to play their role as well.

Education and outdoor sports

Thinking about personal limits leads to thinking about "self" (at a certain level of reflexivity); challenging personal limits leads to learning and transformation (personal development as a 'journey' with a relatively unpredictable goal). An experiential method of learning by doing, where the emphasis is placed on relationships concerning human and natural resources, is achieved in outdoor education. In this type of education, people are engaged in adventurous activities, and they experience the environment directly and use its resources as learning materials. In general, outdoor education supports awareness of and fosters respect for (Nicol, 2002).

a. Self — through the meeting of challenges (adventure)
b. Others — through group experiences and the sharing of decisions
c. The natural environment, through direct experience.

It highlights nature as an important factor and is actually one of the 'actors' that play a role in sporting endeavours – and reveals that sports activities capitalize on ecosystem services, especially the cultural factor aesthetic, spiritual, educational, recreatio-

nal etc. potential (cf. Millennium Ecosystem Assessment, 2005).

Consequences – new research questions

A consistent application of the resilience metaphor would shift attention from raising individual performance to increasing an individual's resilience – which is relevant not only to desired 'better outcomes under constantly improving conditions', but also personal wellbeing. If this transition occurs, the questions posed by sports managers will change – they will no longer concentrate on personal limits and methods to overcome them, but on the sources of the resilience and ways to support them. When resilience of the body is considered, factors that play a role in strengthening it might also be considered a.o. the natural environment. One of the crucial issues would be how to enhance and assess the positive influence of nature on the human being, and reduce the negative influence of humans on nature – one's RELATION TO the natural environment should be promoted while the IMPACT ON it should be penalized in sports activities. Psychology and physiology would be then engaged on the individual level in resilience building and stress management. Maybe other new perspectives will also open up.

The resilience concept in sports also means that attention should be paid not only to success stories but also failures; the voices of sportsmen should be listened to more often. (Sports sociology should play a role here).

Conclusion

Sporting discourse is developing around certain narratives. The deliberations thereof could provide insight into prevailing paradigms and also contribute to a change in these dominant ideologies should the continuation of current trends in sports development become unsustainable and lead up a blind alley. Prevailing practices are efficient, economically feasible, and appear to be widely acceptable but simultaneously appear to be more vulnerable. Established ideologies make it difficult to develop a real and democratic dialogue between the different stakeholders or actors that play a role in or around sports: not only sportsmen and sport managers, but especially (outdoor) educators, environmental conservationists, the general public and society. Some of these actors have conflicting views (they do not support the prevailing paradigm) and therefore it is difficult to achieve a holistic perspective desirable not only in education (where a comprehensive set of skills and values should be delivered) but also in the Olympic movement, at a strategic policy level etc.

The construction of boundary objects that bridge two opposing views might help to improve understanding between different viewpoints and narratives. In our article, we constructed such a boundary object by applying the following method:

(a) a change of perspective. Although sports are often dealt with from an economic point of view (as a symbol of success that could easily be translated into economic terms) or are considered to be a part of the education system (relevant for the development of the psychomotor domain where important skills are developed and related values built), we attempted to look at sports processes from an ecological perspective.

(b) selecting a relevant metaphor that might also work as a part of other perspectives and provide interesting insight concerning in our case the physical development, its limits, and the challenges that should be overcome through sports training, and consequent changes in personal characteristics – the resilience metaphor. Such a metaphor represents a boundary object that could be discussed by representatives of these diverse discourses: educators as well as sports managers.

(c) using this metaphor in different contexts for an analysis thereof, i.e. for broadening understanding of personal limits and possible ways of how to extend them and avoid failures. These considerations provide insight into sports challenges, their management, and the resulting changes in value systems. For example, the resilience metaphor is applied to underline the interests of the individual within the performance oriented discourse.

(d) drafting possible research questions that are an outcome of such considerations – they outline new research themes that could contribute to a shared, publicly acceptable, and sustainable concept of sports management from an environmental point of view.

Posing the correct research questions is an important part of the research itself, and not only that: whenever any transition or paradigm change is foreseen, different types of questions suddenly appear. In order to preserve sport with all its universal values in a contemporary world where economic imperatives seem to be the guiding principles for any action, these innovative questions might foster discussion on new topics that could potentially bring about desired change. In our case, the environment is an opportunity to change the perspective.

Acknowledgments: This article was written with the support of PRVOUK, a Charles University research program.

References

1. Billings, A.C. (ed.) (2011). Sports Media. Transformation, Integration, Consumption. New York, Routledge, Taylor and Francis.
2. Carlile, P. R., (2004). Transferring, Translating, and Transforming: An Integrative Framework for Managing Knowledge across Boundaries. Organization Science, 15, 555-568.
3. Carpenter,S., B. Walker, J. M. Anderies, and N. Abel. (2001). From metaphor to measurement: Resilience of what to what? Ecosystems 4:765-781
4. Dohnal, T. (2010). Systémový přístup k rekreologii. Tělesná kultura, 33(2), 7–29.
5. Folke, C., Carpenter, S., Elmqvist, T., Gunderson, L., Holling, C. S., & Walker, B. (2002). Resilience and sustainable development: building adaptive capacity in a world of transformations. AMBIO: A Journal of the Human Environment, 31(5), 437–440.
6. Franklin, B. (2012). Developing and maintaining mental toughness. Mental Toughness: The Mindset Behind Sporting Achievement, 91.
7. Goldsmith, E. (1978). The Stable Society. Wadebridge Press. Available from http://www.edwardgoldsmith.org/books/the-stable-society/
8. Horká, H. (2011). Health Education in the Environmental Context. In: Řehulka, E; Sollárová E.(ed.) Health Education: Czech-Slovak Experience, Brno : Masarykova univerzita. ISBN 978 -80 -210 -5723, pp. 7–20.
9. Hunter, J., & Csikszentmihalyi, M. (2000). The Phenomenology of Body-Mind: The Contrasting Cases of Flow in Sports and Contemplation. Anthropology of Consciousness, 11(3-4), 5–24.
10. Donella H. Meadows, Gary. Meadows, Jorgen Randers, and William W. Behrens III. (1972).
11. The Limits to Growth. New York: Universe Books. ISBN 0-87663-165-0
12. Millennium Ecosystem Assessment, 2005. Current State and Trends. In: Ecosystems and Human Well-being, vol. 1. Island Press, Washington.
13. Lovelock, J. E. (1994). Gaia : živoucí planeta. Praha : Mladá fronta (Kolumbus). ISBN 80-204-0436-8
14. Plesník, J. (2012). Přínos ekosystémové ekologie pro biologii ochany přírody. In: Machar, I., Drobilová, L. et al. (eds.) Ochrana přírody a krajiny v České republice. Olomouc: UP v Olomouci, 2012.
15. Michálek, J. (2000). Corpus organicum. Praha : OIKOYMENH. ISBN 80-7298-021-1.
16. Neill, J., Gray, T., Ellis-Smith, G., Bocarro, J., Sierra, R., & Kaushal. (2004). 2nd International Outdoor Education Conference, Bendigo, Australia, July 6-9. Available from http://www.wilderdom.com/psycho-evolutionary/
17. Neuman, J. (2011). Současné problémy oblasti zvané "outdoor ". OUTDOOR 2011, 6.
18. Nicol, R. (2002). Outdoor education: Research topic or universal value? Part two. Journal of Adventure Education & Outdoor Learning, 2(2), 85–99.
19. Pound, R. (2008). The Future of the Olympic Movement: Promised Land or Train Wreck? Pathways: Critiques and Discourse in Olympic Research, 1–19.
20. Star, S. L., & Griesemer, J. R. (1989). Institutional ecology, 'translations' and boundary objects: Amateurs and professionals in Berkeley's Museum of Vertebrate Zoology, 1907-39. Social studies of science, 19(3), 387–420.
21. Wilson, E. O., & Kellert, S. R. (1993). The biophilia hypothesis. Washington DC: Island.

Orienteering and sustainability in the Czech Republic

J. Dlouhý
Charles University Environment Center, Charles University in Prague

Abstract
Orienteering is a relatively popular sport in the Czech Republic with more than 7,000 registered competitors. Some ecologists have stated that orienteering, thanks to its off-track nature and the large numbers of competitors, has the potential to damage flora and fauna. In practice, many thousands of orienteering events are held worldwide each year and ecological incidents resulting in unacceptable damage are extremely rare - in fact, close to zero. Unlike some other sports pursued in natural surroundings, orienteering does not require any long-term modifications to the natural landscape, no special devices, and no buildings. And on the other hand, this sport has important social dimensions, as all age groups, including families, meet at sports events and from the performance point of view, are catered for with (almost) equal importance.

The author proposes to use methods similar to those used in tourism by some authors in the past for evaluation of the environmental sustainability of orienteering sport, namely Ecological Footprint (EF) and Life Cycle Assessment (LCA).

Key words
orienteering; nature protection; social factors

Introduction

Orienteering is a relatively popular sport in the Czech Republic – there are more than 7,500 competitors registered for foot orienteering, 725 for mountain bike orienteering, 400 for ski orienteering and 50 for trail orienteering. Competitors are organized into 212 clubs. The first Czech orienteering event took place in 1950 in Zlín (the first ever world o-event took place more than 50 years earlier – in Norway in 1897).
Czech athletes are relatively successful in international competitions – they have brought home nine medals from World Orienteering Championships over the last 10 years – the biggest success being the relay gold medal from in 2012. The World Orienteering Championships were organized in the Czech Republic in 1970 (Staré Splavy), 1991 (Mariánské Lázně) and 2008 (Olomouc).
What factors should be evaluated?
The environmental commission of the International Orienteering Federation (IOF) deals with environmental problems at the international level. The IOF General Assembly approved the IOF Environmental Policy in 1998. The commission published several studies and in 2011 it also conducted a survey across the national orienteering federations (Laininen,2012). The results of this survey are not only very interesting but also rather surprising: the most important environmental problems indicated by the national federations are "disturbance of mammals" and "waste", while "traffic and its CO2 emissions" is identified as the third least important issue (see Figure 1). The results of the survey led us to conclusion that a more detailed study of different environmental factors involved in orienteering would be very interesting. We would like to discuss some of those factors and propose detailed research methods for some of the factors in the Czech Republic.

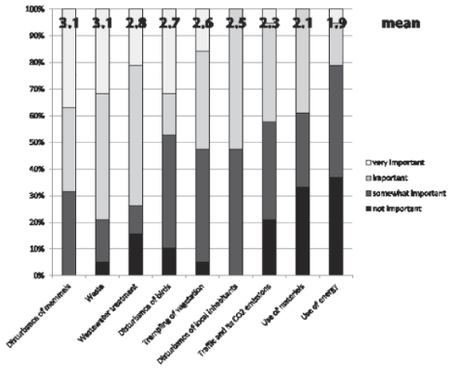


Fig. 1: Results of the IOF Environmental Commission survey (Laininen, 2012)
The research here attempts to assess both environmental and social factors of orienteering sport in our country.
We made some simplifications for the purposes of our research – we consider only o-events and no training activities, as those take place in small groups with almost no equipment, with no need for buildings or other stable constructions. The only exception is winter training in gyms, but in the first stage of research, these rather optional activities are omitted.
We compiled statistics of o-events in the Czech Republic over the last year (ČSOS 2012) and we obtained the results summarized in Table 1.
Table 1: O-event statistics in the Czech Republic in 2012 (Calculated according to http://www.orientacnisporty.cz)

Sport	Events per year	Average no. of athletes per event
Foot orienteering	200	200-2000
MTB	20	250-350
Ski	8	250
Trail-O	12	30

If we consider the nature of different orienteering disciplines and number of athletes, we can focus only on foot orienteering in further discussion.

Nature protection

Disturbance of mammals

In contrast to the results of the IOF survey, mammal disturbance is not a big problem in the Czech Republic; most mammals on the list of endangered animals are small mammals which do not come into contact with orienteers e.g. bats, ground squirrels, garden dormice, wildcat etc. There are only 3 species of big mammalsthat could theoretically be endangered by orienteering – the Brown Bear (Ursus arctos), the Gray Wolf (Canis lupus) and the European Elk (Alces alces). The occurrence of all 3 species is so rare that there have been no recorded encounters between them and orienteers until now.
Another problem could be disturbance of game animals. As all species of game animals are overrepresented in the Czech Republic (Čermák, Mrkva 2007)., there is the potential for some conflicts with hunting associations, especially during spring season.

Disturbance of birds

Nature protection authorities have identified the disturbance of birds as being a serious problem in the Czech Republic, and it is identified as the most important reason for the closure of some regions for orienteering, especially in the spring months. Very different decisions are taken by different regional nature protection authorities, sometimes based on detailed research and sometimes based only on the personal opinion of officials. Research on the disturbance of birds has been carried out in UK (Brackenridge 1988), (Goodall and Gregory 1991).

Trampling of vegetation and erosion

The trampling of vegetation in the Czech Republic can be a problem in some areas – mostly in sandstone regions (Czech Paradise, Kokořín…). No real research has been done on this topic and in some areas the local administration has decided not to allow shoes with spikes, which orienteers oppose for the reason that competitors sliding on terrain can make erosion even worse.

Disturbance of local inhabitants

Disturbance of local inhabitants has to be taken into account in preparing and organizing an o-event – it is necessary to organize proper car parking, the directing of athletes to the start line, and the broadcasting of results and music can disturb the local population. All those problems, however, can be solved relatively easily by o-event organizers.

Traffic and CO_2 emissions

Participants in an o-event travel usually effectively pool their cars mostly for economic reasons, but travelling is nevertheless probably the activity with highest environmental impact in orienteering. We plan detailed research on the CO2 footprint of one or two big o-event in 2013.

Waste

There is not much waste produced during an o-event in comparison with the everyday life of participants. Some additional waste is produced because of catering using disposable dishes. In future, this problem can be partly solved by using fully biodegradable dishes. At present, organizers at some o-events try to separate at least the plastic waste.
On the other hand, all the waste from Czech events is properly collected and disposed of in designated areas, which was even garnered a mention by the state authorities (AOPK 2011): after the o-event there is usually less waste in the area than before it.

We plan detailed research on the amount of waste produced during two big o-events in the future.

Wastewater

Mobile or fixed toilets are used during all o-events and this means that all wastewater is properly disposed of. There could be some additional environmental burden due to the use of chemicals in mobile toilets.

Material flow and energy use

In comparison with almost all other sport disciplines, the usual material flow for orienteering events is very low – there is no need for any permanent construction venues and even the mobile equipment is not extensive. We will calculate the material flow for two big o-events and compare the results with studies that were made in Finland for the World Athletics Championships in 2005 and the Nordic Ski World Championships 2001.

The energy use at o-events is also very low – in many cases o-events are organized at isolated sites in the countryside, and only two or three power generators are used for covering all the electricity demands for the computer center and catering. If technically possible, a more effective connection to the public grid is used, as it is also cheaper. This may, however, cause additional disturbance to the surrounding environment as the generators are rather noisy.

Social factors

The IOF Environmental Commission proposed the following National environmental performance indicators for orienteering:

- number of occasions on which the land use for orienteering has been prohibited by landowners or authorities
- number of complaints from stakeholders (landowners, hunters, environmentalists, authorities, etc.) related to the organization of events
- opinions and attitudes of stakeholders toward orienteering (e.g. national survey of forest owners, feedback after big orienteering events)
- number of discussions with stakeholders at the national / regional level
- number of articles discussing environmental matters in periodicals

In the Czech Republic, there are only some remarks concerning these issues (AOPK 2011), so further research and evaluation would be useful.

Methods

We did not find any study in the literature with a comprehensive assessment of the environmental impact of outdoor activities, but rather only partial studies mostly regarding the impact on mammals, birds and vegetation. The closest research on this topic we found were studies on the impact of tourism. Castellani and Salla (2012) compare methods to assess impact on both environmental and socio-economic factors. Amongst the tools and methodologies used to assess sustainability, Ecological Footprint (EF) and Life Cycle Assessment (LCA) are of specific interest as they use a variety of assumptions and evaluate environmental impacts from different perspectives that may be easily integrated.In similarity with other sectors, the evaluation of orienteering activities using both methods could therefore provide more extensive and comprehensive results, and could lead to more reliable evaluation of the system and hence provide better support for decision making (Wiedmann and Barrett, 2010).

It will be also very interesting in future to undertake a sociological survey that would indicate whether participants in orienteering events have a better relationship to the environment than the general population does – we plan to conduct a standard quantitative survey with the participants of one or two big o-events in 2013 using some of the questions applied in the ISSP 2010 – Environment international survey (Soukup, 2001) and compare the results. A further issue of interest in this context is whether athletes come to o-events only for sports reasons or whether they also participate for its social aspects (to meet friends) and environmental factors (to experience nature).

Conclusions

This article summarizes and categorizes existing information and research about the environmental impact of orienteering sports in the Czech Republic (in the wider context of a European framework and research). It shows that some research on the environmental impact of orienteering has already been undertaken, especially by the IOF Environmental Commission and by Finnish scientists (Laininen 2007). Further comprehensive research at the European level, and comprehensive research within the Czech context is still greatly lacking. It would be very useful to undertake such research using standard methods, i.e. with Life-cycle assessment methods.

References

1. AOPK (2011). Usměrňování vybraných sportovních a rekreačních aktivit v ZCHÚ (Regulation of selected sports and recreational activities in protected areas). Metodické listy Agentury ochrany přírody a krajiny ČR. Agentura ochrany přírody a krajiny ČR.
2. Brackenridge, W.R. (1988) 'Effects of a major orienteering event in Drumore Wood, Aberfoyle, in June 1987,' Compass Sport, March/April, 20-22.
3. Castellani, V., & Sala, S. (2012). Ecological footprint and life cycle assessment in the sustainability assessment of tourism activities. Ecological Indicators, 16, 135–147.
4. Čermák, P., Mrkva, R (2007). Škody zvěří – neřešený eskalující problém (Damage caused by game animals - escalating unsolved problem). Zpravodaj ochrany lesa 14/2007, 39
5. Goodall, A. and Gregory, C. (1991) The effect of the May 1991 orienteering event on the breeding bird community in Brandon Park. Ecosurveys, Spilsby, Lincs.
6. Laininen, E. (2007). Numerical methods of calculating environmental impacts of sports activities, IOF-E-NV-005, International Orienteering Federation 2007
7. Laininen, E. (2012). IOF Survey – Orienteering and the Environment, IOF-ENV-008. International Orienteering Federation.
8. Soukup, P. (2001). ISSP-Životní prostředí. Sociologický ústav Akademie věd České republiky.
9. Wiedmann, T., Barrett, J. (2010). A review of the ecological footprint indicator – perceptions and methods, Sustainability, 2 (2010), pp. 1645–1693

Management of outdoor activities

Managing Outdoor Sports

M. McClure
Outdoor Recreation Development Officer – Sport Northern Ireland

Managing outdoor sports is somewhat like herding cats.

Cat herding would be a very highly skilled profession that requires concentration, dexterity, the ability to perform small miracles and the setting of completely unrealistic targets.

Cats are very distinctive characters – you never own a cat – in fact they probably own you and they are autonomous, self determined, single minded creatures. They are not unlike the very autonomous, self determined, single minded creatures that we call outdoor sports enthusiasts an managing them is about as easy as herding cats.

Northern Ireland is a small country that is part of the United Kingdom – but has obviously strong links with the Republic of Ireland. Some facts and figures are important for understanding the context of managing outdoor sports:

- Size 13,840 km²
- Population 1,810,900 (2011)
- Lough Neagh – 391km2
- Lough Erne – 140km2
- Strangford Lough – 150km2
- 8% (1100km2) is Heather Moorland

While Northern Ireland is not a big place it does have lots of water – the largest sea Lough and the largest freshwater lake in the British Isles and over 350 miles of beautiful coastline. Even where there is land there's water – as over 8% of the land is moorland which is effectively wet for most of the year holding vast amounts of water.

There are no National Parks in Northern Ireland but there are seven "Areas of Outstanding Natural Beauty (AONB) across Northern Ireland which are fantastic landscapes that are highly valued by wildlife and also by people for recreation. In the West we have rolling hills and mountains and extensive forests that are slowly being developed for mountain biking, on the North Coast there are fantastic geological features including the Giants Causeway (and the only real way to see it properly is from the sea in a kayak) and then in the South we have the Mourne Mountains. Not high by European standards (all less than 1000m – but they rise straight out of the sea and are a mecca for climbers and hillwalkers.

It all sounds idyllic and too good to be true…..and it is. We have really weak access legislation which enables local councils to develop public rights of way and access – but does not require them to. Further the land owning patterns in Northern Ireland are different from that in other parts of the UK as most farms are small scale, occupier owned and the land is held very close the heart. There are 26 local authorities across this small area who are for the most part insular looking and we have very limited financial and staff resources to develop outdoor sports.

A new post was created in 2006 within Sport Northern Ireland to manage funding and support outdoor sports in recognition of the (at that time anecdotal) increase in participation in outdoor sports and the growing issues involved in the management of it.

So early in 2008 SNI commissioned 2 reports to try to get a handle on the scale of participation in these activities. The last data set that there was in Northern Ireland on the scale of participation was in 1995 and it was somewhat lacking in data. The first report carried out was into the trends in 23 distinct outdoor sports between 1995 and 2008, and then a second one into walking, cycling and horse riding as these activities warranted a separate study due to their scale. Sports involving engines were excluded as was angling as the scale of angling warranted as study in its own right but an economic impact study of angling was being carried out by another organisation.

So while in Northern Ireland there are increasing concerns about rising levels of obesity and corresponding falling participation in sport – there are significant increases in use of the natural environment by participants engaged in outdoor sport and recreation. While that is very positive – it was starting to put pressure on land management bodies and national federations who were trying to manage this.

Sport Northern Ireland is focused on 2 distinct areas of work: improving performance and increasing participation. The focus of the work in developing and managing outdoor sports is on increasing participation although this has not been exclusively the case. As such there is engagement with a great range of organisations to try to achieve this.

However, it has been important to acknowledge that participation in outdoor sports is not sufficient in itself, it has become increasingly apparent that there is a real need to develop participation that is both sustainable and responsible.

One of the really important organisations for the delivery of this increase in participation that is core funded by SNI is Outdoor Recreation Northern Ireland (ORNI). ORNI was established by a range of government departments in 1999 following the 1998 Countryside Recreation Strategy. ORNI was established to bring together key stakeholders for outdoor and countryside recreation, to disseminate information and to develop and improve access and facilities for outdoor sports.

Sport NI also supports the National Governing Bodies for outdoor sports. Some of these have a strong focus on high performance sport such as the Olympic disciplines of equestrianism and canoeing – but others such as orienteering and mountaineering are much more participation focused.

Mountain and cave rescue is the statutory responsibility of the police in NI but they rely very heavily on voluntary rescue teams that we support both from a financial but also a technical point of view.

The development of policies and undertaking appropriate research is critical part to have a sound evidence base for decision making and investment. Two or three pieces of research that to be undertaken are identified at the start of each year with a business case and the terms of reference being prepared. While a budget at the start of the year to carry them out may not exist - if funding comes available everything is ready for the research to be undertaken.

One of the big growth areas in Northern Ireland is activity tourism with a plethora of new businesses being created in the past 10 years offering all sorts of adventure experiences on a commercial basis. This growth is in the absence of any form of regulation or control and so there was increasing concern within government that a serious accident or incident would be politically untenable but would also be very negative for this new industry. Sport NI was therefore tasked with developing a scheme that would check and ensure that activity providers had suitable safety systems and procedures and operated to recognised standards. A UK wide scheme called "Adventuremark" has been adopted and is being implemented to meet this need. Sport NI provides workshops and seminars on how to develop best practice systems and procedures and also provides a funding scheme for activity providers to go through Adventuremark.

It is critical that the interests of sport and recreation users are represented on the various committees, forums and networks to try and ensure that there is always a voice for outdoor sports.

Voluntary clubs are supported through the provision of small grants, advice and support for their development.

The 1998 Countryside Recreation Strategy was a first for Northern Ireland and was partly responsible for the growth in outdoor sports. In 2010 a review of this strategy was carried out as it was 12 years old and this noted that many aspects of it had been fulfilled but that as much had changed politically and economically since then it was time to renew it.

In 1998 Northern Ireland was just emerging from the troubles and activity tourism did not exist, access for people with disabilities was not as high on the agenda and the economic growth was good.

So over the past 2 years a new outdoor recreation action plan has been worked on for Northern Ireland which while being led by Sport Northern Ireland is a partnership involving the Northern Ireland Environment Agency, the Inland Waterways Branch of the Department of Culture Arts and Leisure and the Northern Ireland Tourist Board.

The Action plan vision is

"Developing, managing and promoting a dynamic culture of sustainable outdoor recreation in Northern Ireland."

To achieve this vision the aim is for Northern Ireland to be a place where:

- There are increasing opportunities and improved access and infrastructure for sustained and increased participation by all in the broadest possible range of outdoor recreation activities.
- There are accompanying benefits to communities in terms of health, social cohesion and economic development.
- People enjoy the outdoors and show a high degree of responsibility for themselves, towards others and the environment they are using and play their part in maintaining, supporting and enhancing that environment.

It is about people, places, demonstrating benefits and all about responsibility and sustainability in the broadest sense.

Outdoor recreation is has many aspect and so when developing the plan these needed to be factored in (Fig.1).

Fig. 1 Outdoor recreation

An extensive consultation was carried out to get feedback from as many organisations as possible including national governing bodies, local councils, policy makers in central government, protected area managers, environmental bodies, tourism bodies and then the users and public at large. These took a considerable amount of time but were hugely beneficial and even of themselves have created new developments whereby users and land managers were brought together for a common purpose.

As a result of the consultation seven significant issues kept arising and right at the top was the concern about the poor access legislation in Northern Ireland. However, lots of concerns were raised about the issues of liability and responsibility and also safety. The main issues therefore were:

1. Access law
2. Liability & Safety
3. Environmental impact and degradation
4. Communication
5. Funding
6. Economic growth
7. Facilities

During the consultation, people were asked not only what the key issues were but what they believed were the potential solutions

Following the consultation process all the information on these issues and solutions was distilled down to 34 key actions that captured all the main suggestions. The actions then were placed into groups which resulted in seven main themes.

In November 2012 the final recommendations and actions were released for a final statutory 12 week consultation process and this can be accessed at www.sportni.net/about_us/consultations

The first section of the draft plan is to put in place new structures that will ensure that the plan is achieved. The national strategy for sport in Northern Ireland is called "Sport Matters" and this has been signed up to by the Northern Ireland Executive which requires all departments to contribute to it. It was agreed early in the process that the Outdoor Recreation Action Plan would sit under this strategy for sport and use the same reporting mechanisms.

A new Strategic Partnership between all the relevant government departments who have a responsibility for outdoor recreation or its impacts needed to be formed. This group needs to be empowered by their departments to deliver relevant actions.

Underneath that and yet holding it to account would be a National Forum for outdoor recreation. This has been articulated as being really needed to create a unified voice for change and development across what is actually a fairly disparate sector. This group would be made up of non-governmental bodies and therefore is free to lobby and articulate the need for change. The Department of Environment that is responsible for the Access legislation does not believe that there is a need for change as they do not hear that call clearly articulated. This forum may be the mechanism to make that happen.

Finally feeding into this would be a range of local outdoor recreation forums from across Northern Ireland. Some of these already exist and are proving very effective at dealing with local issues, exploring solutions to problems and communicating needs between users, local authorities and other bodies. Where a problem cannot be solved at a local level it should be flagged up to a national level.

Scotland has a similar structure to this – but it is primarily focused on access whereas it was felt that there was an opportunity for the focus to be broader. Also the bit that is missing is a strong strategic partnership between the relevant agencies. So the Scottish model has been taken and modified slightly to suit the needs in Northern Ireland.

One of the big areas of concern was about liabilities, responsibility and safety. Landowners are increasingly concerned about their liability to those who use their land for their activities. Outdoor sports are relatively unique in that the participants normally do not own the land on which they practice their sport or activity. Combined with this – there is increasing evidence that people are taking pat in all sorts of new activities and perhaps don't always understand the consequences of actions.

So the action plan has articulated a need to develop clear communications on personal responsibility. Increasingly people who do not have a background in adventure activities are engaging with them – perhaps initially through a commercial provider. So they go and purchase equipment, but do not necessarily get further training, or join a club where training is provided if only informally. In an effort to communicate with such people, partnerships with the retail sector are being developed as the point of sale of equipment is often the only opportunity to impart such information to new participants. This piece of work has been a partnership with the Environment Agency, the National Trust (a conservation body), the Mourne Heritage Trust (mountain management organisation), the Health and Safety Executive in Northern Ireland and Outdoor Recreation NI.

However, in parallel with that there are close working relationships with the Police Service of Northern Ireland to support the mountain and cave rescue teams to ensure that while participation is promoted there is support for those who have to go out and pick up the pieces when it goes wrong.

Unlike other parts of the UK and some other parts of Europe, in Northern Ireland we do not have activity providers regulated in any way at all. Therefore someone could set up a business providing for example sea kayaking who holds no formal qualifications in that sport. Sport NI has therefore been working closely with the industry and the National Governing Bodies in Northern Ireland to implement the Adventuremark scheme. This is a non statutory (optional) scheme that checks that activity providers are compliant with recognised industry standards. This has absorbed a considerable amount of time and energy. As there was no licensing in NI there was a lot of capacity building required with providers to make them aware of how best to undertake appropriate risk assessments and to develop appropriate policies, procedures and management protocols.

The first stage of implementing such a scheme is to communicate it to the activity providers and provide support and guidance for them. Sport NI also provided a grant for these providers so in effect the accreditation process cost them very little financially. This has proved to be very important given the current economic situation.

However, it is imperative that then this communication plan is broadened out so that the public – particularly those with responsibility for young people are aware of the scheme. In fact, most people in Northern Ireland falsely assume that activity providers are accredited or licensed.

There are real advantages to having a non statutory scheme in that the scope of the accreditation can be adjusted with the stroke of a pen. A statutory scheme is bound in scope by the statute that created it and it is cumbersome to effect such changes.

However while there is a clear duty of care on an activity provider, the liability due to an independent participant is low. The courts have been very clear on this subject – if a participant knowingly and willingly has undertaken an activity where there are clear and apparent dangers and risks and subsequently is injured because of said risks – they have no recourse on the landowner. Therefore having clear information that highlights the inherent risks (and the extensive benefits) for participating in outdoor sports is essential.

Sustainable and responsible participation also therefore means thinking very clearly about the impact of these activities on the environment. This raises all sorts of questions about thresholds, capacity, disturbance that is significant or not, erosion, damage and careless destruction. Across the island of Ireland it was recognised that just having a countryside code

was really not sufficient in reducing impacts on the environment.
Hence the Leave No Trace ethic was adopted and is being implemented both in the North and South of Ireland. However, the roll out of leave No Trace has not been without its difficulties in getting organisations to sign up to it.
One of the other significant changes is the increase in both the number and range of charity and challenge type events in the natural environment. These events are also attracting ever increasing numbers which in turn is having significant impacts. Guidance for event organisers has been developed and communicated via a website www.outdooreventplanning.com as well as through publications and a seminar. The website encourages activity providers and organisers to sign up to work within these guidelines and then they can be promoted by the site. Unfortunately while some events are run very well there is evidence that some participants are not particularly sympathetic to the environment and litter and damage can be rife after an event.
Visitor giving as a means of mitigating the impact of outdoor recreation is now starting to be explored. People generally are happy to pay to use sports facilities for other sports – but feel that the natural environment is a free resource. However the reality is that this resource needs to be managed and there is a cost associated with such management. If the cost is to be carried by a public body the benefits from its use needs to be articulate very clearly to justify the expenditure of public funds. However, there are real advantages associated with users being involved in putting something back in to the environment whether that is through voluntary time or finances.
As noted earlier there has been a very significant increase in the number of commercial operators providing outdoor adventure type experiences. Many of these started during the boom times when outdoor team building activities for companies were very popular and also very lucrative. However, with the recession there is a lot less of this type of activity taking place. These commercial providers have now started to look to the schools and youth groups that were traditionally provided with adventure activities as a service and part of their education.
Increasingly some of these providers are challenging the public sector investment in providing these activities at reduced cost, claiming that it is negatively impacting on their businesses. These businesses were established 30 – 40 years after the establishment of the public outdoor education service providers, and so they were very aware of the fact this was the market they were operating in. A demise of the outdoor education sector in NI which has historically been very strong, would be a real setback as the net result would be an outdoor activity provision only for those who can afford it. Aligned to that – some of the commercial operators employ minimally experienced and qualified staff to keep their costs as low as possible. These staff do not have the skill or knowledge to provide connections to the educational curriculum.

The next challenge after that could be to the voluntary sector providing sessions and courses free or very reduced because they have no staff costs through clubs and governing bodies.
The liaison with such a mix of organisations and individuals requires an enormous effort if one was to go it alone and so building relationships with others who have an interest (even if it is only slight) to achieve joint aims is essential. Such partnerships are excellent ways to collectively share information and avoid duplication of work.
However, in a partnership, each of the organisations and individuals will come to the table with their own needs, desires and requirements and will also have different values and ways of working. As funding and resources become tighter government agencies and other organisations retreat into a cocoon known as their statutory requirements and nothing else.
There is also a risk that they become very protective of their own little empires and there is a need to break through that and show that by collaborative working more can be achieved. This doesn't happen overnight and genuinely takes a lot of time.
As an example of this – it has taken over 10 years of engagement and relationship building between recreation providers and the NI Forest Service before the development of recreational facilities especially mountain bike trails could commence in the state owned forests. This has come about through a process of providing the right evidence of the benefits and opportunities that such facilities can bring, combined with the a partnership approach with the local authority and a recognition of the values and priorities of Forest Service.
The principles that are fundamental to developing good partnerships are:

1. Equality
   - Partners must be treated the same
   - Compromises are part of partnership but these should be adopted equally.
2. Clarity
   - Clear objectives for the project or partnership are essential
   - Clear mechanisms for how the partnership will operate
   - Clear ways that each partner organisation functions
3. Transparency
   - There can be no hidden agendas and the processes that partners work to must be made clear.
4. Commitment
   - Partners must be equally committed to the project.
5. Responsibility
   - Partners should only agree to bring to the partnerships what they know they can deliver
   - Targets and goals must be realistic
6. Focus on Action
   - Look to what can be achieved

Finally clear and consistent communication is essential and binds the partnership together.
In conclusion, the management of outdoor sports is only effective when done collaboratively. It is a process that is ever changing rather than a mechanism that is set in stone as it needs to respond to an ever changing set of parameters. It requires commitment and co-operation on the part of many individuals and organisations and is therefore as much about relationship building as it is about procedures. It will involve set backs and failures and yet when done successfully can bring great benefits.
It is rarely if ever perfect – learn to accept that.

To be in the mountains to climb or to climb to be in the mountains? - The notion of competition in Norwegian mountaineering.

I. Mytting[1], I. Mytting[2]
[1]Department for Physical Education, Norwegian School for Sport Sciences, Oslo
[2]Master of Philosophy in History of Ideas, University of Oslo

Abstract
This paper will focus on the notion of competition in Norwegian mountaineering and climbing as outdoor sport. Competition is in Norway a crucial element in the distinction between (outdoor)sport[i] and friluftsliv[ii]. The tension that comes along, origins from questions the pioneers in mountain climbing were facing. Questions that in the explicit Norwegian context were linked to important moral and political issues of the time. By researching the activities of the pioneers in mountaineering and climbing around the change of century, we will investigate why and how competition is the key factor in distribuating the way idrett[iii] are understood and organized in Norway

Key words
Competition, Norwegian mountaineering, nature and nationalism

Introduction

"But are we – within this nation – content, when Norwegians achieve international reputation in various sport fields, then we also should appreciate it when we are able to assert ourselves through this noble sport [Mountaineering], that is more bodily and morally developing than any other, because it is detached from all competition and prize awarding and only appeals to the better instinct in us" (Tønsberg, 1914, 315)

This quote is from the 1914 anniversary-book published by the Norwegian Alpine club; Norsk Tindeklub, only a few years after their founding in 1908. The quote entails some interesting information. First, it tells us that the Norwegian mountaineers demanded recognition from their fellow countrymen, stating that mountaineering was an important national matter. Second, it exposes a certain ambivalence regarding the sentiment towards competition. The mountaineers held a strong desire to prove to the Norwegian public and the international fellowship of mountaineers that they could perform at the level of the best. Still, they claimed that mountaineering is exalted above competition. How could they encourage and reject competition almost at the same time? In the following we will take a look into this question.

Metods

This presentation is based on a material from Iver Mytting´s Master Thesis Project at the University of Oslo, published spring 2012: Erobringen av fjellet. Erobringen av fjellsporten. Erobringen av det norske: Om Norsk Tindeklubbs nasjonalisering av fjellsporten.
("The conquest of the mountains, the conquest of the mountaineering, the conquest of Norwegianess: about Norwegian Alpine club's nationalization of mountaineering")
The thesis is based on a close reading of texts written by the mountaineers, applying interpretational methods commonly associated with intellectual history or history of ideas. This form of literature study emphasizes the placement of texts in their historical context, implying a thorough knowledge of the rhetorical situation, the general debates and the intellectual premises of the time.

Findings

In 1911 the club received an inquiry from the organizers of the 1912 Stockholm Olympics, asking for candidates to a gold medal on the field of Mountaineering: awarding "the finest performance in mountain ascents". The board of the Norwegian club debated the matter and found there was some uncertainty connected to the inquiry ; on what premises an ascent should be judged upon: was there only talk of ascents of major peaks, or would one consider the technical difficulties of maybe smaller ascents? They decided to pose the matter on to the general assembly. (Grimeland, 2000, 45) Before we reveal what was decided, we will look closer at the Norwegian context.

When the climbers´ club were established, there already existed a long tradition for mountain touring. The Norwegian Trekking Association was founded back in 1868. But it was no climbers´ club. In fact, very few Norwegians were climbing mountains before the turn of the century. It was the British who in the 1870's introduced the sport in Norway, notably William Cecil Slingsby. He and other countrymen almost have had the mountain-peaks to themselves. Mountaineering was among the common Norwegian strongly associated with Englishmen, and in addition regarded as extremely hazardous and a meaningless risk of life; "either he's an Englishman or he is completely insane..." was the saying.

But the founders of the Norwegian climbers´ club stated that the English dominance was the result of Norwegian prejudice against the sport. (Tønsberg, 1933, 42) The foreigner's dominance was deeply unnatural and also quite embarrassing to the nation, the task of conquering untrodden land inside their own country should be carried out by Norwegians. They wanted to persuade their fellow countrymen with this belief.

A Norwegian sport?

The mountaineers claimed the sport to be distinctly Norwegian. A recurring argument for that was the character of Norwegian nature, where mountains are a dominating feature. So the inhabitants must have acquired certain skills from living among mountains throughout the ages. (Horn, 1923, 22.) They argued that Norwegians are born with a natural ability for mountaineering, that it has to be deeply rooted in the national character, a concept originating in The Romantic Nationalism and still highly in force. To quote Slingsby's view on Norwegian peasants, who, although unfamiliar with mountaineering, had their skills.

"Rock climbing, in the path of duty, has nevertheless always to some extent been exercised in every rocky mountain valley in Norway and there are and have been for centuries hundreds of peasants who have literally toddled out of their cradles on to the rocks, and who are surefooted and fearless before they have learned their alphabet. The best of them become excellent cragsmen and are in great request when a crag-fast goat or sheep has to be rescued." (Slingsby, 1914, 14)

This sort of statement were frequently repeated by the members of the Norwegian club, arguing that Mountaineering is a sport especially suited for Norwegians, trying to present it as a summertime equivalent to skiing, the national sport.

It´s was of course not an easy task. A revision of history was therefore an important strategy. The historical narratives by the members of the club, is thus a domain where the rhetoric strategies are easily spotted.

Competing with the English

In their anniversary books, the history of mountaineering in Norway had its obvious place. Also when they published elsewhere, it was variations of the same narrative, and their mission to construct mountaineering as a Norwegian sport. If it didn´t have its origin in Norway, it could have Norway as its destination. Norwegians were portrayed as the legitimate sons of the mountains, born with natural skill. Their embrace of mountaineering was only a matter of time. A teleological story is written, where all history leads up to the point where Norwegians re-conquers the mountains from the English, and at the same time, conquering the sport of mountaineering.

In their own understanding, it is especially their prominent skills as rock-climbers that enables them to compete even with the best. (Backer Grøndahl, 1918, 177.) On rock they are able to get up where others have to give up.

When the Norwegians roped up and started to go vertical, it was in the high alpine-like mountains in the central regions where the foreigners had been climbing for several decades. There were few unclimbed peaks, even few new routes to try. But now Slingsby and others started to go north to explore these parts of Norway, where there were many unclimbed steep walls and mountains. To these areas he also directed the Norwegians who in 1910 went north for the first time, conquering a series of peaks. Among them was Stetind.

In the historical writings the opening up of the northern regions is described as a preparation for some kind of final battle; here were unconquered

mountains on which to measure strength and ability. How would the Norwegians assert themselves there? "And time was short, should not these mountains be conquered by strangers as well. Above all it was Stetind that the interest evolved around. Through the years it had been tried in vain by outstanding climbers. It became the great goal, it had to be the ultimate trial for Norwegian Mountaineering." (Tønsberg, 1923, 103)

Three Norwegians set out for it, and as Tønsberg, the main chronicler of the club, stated: "they came, they saw, they won" (Tønsberg, 1914, 214) .

This was the turning point in the history of Norwegian mountaineering, the incident that all evolution led up to. The Norwegian mountaineers were extremely proud of this achievement, and took it as a proof of victory over both the mountains and the mountaineers who had failed to climb them. On Stetind the Norwegians won the battle. After this, they stated, all first ascents were done by Norwegians; they have finally taken the lead on their home ground (Tønsberg, 1933, 48).

What kind of competition?

After this short survey of the history writing, we see that they didn´t seem to reject competition as such. To grasp the motivation for representing mountaineering history as a competition against the English, we need to look at the specific Norwegian context.

The country had just become independent from Sweden in 1905, after increasingly striving for its independence since 1814, until when Norway had been a junior partner in union with Denmark some 400 years. The process leading up to the secession and the aftermath of it, contained strong desires for recognition as an authentic nation and to gain the self-confidence that came along with it. Who became heroes and national icons were the polar explorers, men who explored and conquered the unmapped regions of the world: Fridtjof Nansen crossing Greenland in 1888, his attempt on the North Pole in 1893-96, and Roald Amundsen, who in 1912 became the first to reach the South Pole, in what was perceived as a contest with the British empire, represented by Robert F. Scott. Through this narrative the old notion of the great Viking nation was strengthened, as a particularly persistent, strong and daring people when facing nature´s dangers and challenges.

The Norwegian mountaineers understood themselves as part of this narrative. I our understanding, a big part of their motivation was to create an imagery of themselves as heroic figures that performed important deeds on behalf of the nation. The conquest of mountain peaks was no personal matter, rather great achievements in a larger scale, even more so when there were other nationalities that were striving to do the same. In this understanding the English were given the role almost as rivals by coming here and conquering untrodden land. Their dominance had to be fought back.

Here one could remark that history has shown that mountaineering sometimes becomes a field incorporating certain nationalistic attitudes. So it´s maybe important underlining that the Norwegian context has little similarity to what we know from the Alps between the wars, were politics and fascistic nationalism was brought into the race for the great north walls. Since the beginning Norwegian mountaineering has had a strong focus on safety, rejecting ideas of death romanticism and heroism. It was emphasized that climbing mountains wasn´t worth risking of lives.

Meanwhile, regardless of the nationalistic elements, there was a firm focus on first-ascends and new routes. Every year a list of new ascents were published.

But still they maintained that competition should not occur in mountaineering. Reasons for this were several. First was a fear that elements of competition would endanger the safety of mountaineering. A climber should always keep within his own limits and always be prepared to turn around where the risk was taken to be too great. And competition was also believed to threaten the warm friendship that the sport inevitably had to be built upon. Team spirit and cooperation had to be strong, misconstrued self-asserting would endanger the whole group and therefore had no place. (Horn, 1923, 18.) But all this does not exclude the measuring of strength with others outside the rope-party, which has to be regarded as a form of competition. And exactly this form of competition is what many of the Norwegian mountaineers are devoted exponents of. But the opposition against competition was much a result of the need to distinguish oneself from the realm of modern Sport.

Sport was often regarded as a more trivial activity, containing dubious and unhealthy characteristics, such as excessive individualism, self-assertion, spectacle and entertainment, as opposed to the supposed higher morality of mountaineering. Receiving a medal or admitting elements affiliated with Sport would endanger the autonomy and purity of mountaineering.

An understanding still being found today in the discourse of sport and friluftsliv in Norway.

So we return to the question: what did the club decide regarding to the possibility of an Olympic Medal? There was disagreement among the members. Some would undoubtedly welcome a medal, but others were against it. On the general assembly they determined that The Alpine Club - the mother club of montaineering - must be consulted. Strangely enough, the British club claimed it had not received the same inquiry from the Olympic Committee. (Grimeland, 2000, 47) The case was thus closed. To stand as recipients when British climbers weren´t considered, obviously felt wrong.

But we´ll end by saying that all that is written rejecting competition is formulated after this decision was taken. It became constitutive for the mountaineers´ self-understanding. In the clubs posterity the opposition against Sport and its elements of competition was taken to be a natural part of the essence of mountaineering. But if the inquiries from Stockholm hadn´t come at this point in time, a decision wouldn´t have been compelled to be taken, and the mountaineers would maybe have welcomed elements of competition at an earlier stage.

In Norway, it wasn´t until the 1990s that a division of mountaineering was incorporated in the general sport, when Norwegian Climbing Federation (Norsk klatreforbund) was established within the Norwegian Sport Confederation (NIF – Norges idrettsforbund). The point being that if we shall succeed in understanding historical events, we need to study them in their specific context and surroundings, instead of starting with the subsequent development, projecting it backwards.

References

1. Backer Grøndahl, N. (1918). Litt om norsk tindebestignings utvikling.
2. In Den Norske Turistforenings årbok.
3. Horn, H. Fjeldsport. (1923). In Amundsen, K. Vilh. Idrætsboken. Kristiania: Aschehoug & Co.
4. Grimeland, G. (2000). Vor sport: Klatring i Norge 1900-2000. Master thesis, Norwegian Sports University, Oslo.
5. Slingsby, W. C. (1914). The history and development of Norsk Mountaineering. In Tønsberg, H (red.), Norsk fjeldsport 1914. Kristiania: Steenske.
6. Tønsberg, H. (1914). Norsk tindessport – dens utvikling. In Tønsberg, H (red.), Norsk fjeldsport 1914. Kristiania: Steenske.
7. Tønsberg, H. (1923). Norsk fjeldsport. In Amundsen, K. Vilh. Idrætsboken. Kristiania: Aschehoug & Co.
8. Tønsberg, H. (1933). Tindesport – Norsk Tindesport – Norsk Tindeklub. In Tønsberg, H (red.), Norsk fjellsport 1933. Oslo: Grøndahls & søns.

Czech research in outdoor experiential education

J. Neuman[1], I. Turčová[1], A.J. Martin[2]
[1]Faculty of Physical Education and Sport, Charles University, Prague, Czech Republic;
[2]School of Sport & Exercise, Massey University, Palmerston North, New Zealand

Abstract
Over the past decade there has been limited publication in journals in the outdoor experiential education field of non-English-language perspectives (Thomas, Allison, & Potter, 2009), although there has been acknowledgement of non-English-language outdoor terminology (Turčová, Martin, & Neuman, 2005). The indigenous nature of the Czech turistika activities (Martin, Turčová, & Neuman, 2007) and the dramaturgy methods of creative course design have also attracted recent attention (Kudláček, Bocarro, Jirásek & Hanuš, 2009; Martin, Franc & Zouncová, 2004). This paper provides an overview of Czech outdoor research over the past decade. The findings indicated that there is a need for more collaborative cross cultural (language) outdoor research to provide greater understanding of these context specific differences and theoretical perspectives.

Key words
Outdoor education, experiential learning, dramaturgy, turistika activities

Introduction

Recent analysis of journals in the outdoor experiential and adventure education field (Journal of Experiential Education, Australian Journal of Outdoor Education, Journal of Adventure Education and Outdoor Learning) indicated limited publications related to non-English perspectives (Thomas, Allison & Potter, 2009). However, over the past decade there has been increasing recognition of research published in English related to the indigenous nature of Czech turistika activities (Martin, Turčová & Neuman, 2007). The purpose of this paper is to review outdoor research undertaken in the Czech Republic over the past decade.

Methods

Recent Czech outdoor experiential education research sources were analysed primarily from doctoral and master theses (www.theses.cz), particularly from the three biggest universities Charles University Prague, Masaryk University Brno and Palacky University Olomouc, which have specific departments and related programs of turistika, outdoor sports and outdoor education; sport studies; and recreology (leisure studies), respectively. Other sources were from Czech research journals in the field, based at different centres (e.g. Prague, Olomouc, Brno, Č. Budějovice).

Results and discussion

Preliminary findings indicate that outdoor research in the Czech Republic has developed since the foundation of the International Mountain and Outdoor Sport conferences (Charles University, 2004, 2005, 2006, 2008, 2010, 2012). These conferences have provided excellent international networking opportunities and sharing of best practice, particularly with Eastern European colleagues, however, empirical research has been limited (Baláš, Martin, Neuman & Nováková, 2012; Baláš & Nováková, 2011; Baláš, Pohanka & Vomáčko, 2006; Neuman & Turčová, 2004; Turčová & Martin, 2009; Turčová, Bartůněk & Martin, 2007).
The Journal of Outdoor Activities (University J.E. Purkyně Ústí nad Labem, 2008), and the e-journal for theory and research Gymnos Akadémos (Palacky University Olomouc, 2010) have also been developed. Most studies presented are inspired by foreign (English language) theories and methods. The number of studies discussing the influence of zážitková pedagogika has increased, but the difference in understanding of this Czech term makes comparison with foreign terms difficult (Experiential Education, Adventure Education, Experiential Learning, Erlebnispädagogik, Abenteurpädagogik). The findings indicate that although there are many diploma or masters theses connected to some 32 study programs about experiential education at various faculties, there have been limited PhD studies in outdoor education (Bartůněk, 2008; Turčová, 2005); see Figure 1. The following is a summary of recent research publications in English related to Czech outdoor experiential education studies.

University	PhD	Outdoor education	Experiential education	Turistika	Outdoor sports	Quan.	Qual.
UK FTVS Prague	153	2	3	2	13	18	2
MU FSS Brno	75	0	0	1	7	8	0
UP FTK Olomouc	93	0	5	0	3	2	6
Total	321	2	8	3	23	28	8

Turistika activities

Martin, Turčová and Neuman (2007) reviewed the historical development of Czech outdoor experiences in nature in Henderson and Vikender's (2007) text on Outdoor life the Friluftsliv way. The turistika approach of Czech origin has some parallels and connections with Scandinavian Friluftsliv, for example the Norwegian adventurer, Fridtjof Nansen's (1861-1930) influence on the Czech skiing movement (Repp, 1994). These activities link to a specific style of living and ecotourism. In the Czech Republic, their development parallels that of the Sokol (physical education) movement and Turistický organisations from the middle of the 19th century, and then more formal stays in nature and informal tramping and outdoor life. They then trace the 20th century origins of the Junák (Scouting) and Foglar movements, and schools in nature (Jirásek, Martin & Turcová, 2009; Neuman, Turčová & Martin, 2007).
Guth-Jarkovský (1917) originally defined the term turistika, as travelling for fun with the aim of learning about nature with the primary goal being mainly about developing aesthetic and educational experiences. Turistika activities also link to basic sport activities. The original form of turistika was on foot (walking, hiking), but more recent forms use movement for learning about nature, for example predominantly bicycles, canoes, boats and skies. According to Guth-Jarkovský (1917), scouting, focussing on movement and stays in nature connected with camping can also be included as turistika, along with combining activities using different means of transport. Mountaineering and easy forms of climbing are also part of turistika activities (Martin, et al., 2007).

Outdoor terminology

Turčová, Martin and Neuman (2005) reviewed literature related to outdoor terminology as it is used within the languages of British English and Czech, which has adopted and adapted many English language outdoor terms. Based on Turčová's (2005) PhD thesis, where semi structured interviews were conducted with British and Czech academic experts, the research highlights problems associated with defining and explaining outdoor terms and translating the British English terms into Czech and vice versa. The findings suggest that as the outdoor field develops there is a need for more understanding of the cultural, historical, and geographical differences between concepts and terminology used in both English and non-English speaking countries, for example, as highlighted above, the specific indigenous nature of the Czech turistika activities (Turčová, Neuman & Martin, 2003, 2004).
The most commonly used term is výchova v přírodě (outdoor education) followed by zážitková pedagogika, výchova prožitkem (experiential education). However, the translation of výchova v přírodě is not directly 'outdoor education', but education in nature, which links more effectively to turistika approaches (Martin, 2008). Similarly zážitková pedagogika is not expressed as 'experiential education' but a more holistic, experiential or experimental pedagogy, which links to the dramaturgy approach described below.

Dramaturgy methods of course design

Martin's PhD thesis (2001a) evaluated the impact of a Czech outdoor experiential education course (Martin & Leberman, 2004), which was developed using an holistic approach to course design involving dramaturgy methods (Martin, Leberman & Neill, 2002). The international 'Intertouch' courses provided a new dimension for Outward Bound (Martin, 2000), and were trialled in Australia (Martin, 2001b), New Zealand (Leberman & Martin, 2004, 2005), Singapore and Hong Kong (Martin & Abdul, 2007). Dramaturgy wave principles (Martin, 2001c) challenge all the senses and push comfort zones in many different areas (Leberman & Martin, 2002/03). Framing 'games' in fantasy allows the use of 'play' in achieving educational outcomes, and is a distinctive part of Czech outdoor experiential edu-

cation courses (Martin & Jirásek, 2008).
The dramaturgy methods were developed by Vacation School Lipnice (VSL) in the Czech Republic. VSL is a non-profit, non-governmental organization of about 100 active members—volunteers coming from all over the Czech Republic, Slovakia, and other countries. Since 1991 VSL has been a member of Outward Bound International, a global experiential education organization. The aim of the VSL courses is to provide ways for further development of the capacities of body and mind using the 'dramaturgy' approach to creative course design (Martin, & Krouwel, 2006), which brings together the distinct elements of art, music, drama and adventure. Courses consist of body-and-mind challenging activities, creative art workshops, discussions and reflection. Dramaturgy goes beyond traditional interpretations of adventure training, allowing for the integration and balance of physical, social, creative and reflective/emotional 'waves' that can change according to the needs of the group (Martin, 2011). Kudláček, Bocarro, Jirásek and Hanuš (2009) presented the development by VSL instructors of an inclusive outdoor experiential education course using dramaturgy methods by VSL instructors. The article provides specific examples of activities that can help enhance the inclusion of people with disabilities within such environments.

Other Czech research

Bartůněk (2008) conducted a meta-analysis of Czech outdoor research, as part of his PhD thesis. However, although the findings indicated significant increases in effect size for participant's self-concept, and medium effect size for participants' behaviour and locus of control, there were a limited number of studies to be analysed. These results compared favourably with the other outdoor education meta-analyses presented (e.g., Hattie, Marsh, Neill & Richards, 1997), but a mixed method approach that leads to a bigger picture of experiential education linked to turistika activities and the natural environment may be more appropriate to the Czech context (Bartůněk, Neuman & Martin, 2008). Zappe and Okrouhlý (2007) used examples from published studies to focus on problems of quantitative and qualitative approaches. Although there has been some emphasis on developing a theoretical structure (Higgins & Loynes, 1997; Gilbertson, Bates, McLaughlin & Ewert, 2006) and subsequently verifying these theories, Zappe and Okrouhlý (2007) argued that generating theory peculiar to outdoor experiential education in the Czech natural environment may help contribute to the creation of more common international outdoor language.
In the international literature there has recently been some reconceptualising of outdoor adventure education and critiques of experiential learning (Brown, 2009; Fox, 2008; Ord & Leather, 2011). Ord and Leather (2011) argued that the work of John Dewey (1938) was particularly important in developing conceptualisation for outdoor education, where 'doing' is integrally linked to 'meaning' (Dewey, 1938). They indicated that more recent models of experiential learning (Kolb, 1984) are too simplistic. Leberman and Martin's (2004) study suggested an extension and revision to Kolb's 'Experiential Learning Cycle' model in relation to extended time of reflection. Brown (2009) highlights the importance of the situated nature of learning in the outdoors. Further, Wattchow and Brown (2011) advocate outdoor educators developing programmes that are responsive not only to their students' needs but to their community and developing place responsive pedagogy that enhances connections to specific contexts. These suggestions support the use of the creative dramaturgy methods in outdoor experiential education course design (Martin, 2011) and the development of theories and research that are specific to the Czech outdoor context (Zappe & Okrouhlý, 2007).

Conclusions

The field of outdoor experiential education still suffers from cultural (English and non-English) terminology misunderstanding. Research aims often provide no causal relation between activities for teaching and activities for research. There is a need for more collaborative cross cultural (language) research to provide greater understanding of these context specific differences and perspectives. To improve research, teaching and leadership in the outdoor experiental education field there is a need for more, non-English outdoor terminology understanding, collaborative team-focused cross-cultural research and evidence--based research across disciplines and contexts, for example, health (Ewert & Sibthorp, 2009).

References

1. Baláš, J., Martin, A.J., Neuman, J., & Nováková, L. (Eds.) (2012). Proceedings abstracts of the 6th International Mountain and Outdoor Sports Conference 22-25 November. Charles University, Prague, Czech Republic: Faculty of Physical Education & Sport. Journal of Sport Medicine and Physical Fitness, 52, Suppl. 1-6, 1-21.
2. Baláš, J., & Nováková, L. (2011). Outdoor Activities in Educational and Recreational Programmes. Proceedings from the 5th International Mountain and Outdoor Sports Conference , 18th-21st November 2010, Svatý Jan pod Skalou, Czech Republic. Praha: Falešník Ondřej Ing. – FALON.
3. Baláš, J., Pohanka, O., & Vomáčko, S. (2006). Proceedings from the 2nd International Mountain and Outdoor Sports Conference. Praha: IYNF.
4. Bartůněk, D. (2008). Applying meta-analysis to Czech outdoor research. Unpublished doctoral thesis, Charles University, Prague, Czech Republic.
5. Bartůněk, D., Neuman, J., & Martin, A.J. (2008). Applying meta-analysis to Czech outdoor research. Horizons, 43, 29–31.
6. Brown, M. (2009). Reconceptualising outdoor adventure education: Activity in search of an appropriate theory. Australian Journal of Outdoor Education, 13(2), 3-13
7. Dewey, J. (1938). Experience and education. New York: Collier books.
8. Ewert, A., & Sibthorp, J. (2009). Creating outcomes through Experiential Education: The challenge of confounding variables. Journal of Experiential Education, 31(3), 376-389.
9. Fox, K. (2008). Rethinking experience: What do we mean by this word "experience"? Journal of Experiential Education, 31(1), 36-54.
10. Gilbertson, K., Bates, T., McLaughlin, T., & Ewert, A. (2006). Outdoor Education: Methods and strategies. Champaign, IL: Human Kinetics.
11. Guth-Jarkovský, J. (2003). Turistika. Turistický katechismus. Praha: Baset (original work published 1917).
12. Hattie, J., Marsh, H. W., Neill, J. T. & Richards, G. E. (1997). Adventure Education and Outward Bound: Out-of-class experiences that have a lasting effect. Review of Educational Research.
13. Henderson, R., & Vikender, N. (Eds.) (2007). Nature first: Outdoor life the Friluftsliv way. Toronto: Natural Heritage.
14. Higgins, P., & Loynes, C. (1997). Towards consensus on the nature of outdoor education. Journal of. Outdoor Education and Outdoor Leadership, 13(4), 2-3
15. Jirásek, I., Martin, A. J., & Turcová, I. (2009). Games and play: Jaroslav Foglar's influence on Czech education in nature, Horizons, 45, Spring, 28-32
16. Kolb, D.A. (1984). Experiential learning: Experience as the source of learning and development. Englewood Cliffs, N.J.: Prentice Hall.
17. Kudláček, M., Bocarro, J., Jirásek, I., & Hanuš, R. (2009). The Czech way of inclusion through an experiential education framework. Journal of Experiential Education, 32(1), 14–27.
18. Leberman, S.I., & Martin, A.J. (2005). Applying dramaturgy to management course design. Journal of Management Education, 29(2), 319-332.
19. Leberman, S.I., & Martin, A.J. (2004). Enhancing transfer of learning through post-course reflection. Journal of Adventure Education and Outdoor Learning, 4(2), 173-184.
20. Leberman, S.I., & Martin, A.J. (2002/03). Does pushing comfort zones produce peak learning experiences. Australian Journal of Outdoor Education, 7(1), 10-19.
21. Martin, A.J. (2011). The dramaturgy approach to education in nature. Journal of Adventure Education and Outdoor Leadership, 11(1), 67–82.
22. Martin, A. J. (2008). Education in nature: Reflections on the Czech way of outdoor and experiential learning. In S. Galloway (Ed.), Proceedings of the International Outdoor Recreation and Education Conference, 21-24 January, Christchurch, New Zealand [CD-Rom]
23. Martin, A.J. (2001a). Towards the next generation of experiential education programmes: A case study of Outward Bound. Unpublished Doctoral Thesis, Massey University, Palmerston North, New Zealand.
24. Martin, A.J. (2001b). Dramaturgy: An holistic approach to outdoor education. Australian Journal of Outdoor Education, 5(2), 34–41.
25. Martin, A.J. (2001c). The dramaturgy wave. Horizons, formerly the Journal of Adventure Education and Outdoor Leadership, 15, 26-29.
26. Martin, A.J. (2000). Towards a new generation of Outward Bound. Horizons, 10, 29-30.
27. Martin, A.J., & Abdul, S. (2007). Transcending boundaries: An experiential program promoting multicultural partners in harmony. In Proceedings of the 15th World Conference on Cooperative Education,

26-29 June, Singapore [CD-Rom].
28. Martin, A. J., & Jirásek, I. (2008). The Czech way of experiential education: A symbol of games and play. In E. Leigh & K. Collier (Eds.), Proceedings of the 11th International Conference on Experiential Learning, 8-12 December, University of Technology, Sydney, Australia [CD-Rom].
29. Martin, A.J., & Krouwel, W. (2006). Creative course design: Reflection on a workshop for trainers. Horizons 33, 6-9.
30. Martin, A.J., & Leberman, S. I. (2004). Adventure the Czech way. New Zealand Journal of Outdoor Education, 1(3), 65-85.
31. Martin, A. J., Franc, D., & Zounková, D. (2004). Outdoor and experiential learning. Aldershot, UK: Gower.
32. Martin, A.J., Leberman, S.I., & Neill, J.T. (2002). Dramaturgy as a method for experiential program design. Journal of Experiential Education, 25(1), 196–206.
33. Martin, A.J., Turčová, I., & Neuman, J. (2007). The Czech outdoor experience: Turistika and connections to Friluftsliv. In R. Henderson & N. Vikender (Eds.), Nature first: Outdoor life the Friluftsliv way (pp. 197–208). Toronto: Natural Heritage.
34. Neuman, J., & Turčová, I. (Eds.). (2004). Proceedings from the international symposium Outdoor Sports Education, 18-21 November 2004, Hrubá Skála, Czech Republic. Praha: Duha.
35. Neuman, J, Turčová, I, & Martin, A. J. (2007). Being in nature: Summer camp, but not as we know it. Horizons 40, 25-30.
36. Ord, J., & Leather, M. (2011). The substance beneath the labels of experiential learning: The importance of John Dewey for outdoor educators. Australian Journal of Outdoor Education 15(1) 13-23
37. Repp, G. (1994). Norwegian relationships to nature through outdoor life. In J. Neuman, I. Mytting, & J. Brtník (Eds.), Outdoor activities: Proceedings of international seminar Prague '94 Charles University (pp. 32-42). Lüneburg: Verlag Edition Erlebnispädagogik.
38. Thomas, G., Allison, P., & Potter, T. (2009). A tale of three journals: An investigation of the development and futures of AJOE, JAEOL and JEE. Australian Journal of Outdoor Education, 13(1), 16–29.
39. Turcová, I. (2005). Diversity in language: Outdoor terminology in the Czech Republic and the UK, Unpublished doctoral thesis, Charles University, Prague, Czech Republic.
40. Turčová, I., Bartůněk, & Martin, A.J. (Eds.) (2007). Proceedings of the 3rd International Mountain and Outdoor Sports Conference 23-26 November. Hrubá Skála, Czech Republic. Prague: International Young Nature Friends.
41. Turčová, I., & Martin, A.J. (Eds.) (2009). Proceedings of the 4th International Mountain and Outdoor Sports Conference 24-26 November 2008. Hrubá Skála, Czech Republic. Prague: International Young Nature Friends.
42. Turčová, I., Martin, A.J., & Neuman, J. (2005). Diversity in language: Outdoor terminology in the Czech Republic and Britain. Journal of Adventure Education and Outdoor Learning, 5(1), 99–116.
43. Turčová, I., Neuman, J., & Martin, A. J. (2004). Navigating the outdoor education 'terminological jungle': Outdoor education in the Czech Republic. 'Pathways', The Ontario Journal of Outdoor Education, 16(2), 25-27.
44. Turčová, I., Neuman, J., & Martin, A. J. (2003). The outdoors from a Czech perspective. Horizons, 24, 26-29.
45. Wattchow, B., & Brown, M. (2011). A pedagogy of place: Outdoor education for a changing world. Melbourne: Monash University Publishing.
46. Zappe, P., & Okroughly, J. (2007). Chosen problems in experiential education research. Acta Univ. Palacki. Olomouc., Gymn, 37(4), 61 65.

Organization management and the development of a qualification system in the outdoor recreation sector: A case study of Estonia

R.Tuula[1], A.J. Martin[2]
[1]Institute of Health Sciences and Sports, Tallinn University, Tallinn, Estonia
[2]School of Sport & Exercise, Massey University, Palmerston North, New Zealand

Abstract
In the Estonian context, where the outdoor sector (outdoor recreation, outdoor activities, outdoor pursuits, adventure tourism or adventure sports, ecotourism, nature based tourism etc.) is a substantial part of the overall 'Sport & Active Leisure' scene, the need for qualified providers or program managers continues to grow. Emerging issues are a lack of organization structure, clear legislation, risk management, and a satisfactory qualification system. Despite the recent economic recession that adjusted the market in many ways, including active leisure markets, the number of participants in different forms of outdoor activities has been growing remarkably, and the number of providers has not decreased in Estonia. Therefore facilities and conditions provided for recreational use in the outdoors continue to be developed. However, in order to provide balanced development of the sector, there is a need to focus on more aspects than just making the outdoors available for multiple use. Through a review of local literature, this paper discusses the issues Estonia is facing and raises questions about the need for organizational management and the development of a qualification system in the outdoor sector.

Key words
Outdoor recreation, Estonia, organization management, qualifications

Outdoor recreation

Outdoor recreation has shaped human-environment relationships throughout history and is an integral part of many cultures and economies. The popularity of outdoor recreation has grown remarkably, and new forms of activities continue to be developed (Plummer, 2009). Outdoor recreation is an interdisciplinary area of study. In Estonia, there are three main areas that are closely related: sports, active tourism and recreation. All these areas can be compared based on primary dual pairs: location (inside/outside; close to home/outside home area), purpose (process/result oriented), the form of action (cooperative/competitive), rules (formal/non-formal), the form of participation (active participation/passive observation), philosophical principles (hedonistic/lust) (Noormets, 2011). So called 'sporting leisure pursuits' are often rephrased into 'active leisure' (Smulders, 2010) or 'recreation' (Noormets, 2011) where 'fitness' and 'outdoors' are considered to be the most important cornerstones. Figure 1 explains the relationship between different segments related to sport, recreation or active leisure and active tourism (or experiential tourism).

In Europe, outdoor activities have been categorized into subcategories that differ due to safety regulations and expected management competence (knowledge and skills specific to sub-sectors and activities): lakes and sea; snow; earth, stream; air (EQFOA[1]). The safety of consumers is influenced by many factors including the design and manufacture of constructions/facilities and products, and the behaviour of individuals (Sman et al, 2003). The fact that some organizations are issuing or applying voluntary safety guidelines indicates that they recognize their responsibility for safety, however arguably this leads to a lack of consistent systemic approaches. Across all outdoor activities the main purpose is to provide positive opportunities for managed experiences through challenging outdoor activities. Participant should enjoy, learn or develop through the provision of effective services and products that meet and/or exceed individual's expectations and potential (EQFOA, 2008a).

1 'European standards for Outdoor Animators' is the first European Leonardo da Vinci project executed by Skills Active in 2006-2008 to respond to 'outdoor sector' issues. www.eqfoa.eu

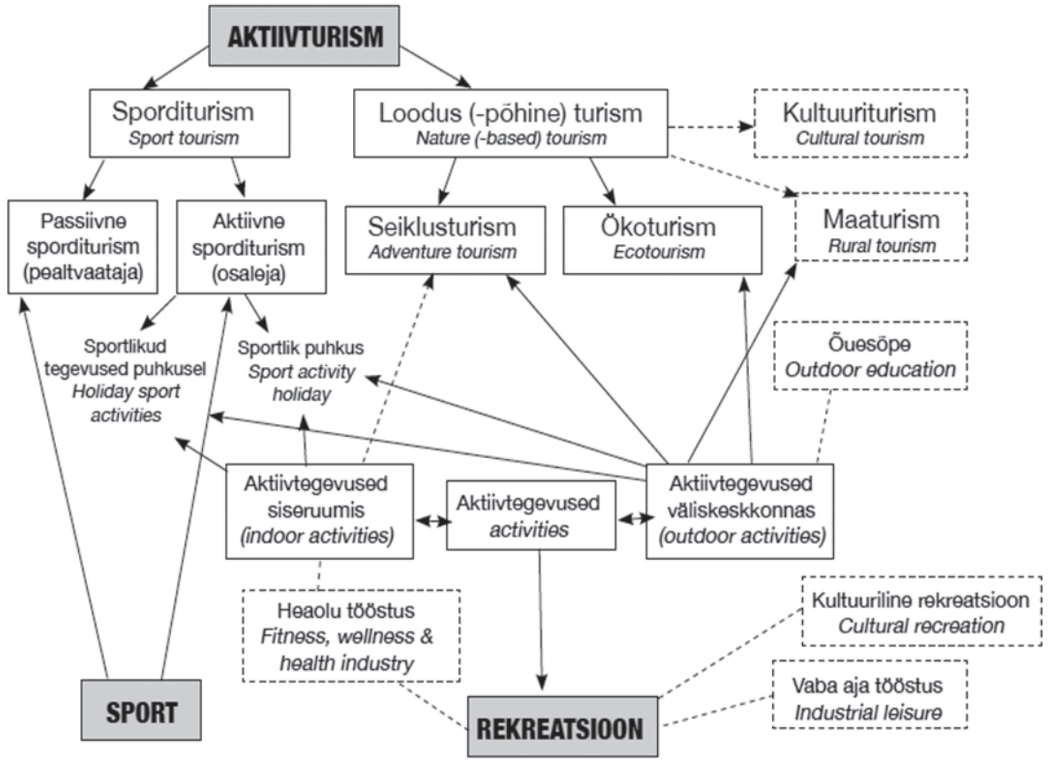


Fig. 1. Sports, Recreation/Active Leisure, Active tourism – related links (Noormets, 2011)

Outdoor recreation organization

Outdoor recreation providers need to guarantee the quality of the product/service and safety for the participant. They also need to analyse the market, potential demand, participation in specific products and services, acceptable costs and prices, and available and accessible resources (natural, human, physical, financial). A national and international framework for the outdoor sector in Europe has been argued within 'sport & active leisure' organizations (Smulders, 2010) (e.g. ENGSO[2], ENSSEE[3], EOSE[4], EASE[5]). In the 1990s there were very few organizations focusing on the outdoor sector, in contrast to the field of fitness (European Health and Fitness Association, est. 2001). More recently, the European Confederation of Outdoor Employers (EC-OE)[6] was founded (2008). A milestone for active leisure in Europe was the extensive study published in 2004 by EOSE called Vocasport[7]. According to Vocasport over 70 000 commercial companies (small and medium-sized) are employing some 300 000 employees to provide recreational leisure activities in the open air in Europe today (for local urban customers, European and global tourists) (Smulders, 2012).

Significant growth has been in the commercial sector, where small and medium-sized providers perform most of the management functions, e.g., marketing, sales, finance, logistics, administrative, executive. Typically products/services in commer-

2 The European non-governmental Sports Organization (1995) www.engso.com
3 The European Network of Sport Science, Education & Employment (1989) www.enssee.eu
4 The European Observatoir of Sports Employment (2002) www.esose.org
5 The European Association for Sports Employers (2003) www.easesport.org
6 The European Confederation of Outdoor Employers (2008) www.ec-oe.eu
7 Vocasport is the name for an extensive study 'Improving employment in the field of sport in Europe through vocational training' by EOSE in 2004

cial outdoor companies are diverse: organizing transport and overnight stays, supplying food, organizing activities and logistics, guiding/educating participants, renting equipment or infrastructure. There is a fundamental issue of professionalizing and up-skilling the sector, especially in key areas of business, organizational and management development, due to the high degree of seasonal fluctuation in the workforce. Whilst paid employment is a key economic feature, and plays an enormous part in the successful delivery of outdoor services, competence and risk management developments are priorities. A competence framework should include all the functions within the outdoors, from management and customer service to technical operations and maintenance (EQFOA, 2008b). The mobility of customers throughout Europe has increased debate about the mobility of staff and of mutual recognition of qualifications (Smulders, 2012). Outdoor recreation is not a limited phenomenon and doesn't exist in a vacuum – it is a profession that also needs proper organization, specific training, and governmental support in development to guarantee qualified delivery.

Method

This case study provides a review of recent Estonian outdoor recreation publications. Research literature and professional sources were analysed primarily from tertiary, not-for-profit, commercial, tourism, public and governmental organisations.

Findings/Discussion

The outdoor sector in Estonia is relatively small economically, but plays a significantly more important and influential role than its economic size would suggest. There are some major interdisciplinary denominators of outdoor recreation management (Smulders, 2010, 2012).

- Economic sector, governance and counterparts (see classification of economic activities, NACE)[8]): governing bodies, ministries (labour, economy, tourism, education), Olympic committee, employee unions, leagues, other federations, and related specific revenue and fiscal aspects (service purchase, taxes, VAT regulations, and accountancy).
- Multifaceted characteristics of the market: outdoor companies are mostly small or medium sized business (self-delivered/organized/guided, sole traders and individual service providers, commercial/public/not-for-profit organizations and clubs, volunteers and charity, specialist organizations or part of large diverse corporations) with focus on service competences, often delivering 'packaged or personalized and multi-activity' products to different types of clients (individuals, families, social-educational-work groups, children-youth-adults etc.
- Technical aspects of outdoor activities (risk management) and quality issues: refers to general job descriptions of outdoor animators (competence framework), qualification systems, insurance and justice principles, and existing non-regulatory measures (co-regulatory or self-regulatory) related to the safety of outdoor leisure activities (codes of conduct, guidelines, best practices, voluntary standards, etc.)

Characteristics of the outdoor market

According to Statistics Estonia[9] (SE), during 2009-2010 one-third of the population participated in sport, i.e. 425 000 of approximately 1.3 million; 41 % of men and 31% of women (Kommel, 2012). Approximately 59% do sports at least once/twice a week, 41% spend time on sports at least three times a week. The majority do not visit any fitness/sport clubs or centres but prefer to enjoy recreational sports in a self-organized way. According to a health tourism (including medical, health care, spa and wellness tourism) survey issued by Estonian Enterprise (EAS) (Tooman, 2012) there are approximately 34 venues offering services related to health promotion. Health clubs and sport centres are also offering coaching in different outdoor activities.

The State Forest Management Centre (RMK) has developed a network of nature trails (over 90) in protected areas (12) and national parks (5) (including 13 recreational areas), nature centres (10), campfire places, and forest huts. Estonia has a remarkably large variety of resources for nature (based) tourism. According to the survey on nature (based) tourism entrepreneurs in 2008 (executed by EAS) and the development plan of Estonian Rural Tourism[10] (Eesti Maaturism, 2004; 2009) approximately 500 organizations (small companies with 2-10 people), self-employed entrepreneurs (FIE), and freelancers were mapped in Estonia engaged in nature (based) tourism. Most providers practice in the outdoors as a secondary job, over 40% are non-profit organizations and freelancers, and approximately 60% use subcontractors to deliver active tourism services. Their main clients are Estonian, with less than 30% being foreign clients. The sector is versatile, seasonal (very weather dependable) and fragmented (lots of self--operation and self-guided activities). Competition is high and one problem is little cooperation between companies. Obstacles in sector development have been argued to be a lack of financial support, competent workforce, and national regulations. Further research in addition to nature (based) survey and rural tourism development plans revealed that the number of entrepreneurs in active tourism is even larger. There is a need for quality systems (standards, levels on services/products, competence), for product/service innovation, for legal support, and for cooperation (national, international). For example there were 45 entrepreneurs detected delivering ropes course related services (adventure park, ropes courses, rappelling, rock climbing) (Koppelmann, 2009); there are 7 adventure parks. There are over 100 service providers related to shooting activities (paintball, archery, hunting, air-soft, practical shooting etc.) (Lill, 2009). Archery and paintball are the most popular including over 50% of providers. In water based activities (canoeing, sea-kayaking, rafting, recreational boats, jet-skis), there are some 75 providers (Hännikäinen, 2010).

Governance support of the outdoor sector through sport & tourism

In Estonia there is lack of common understanding, and it is unclear whether nature (based) tourism (including the outdoor sector/active tourism) is governed by 'tourism' or the 'sports' sector. In addition, recreation, sport and active tourism are closely related to the health sector which should be at least passive partner in the development of the sport and tourism sector. All these mentioned sectors belong to the service sector according to NACE. In Estonia, the field of 'tourism' is managed by The Ministry of Economic Affairs and Communication, under whose governance the Estonian Tourist Board of Enterprise Estonia[11] acts. Departments and activities of The Ministry of the Environment[12] (ME) give regulations for risk management to active tourism providers using the natural environment for recreational purposes. ME also administers the State Forest Management Centre[13] (RMK), the Environmental Board[14] (KA) and the Estonian Maritime Administration[15] (VTA), which are involved in the management of natural resources and the environment. All these national governmental organizations control the outdoor sector with general regulations, guidelines, codes of conduct concerning the outdoors as a place/location for recreation. Several other tourism related organizations are important for promoting active tourism and the outdoor sector: the Estonian Rural Tourism and Estonian Ecotourism Association[16] (ESTECAS). Both organizations are non-governmental and non-profit member organizations that connect individuals, organizations and authorities for ecotourism and rural tourism.

At a state level, the Ministry of Culture, who work in close cooperation with the Ministry of Social Affairs and the Ministry of Education and Research, coordinates sport and recreational sport. Traditionally, the public sector provides the conditions for independent and organized sports activities leaving the day-to-day management to sports organizations and federations. The Estonian Olympic Committee[17] (EOK), sport federations and unions (majority are members of EOK), Sport-For-All (member of EOK) support, develop, promote sport and act upon Fair Play, the Olympic Charter, and the Estonian Sport Charter. A direct link between the sports sector and the outdoor sector on organizational level is the Estonian Ramblers Association (ERA) who is a member of the EOK. However, within this sport focused system, the outdoor sector and active leisure as a recreational outcome is poorly focused.

The conflict between the sport and tourism sector is further explained through aspects of the qualification system. The Estonian Qualification Authority[18] (trademark – Kutsekoda, EQA) facilitates the establishment and development of an integrated and organized professional qualifications system, linking the educational system and the labour market. EQA is directed by the European qualifications system, NACE and ISCO principles. EQA uses the major grouping of 'service professions' to include tourism and travel related occupations currently available in Estonia (tourist guide, rural tourism entrepreneur,

8 NACE code: Statistical classification of economic activities in the European Union, harmonized in 2008 http://ec.europa.eu/competition/mergers/cases/index/nace_all.html

9 Statistics Estonia (SE): http://statistikaamet.wordpress.com/2012/06/28/tervisesporti-teeb-iga-kolmas-inimene/

10 Estonian Rural Tourism (Maaturism) : http://www.maaturism.ee/index.php?id=contact

11 Estonian Enterprise (EAS) http://www.eas.ee/en/for-the-entrepreneur/tourism promotes business and regional development in Estonia. EAS is one of the largest institutions within the national support system for entrepreneurship

12 The Ministry of the Environment: http://www.envir.ee/58737

13 State Forest Management Center: http://www.rmk.ee/organisation/operating-areas

14 Environmental Board: http://www.keskkonnaamet.ee/eng

15 Estonian Maritime Administration (VTA): http://www.vta.ee/atp/?lang=en

16 Estonian Ecotourism Association (ESTECAS): http://www.ecotourism.ee/eng/

17 Estonian Olympic Committee (EOK): http://www.eok.ee/organization

18 The Estonian Qualification Authority (trademark – Kutsekoda;EQA) http://www.kutsekoda.ee/en/kutsekoda

travel consultant, tour operator, tourism manager, wilderness guide). However, occupations in the outdoor sector (instructor, guide, outdoor facilitator, outdoor coach etc.) are divided unclearly in the EQA system. As the only so called formal representative of outdoor employers, the ERA (member of the EOK), issues the only qualifications available (coach in hiking, in mountaineering, in water based hiking, on bicycle) for the outdoor sector today. The qualification system in the outdoor sector is governed by the Estonian Coach's Qualification system (managed by EOC) and evaluated by the Council of Culture (under jurisdiction of Ministry of Culture) in Estonia. The difficulty lies in the fact that according to NACE and ISCO the outdoor sector should be evaluated by the 'service sector' (Council of Service) not by the 'education or culture sector' (Council of Culture).

Quality and safety issues in the outdoor sector

The quality of the services depends on the infrastructure and their attractiveness, the risk management system of the target centres and their activities, and proactive providers (client behaviour and qualifications). Tourism development plans (Eesti Maaturism 2009; MKM, 2013) are focusing on quality system development, sustainability and attraction factors of services/products in all tourism categories (conference, business, culture, sports, food, nature and sea, health and family). In Estonia safety in the outdoor activities (within active leisure and tourism) is managed mostly within companies itself. In 2000 the Law of Tourism was received by Parliament. It does not clearly express understanding of active tourism, as an object/service/product. According to a nature (based) tourism survey (EAS, 2008) the services and products delivered by providers have uneven understanding on tourism products (packages), and it is not defined in any regulations what are the requirements of the complete tourism product or service package. Active tourism entrepreneurs deliver services that have elements of tourism services described in the law: passenger service, accommodation and catering, guide service, also entertainment, transportation rental. Active tourism entrepreneurs have considered The Law of Tourism to be an important legal aspect in their business operations. The conduct and technical aspects of safety of the outdoor service can be controlled through the occupational qualification system, where required sports/activity specific training and developmental programs should deliver competence in specific sports/activity. Considering the political jurisdiction of the qualification system in Estonia for a sports coach that expands for the ERA, the Sports Act as legislation in sports is focused instead on the Law of Tourism. Another difficulty with the qualification certification issued by ERA is the fact that at a national level there is no requirement for the personnel to work in the outdoor sector. Further, providers are not motivated to become qualified according to the coach's system, especially due to its focus on sports. Compared to the approximate number of providers (over 500) there is a remarkably small number of certified 'instructors' in the field (approximately 65). According to the study of outdoor activities by categories of EQFOA (lakes and sea; snow; earth, stream; air) on 'non-regulatory measures related to the safety of outdoor leisure activities in the EU' by ECOE (2012, final report has not been issued yet), the situation in Estonia revealed that there are very few regulations and laws and non-regulatory measures (guidelines, best practices, codes of conduct, voluntary standards) related to safety that are commonly accepted among providers in the outdoor sector. However outdoor instructors/coaches have mentioned other laws and regulations to be followed concerning safety (Siim, 2005;Lobjakas, 2009): Law of Safety of the Product and Service, Rights for Passage (not formal legislation), Law of Obligations, Consumer Protection Act, Profession's Act, Conservation Act, Rights of Passage. All national governmental organizations control the outdoor sector with general regulations, guidelines, codes of conduct concerning the outdoors as a place/location for recreation with focus on risk management (departments of ME, RMK, KA and VTA), which are mostly being considered in the delivery of service by providers. For example, most local regulations for using lakeside, riverside, seaside areas are set by local operators (park service, RMK etc), and traffic on the sea is regulated by the Estonian Maritime Administration[19] within the Maritime Safety Act and Traffic Act. The rules and regulations of the Estonian Rescue Board[20] are also being followed by most outdoor providers, especially ones involved in water based active leisure. Regulatory measures, such as the Nature Conservancy Act and Traffic Law are specifically followed and controlled as safety measures for small motor vehicles (4x4 drivers, quads, snowmobiles). The regulations and non-regulatory measures (in addition to the main ones mentioned above) to be followed in shooting activities are more clear than in any other activity (due to the risk level of the equipment use): Arms Act, Safety Regulations for shooting range and area and competitions/trainings, Hunting Act and Regulations, Forest Act (using parts of the forest).

Some providers have cooperation with sports federations/association that issue the sports coach qualification and have issued risk management guidelines to be acknowledged and followed (snowboarding, downhill skiing, sea-kayaking, hiking). But in the sports-focused system, recreational aspects often suffer from a lack of attention (horseback riding, shooting activities). Many providers, community based associations and clubs develop the market through their international instructors training system but at a national level there are no requirements or supervision on service delivery and safety management (kite-surfing, windsurfing, diving, sea-kayaking).

There are international EU regulations also for constructions and facilities prepared for recreational use, which have no surveillance at a national level (ski lifts, water-skiing/wakeboarding cables, high ropes courses/adventure parks, sky diving). In many cases suggested non-regulatory measures are presented in the association's, providers', entrepreneurs' websites (water based activity providers, small motor vehicle operators, rope climbing, sky diving). Often most of the communication is shared within the community in forum based websites and have a strong community based initiations (sea-kayaking, rope climbing, ropes courses/adventure parks). However, within specific activities the safety regulations and qualification requirements are unclear, not unified or commonly accepted, with no surveillance of the market. International membership in specific organizations and acceptance of international qualification and safety regulations and measures within communities is encouraging to claim about the quality of the services. But in general, anyone could currently provide services in the outdoor sector.

Conclusions

The development of the outdoor sector is not structured, lacks consistency and clear support at a governmental level. The outdoor sector needs clear management and organizational structure but first common understanding of the definition of the sector needs to be reached. In addition a clear position on NACE and ISCO should be stated to endorse common understanding of the sector and governmental support. Safety regulations and occupational qualifications necessary for the outdoor sector require the jurisdiction of a governmental body (e.g., the Ministry of Economic Affairs and Communication). National authorities should improve their surveillance systems in view of providing better information on active leisure related services. Tourism laws should be revised and articles on active leisure/tourism should be added. An occupational system needs to be specified or created for the active leisure/tourism sector similar to the qualification system of 'sports coach', which is accepted, functioning and justified in the sports sector. Further study on job analyses needs to be done to show the differences at an occupational qualification level between the sports and tourism sector. It is also advised to encourage national organizations in sports and leisure businesses (profit as well as non-profit) to further develop the effectiveness of their quality and safety promotion programs, in order to ensure reduction in injury risks and higher safety levels for consumers.

19 Estonian Maritime Administration (MA) a governmental agency that operates within the area of government of the Ministry of Economic Affairs and Communications. http://www.vta.ee/atp/index.php?id=2098

20 The Estonian Rescue Board (ERB) is part of the Ministry of the Interior, http://www.rescue.ee/index.aw/set_lang_id=2

References

1. Eesti Maaturism MTÜ, Turismimaailm OÜ (2003) Eesti Maaturismi arengukava 2004-2007 Retrieved January 8, 2013 from http://www.maaturism.ee/index.php?id=projekti-kaigus-valminud-dokumendid
2. Eesti Maaturism MTÜ (2009) Eesti Maaturismi Arengukava 2010-2014 Retrieved January 8, 2013 from http://www.maaturism.ee/index.php?id=projekti-kaigus-valminud-dokumendid
3. Ettevõtluse Arendamise Sihtasutus (EAS). (2008). Eesti loodusturismi pakkumise.uuring Teostaja: Consumetric. Retrieved November 1, 2012 from http://www.puhkaeestis.ee/et/eesti- cturismiarenduskeskus/spetsialistile/turismistatistika
4. EQFOA (2008a). Industry functional map for the outdoor sector. European Commission, Leonardo da Vinci programme: UK/06/B/F/PP-162_622. Retrieved November 1, 2012 from http://www.ec-oe.eu/fileadmin/Projekte/EQFOA/EQFOA_C_Functional_Map_Outdoor_Sector__en_.pdf
5. EQFOA (2008b). Industry occupational description for the outdoor sector. European Commission, Leonardo da Vinci Programme: UK/06/B/F/PP-162_622 Retrieved November 1, 2012 from http://www.

ec-oe.eu/fileadmin/Projekte/EQFOA/EQFOA_B_Industry_Occupational_Description_for_the_Outdoor_Sector__en_.pdf
6. Hännikäinen, T. (2011). Veematkade õnnetuste põhjused Eestis : bakalaureusetöö / Tallinna Ülikool, Terviseteaduste ja Spordi Instituut
7. Kommel, K. (2012). Tervisesporti teeb iga kolmas inimene. Eesti Statistika Amet Retrieved November 1, 2012 from http://statistikaamet.wordpress.com/2012/06/28/tervisesporti-teeb-iga-kolmas-inimene/
8. Koppelmann, H. (2009). Köietegevuste pakkumine Eestis : bakalaureusetöö. Tallinna Ülikool, Terviseteaduste ja Spordi Instituut.
9. Lill, J. (2009). Laskimistegevuste pakkujate kaardistamine ja pädevus Eestis : bakalaureusetöö. Tallinna Ülikool, Terviseteaduste ja Spordi Instituut
10. Lobjakas, H. (2009). Aktiivtegevuste teenuste pakkujate kutsekvalifikatsioon ja teadlikkus seadusandlusest : bakalaureusetöö. Tallinna Ülikool, Terviseteaduste ja Spordi Instituut
11. Majandus ja Kommunikatsiooniministeerium (MKM) (2013) Eesti riikliku turismiarengukava 2014-2020 eelnõu avalik konsulteerimine. Retrieved January 8, 2013 from https://www.osale.ee/konsultatsioonid/index.php?page=consults&id=228
12. Noormets, J. (2010). Sport, rekreatasioon ja aktiivturism – mõisted ja Seoste Väli. Liikumine ja Sport IV. Retrieved November 1, 2012 from http://www.sportkoigile.ee/images/stories/ajakiriliikuminejasport/liikumine%20ja%20sport_lplik.pdf
13. Plummer, R. (2009). Outdoor recreation: An introduction. NY, London: Routledge
14. Siim, K. (2005) Juriidilised nõuded aktiivse turismi teenuste pakkujatele: bakalaureusetöö. Tallinna Ülikool, Kehakultuuriteaduskond
15. Sman, C.; Marle, A.; Eckhardt, J., & Aken, D. (2003). Risks of certain sports and recreational activities in the EU: The Role of services. European Commission Directorate-General Health and Consumers/Consumer Safety Institute. Retrieved November 1, 2012 from http://ec.europa.eu/consumers/cons_safe/news/rep_risk_sport_en.pdf
16. Smulders, H. (2010). Defining the "outdoors". ECOE. Retrieved November 1, 2012 from http://www.ec-oe.eu/fileadmin/Defining_the_Outdoors/Defining_the_Outdoors_en.pdf
17. Smulders, H. (2010). EC-OE and (consumer) safety. ECOE. Retrieved November 1, 2012 from http://www.ec-oe.eu/fileadmin/user_upload/Publications/EC-OE_Presentations/EC_OE_and_consumer_Safety.pdf)
18. Smulders, H., Lapeyrere, J., Deruytter, D. (2012) European learning syllabus for outdoor animators ELESA. Retrieved November 1, 2012 from http://www.ec-oe.eu/fileadmin/Projekte/ELESA/1_ELESA_Description_of_project_2.pdf
19. Tooman, H. (2012). EAS Turismiarenduskeskuse ja MTÜ Eesti Terviseturismi Ühenduse lähteülesande täitmisest terviseturismi valdkonnas. EAS/ Tartu Ülikooli Pärnu Kolledz

Difficulty rating in mountain biking

S. Siebert, M. Kolleck
German Sport University Cologne, Institute of Outdoor Sports and Environmental Science

Abstract
The aim of this study was to investigate the gaze behavior of mountain bike riders while analyzing and rating the technical difficulty of mountain bike trails. Differences in the visual attention to the trail itself and its surrounding risk parameters were expected between skilled mountain bike riders and beginners. Gaze behavior of 12 beginners and 17 experts was measured using a portable eye-tracking system. As predicted, visual attention to certain areas of interest differed in many cases. While experts predominantly focus the trail itself to analyze its grade of difficulty, beginners give significantly more attention to the surrounding risk parameters. In some cases the beginners gaze these risk parameters more intensively than the trail. Furthermore, experts observe single key sections on the trail while beginners just get an overview of the trail. The findings suggest that difficulty rating systems in mountain biking should provide both, information on the technichal challenge of the trail and also information on its potential risk parameters.

Key words
eye-tracking, gaze behavior, visual attention, mountain biking, risk, difficulty rating, sports

Introduction

In many outdoor sports, like kayaking or rock climbing, difficulty rating systems are obligatory by now. These difficulty rating systems allow athletes to match their own skill level to the challange of a river or a climb. In kayaking for example, the international scale of river difficulty is a worldwide spread and generally accepted tool to describe the difficulty of rivers in six grades (Nies et al. 2005, DKV, 2012). It merges the technical challenge of a section and its potential risk in a single number. In climbing there are some different difficulty rating systems, but they are all composed in the Table of Difficulties of the International Mountaineering and Climbing Federation (Union International des Associations d'Alpinisme - UIAA, 2012), what makes each rating system comparable to another.

In mountain biking numerous types of different scales have spread locally. Most of these scales in mountain bike destinations or bikeparks just reflect the technical difficulty of the trail itself, but give no information about risk parameters like exposure or obstacles surrounding the trail that could hurt the rider in case of an accident. The Trail rating Guidelines published by the International Mountain Bicycling Association for example (IMBA) give the advice to rate the technical challange of a trail only (IMBA, 2012). However, these guidelines admitt in point six that a wide variety of additional features could contribute to the difficulty of a trail. They mention exposure as an example that could provide an added psychological challenge beyond the technical challenge of the trail. But there is no further information how to handle with these additional features when rating a trail.

In german speaking mountain bike communities another rating system called singletrail-skala (STS, Schymik et al. 2008) is spreading since the last years. It describes the trail difficulty in six grades from S0 (easy) to S5 (severe). Allthough there is known no tourist destination that uses this rating system, the mountain bike guide education curricula of the German and the Austrian Alpine Clubs (www.alpenverein.de, www.alpenverein.com) support this difficulty rating system. It exclusivly describes the technical challenge of a trail and excludes strictly the use of other criteria like exposure or obstacles surrounding the trail (Schymik et al., 2008).

Both examples show that there seems to be lack of knowledge about how much mountain bike riders are influenced by these risk parameters when rating a trail. Apart from that, there is no evidence whether riders of different skill levels are affected differently. The aim of this study was to quantify the visual attention towards these surrounding risk parameters when mountain bike riders of different skill levels are rating the difficulty of a mountain bike trail.

Methods

Participants, task and procedure

29 Subjects (12 mountain bike beginners, mean age 31 ± 9 years; 17 Experts, 34 ± 9 years) volunteered to participate in this study. The participants' task was to analyze and rate 18 trail situations of different difficulty levels. Three situations of each grade according to STS were chosen. These were shown as pictures by a data projector on a projection screen and randomly presented to each subject separately. The participants were allowed to analyse the pictures for 15 seconds. Afterwards the rating sheet appeared automatically on the projection screen with following question: "How would you rate the technical difficulty of this mountain bike trail section?". Subjects were able to click their vote on a six-point bi-polar Likert scale below the question. Time for rating was also limited to 15 seconds while the last three seconds were visualized by a countdown to get sure that the voting was finished before the next trail situation appeared. As the rating of the difficulty of different trail situations was the purpose of a previus study, the main focus in this study was on analysing the subjects' gaze behavior while watching the pictures of the trails.

Apparatus and data analysis

While analyzing the pictures gaze behavior of the subjects was recorded by a Tobii Eyetracking System (Tobii Glasses, www.tobii.com). Eye gaze has been used as a proxy for visual attention in many investigations in sports (for a review, see Williams et al., 2004). The system used in this study works with a sampling rate of 30 Hz. The eye-tracking system allows analyzing the participants view on different areas of interest (AOIs).

Fig. 1: example of a trail situation (left) and its AOIs (right).

Figure 1 shows an example of one riding situation and its AOIs. Similar to this example following AOIs were defined for all the pictures in case they appeared:

Trail: as the subjects' task was, to rate the technical challenge of the trail section, this is the area which gives the main information on this topic.

Risk of Obstacles (RO): this area was defined as the corridor in the direct surrounding of the trail which contains obstacles that could hurt the rider in case of an accident (e.g. rocks, trees, rough surface, etc.).

Risk of Exposure (RE): this area gives the observer visual information on the height and steepness of the abyss next to the trail tread. In some of the chosen pictures a fall would be certainly fatal.

Key Sections (KS): some trails featured additional challenges on the trail that impede travelling (e.g. roots, rocks, ledges, etc.), those were defined as an extra AOI.

R*ider:* All pictures used in this study showed a mountain bike rider. The rider gives the observer realistic information on the proportions of the trail (width, length, etc.).

Danger Area (DA): both risk parameters (RO and RE) were added and defined as the Danger Area. Consider that not all pictures show all of these AOIs. For example some of the riding situations featured no KS while others have no DA because of inexistent exposure or obstacles in the surrounding of the trail. This mixture was selected to get information on how the different AOIs influence the subjects gaze behavior.

Data was analyzed by using the Tobii Studio Eye Tracking Software Version 3.1 (Tobii Glasses, www.tobii.com). The total fixation duration on each AOI was calculated for each subject and laterly summed for both groups, the beginners and expert group. As in other studies (Heinen, 2011), fixations were defined as a gaze of at least 100ms duration to the same position. Gazes shorter than 100ms were filtered out.

Dependent variables were compared using an independent samples t-test. Significance criterion was defined as α=5%.

Results

Mean values of all trail situations

Figure 2 and Table 1 present an overview of fixation durations of experts and beginners towards the definded AIOs (Rider, DA, KS, Trail) as mean values of

all trail situations. As can be seen, beginners gaze significantly longer towards DA (p<0.001) while experts gaze significantly longer towards the trail (p<0.001). Furthermore, experts give significantly more visual attention to KS (p=0.044). There is no difference in gazing the rider (as this was not expected).

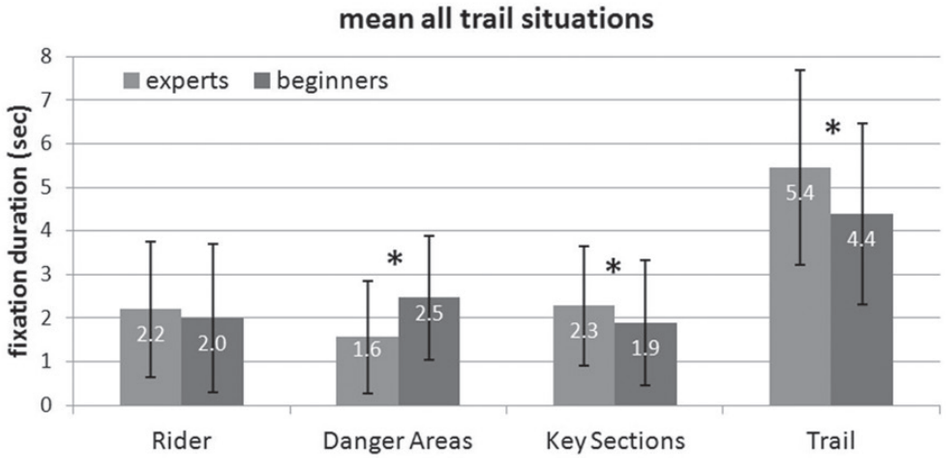


Fig. 2: differences in fixation durations between experts (light grey) and beginners (dark grey). Mean values of all analysed trail situations. (* p<0.05)

Tab. 1: Mean values (M) and standard deviations (SD) of fixation durations (sec) of experts and beginners on different AOIs. Mean of all trail situations.

	Rider		Danger Areas (DA)		Key Sections (KS)		Trail	
	experts	beginners	experts	beginners	experts	beginners	experts	beginners
M	2.2	2.0	1.6	2.5	2.3	1.9	5.5	4.4
SD	(±1.6)	(±1.7)	(±1.3)	(±1.4)	(±1.4)	(±1.4)	(±2.2)	(±2.1)
	p=0.216		p<0.001*		p=0.044*		p<0.001*	

Selected case studies of trail situations

Figure 3 shows an S1 graded trail according to STS. While there is no difference between experts and beginners concerning gazing the trail, beginners gaze significantly longer to DA (p=0.007).

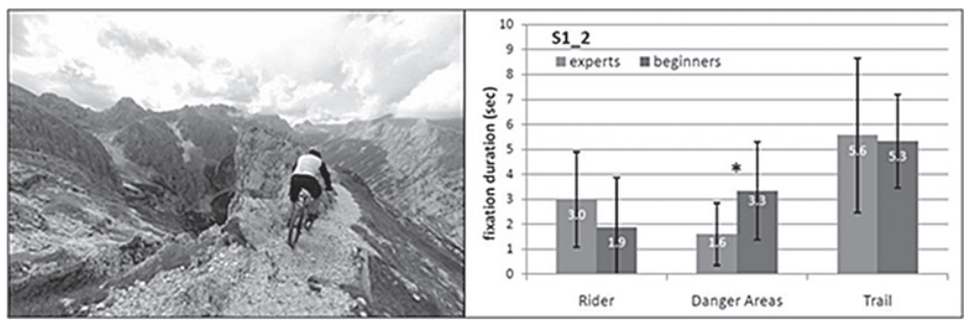


Fig. 3: S1 graded trail (left) and differences in fixation durations (right) between experts (light grey) and beginners (dark grey). (* p<0.05)

Figure 4 shows an S2 graded trail according to STS. Statistical analasys reveals significant differences in gazing DA (p=0.030) and KS (p=0.047). Again, beginners are gazing longer towards DA, while experts' visual attention towards KS is higher.
Describtiv analysis of this trail situation shows, that beginners even gaze longer towards DA (4.6 sec ± 2.3 sec) than to the trail (4.1 sec ± 2.6 sec). In contrast, experts are gazing more than twice as long towards the trail (5.9 sec ± 2.2) than to DA (2.8 sec ± 1.8 sec).

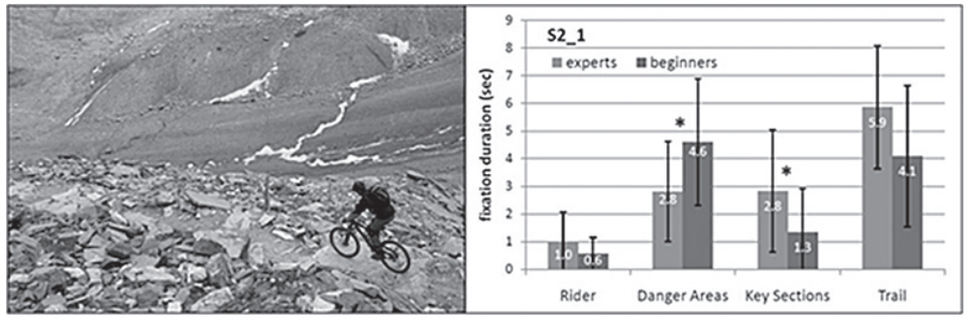


Fig. 4: S2 graded trail (left) and differences in fixation durations (right) between experts (light grey) and beginners (dark grey). (* p<0.05)

Figure 5 shows an S3 graded trail according to STS. In this case, the beginners gaze significantly less towards the trail than the experts (p=0.018). Instead, beginners pay more visual attention towards DA compared to the experts (p<0.001).

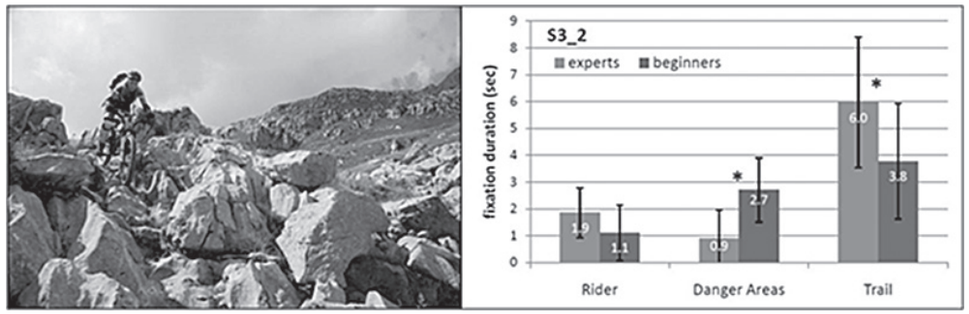


Fig. 5: S3 graded trail (left) and differences in fixation durations (right) between experts (light grey) and beginners (dark grey). (* p<0.05)

Figure 6 shows an S3 graded trail according to STS. Although we defined a KS in this trail situation (the ledge beyond the front wheel of the rider), significant differences were just figured out in gazing DA (p=0.009) with longer fixation durations of the beginners. Again, describtiv analysis of this trail situation shows, that beginners gaze longer towards DA (4.0 sec ± 1.7 sec) than to the trail (3,7 sec ± 2.4 sec) while experts are gazing predominantly the trail (4.7 sec ± 2.4 vs. DA=2.2 sec ± 1.8 sec).

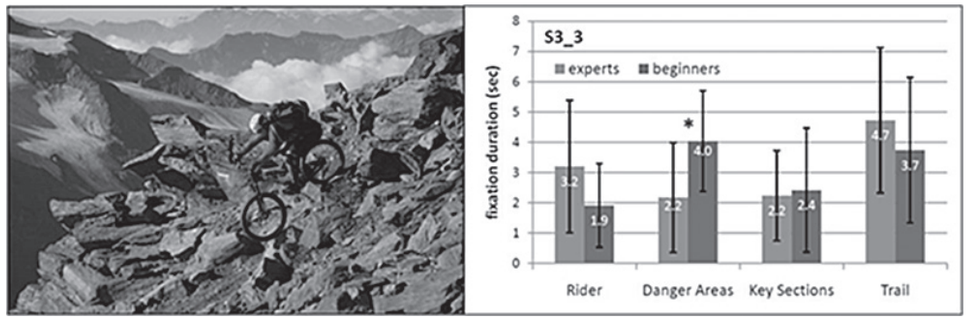


Fig. 6: S3 graded trail (left) and differences in fixation durations (right) between experts (light grey) and beginners (dark grey). (* p<0.05)

Figure 7 shows an S3 graded trail according to STS. This trail situation features no DA. As a result, statistical analasys identified no differences in visual attention between experts and beginners.

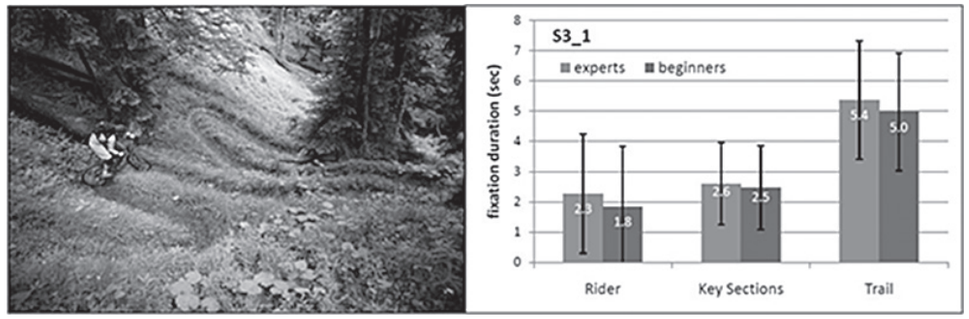


Fig. 7: S3 graded trail (left) and differences in fixation durations (right) between experts (light grey) and beginners (dark grey). (* $p<0.05$)

Discussion

Visual attention can provide important insights to the information used in desicion situations (Raab, Johnson, 2007). The main aim of this study was to quantify the visual attention towards different areas of interest while analyzing the technical challange of a mountain bike trail. The technical challange is commonly described by objective criteria such as trail width, tread surface (e.g. hardened or loose), steepness, turn radius or obstacles that impede riding (e.g. roots, rocks, ledges, etc.) (Schymik et al., 2008, IMBA, 2012). So as the participants task in this study was to rate the technical challange of a mountain bike trail, their visual attention should be expected exclusively on these criteria. Against this assumption, we predicted that mountain bike riders do not solely focus on that objectiv trail creteria but also attend to risk parameters that surround the trail. Furthermore, differences in the visual attention towards these AOIs were expected between skilled mountain bike riders and beginners.

Analyzing the visual attention of athletes of different skill levels has been purpose of many research projects in sport (for a review, see Williams et al. 2004). A common finding is that highly skilled athletes show longer fixation durations to more important areas, compared to less skilled athletes (Raab, Johnson, 2007). These findings are consistant with those in our study as the skilled mountain bike riders gaze the trail in all situations longer than the surrounding danger areas. In contrast, the beginners in some cases even focus the danger areas longer than the trail. Furthermore, in most cases the skilled riders visual attention is focused significantly longer to the key sections as these are an important predictor of the technical challange of the trail. The explanation for this phenomenon is that expert athletes use their rich knowledge base to pick out the most important aspects of the displayed scene (Moran et al. 2002).

Another finding of this study is that if the trail is not surrounded by danger areas, there are no differences in visual attention between both experimental groups. This leeds to the conclusion that (in case of the beginners) risk parameters are responsible for the deflection from the main task, analysing the objectiv trail criteria. Maybe the presence of risk parameters leads to a kind of arousal or even to a state of anxiety even though participants are just analysing pictures and are not in a realistic setting. This assumption is supported by the results of Moran et al. (2002). They investigated the influence of risk parameters on anxiety and visual attention in gymnastics (back flip on a beam) in a similar experimental setup than in our study. Moran et al. report that an increase of risk parameters (low beam with safety mats, low beam without safety mats, high beam without safety mats) involves an increase of anxiety level. Furthermore, this increase of anxiety level evoked more and longer gaze fixations on unimportant peripheral areas than on central locations.

Due to the fact that the study of Moran et al. (2002) as well as ours is based on an laboratory experimental setup using picture slide shows, the transfer to realistic situations seems to be limited at first glance. In both cases a realistic setup certainly would not withstand the ethical review committees scrutiny. Nevertheless there is some research correlating visual attention with anxiety or arousal in realistic setups. Causer et al. (2011) examined visual attention of elite shotgun shooters under low (practice) and high (competition) anxiety conditions with the result of reduced duration towards the center of target in high anxiety conditions. In a more comparable action to mountain biking Janelle et. al (1999) investigated the influence of anxiety on visual attention in simulated auto racing. The results indicate that as anxiety increased, drivers increasingly fixated peripheral areas of the display with a corresponding decrease in visual attention towards the racetrack. Wilson et al. (2006) report similar findings in a similar experimental setup with an additional decrease of driving performance (driving time) and driving control (variability of wheel and accelerator pedal). These findings confirm attentional control theory (ACT, Eysenck et al. 2007). ACT maintains that an increase of anxiety reduces attentional control at the cost of goal directed control. Reduction of attentional control is discribed as a distraction from task-relevant stimuli to task irrelevant ones (see also Wilson, 2008). Allthough we did not meassure anxiety levels of participants when analysing the trail situations in our study, evidence is made that mountain bike beginners are diverted from objective trail criteria (task-relevant stimuli) to danger areas (task--irrelevant stimuli) more than experts. In consideration of ACT, this could lead to reduced performance and riding control and in consequence to accidents especially if mountain bike beginners ride trails in deceiving awareness of there are no risky danger areas surrounding the trail. That leads to the conclusion that describing the difficulty of mountain bike trails requires both, information on the technical challenge of a trail and its potential risk parameters. And furthermore - due to the fact that skilled riders and beginners are affected differently by risk parameters - the technical challenge and the risk parameters should be described separately in a difficulty rating system for mountain bikers.

References

1. Causer, J., Holmes, P. S., Smith, N. C., Williams, A. M. (2011). Anxiety, movement kinematics, and visual attention in elite-level performers. Emotion, 11(3), 595-602.
2. Deutscher Kanu-Verband e.V. (DKV, 2012). Wildwasser-Schwierigkeitstabelle. Retrieved from http://www.kanu.de/nuke/downloads/Schwieriegkeitsgrade.pdf
3. Eysenck, M.W., Derakshan, N., Santos, R., Calvo, M.G. (2007). Anxiety and cognitive performance: Attentional control theory. Emotion, 7 (2), 336-353.
4. IMBA (2012). Trail Difficulty Ratings and Signs. Retrieved from http://www.imba.com/resources/maps/trail-difficulty-ratings
5. Janelle, Ch.M. (2002). Anxiety, arousal and visual attention: a mechanistic account of performance variability. Journal of Sports Sciences, 20, 237–251.
6. Janelle, Ch. M., Singer, R. N., Williams, A.M. (1999). External distraction and attentional narrowing: Visual search evidence. Journal of Sport & Exercise Psychology, 21 (1), 70-91.
7. Moran, A., Byrne, A., & McGlade, N. (2002). The effects of anxiety and strategic planning
8. on visual search behavior. Journal of Sports Sciences, 20, 225–236.
9. Nies, E., Walbridge, C., Singleton, M. (2005). International Scale of River Difficulty. Safety Code of American Whitewater. Retrieved from http://www.americanwhitewater.org/content/Wiki/safety:start
10. Raab, M., Johnson, J.G. (2007). Expertise-based differences in search and option-generation strategies. Journal of Experimental Psychology, 13 (3), 158-170.
11. Schymik, C., Philip, C., Werner, D. (2008). Singletrail-Skala (STS), Version 1.4. Retrieved from http://www.singletrail-skala.de/downloads.
12. UIAA (2012). Comparison between UIAA grades and other grading systems. Retrieved from http://www.theuiaa.org/upload_area/files/1/Comparison_between_UIAA_grades_and_other_grading_systems.pdf
13. Williams, A.M., Janelle, C.M., Davids, Keith (2004). Constraints on the search for visual information in sport. International Journal of Sport and Exercise Psychology, 2, 301-318.
14. Wilson, M. (2008). From processing efficiency to attentional control: a mechanistic account of the anxiety-performance relationship. International review of Sport and Exercise Psychology, 1 (2), 184-201.
15. Wilson, M., Smith, N.C., Chattington, M., Ford, M., Marple-Horvat, D.E. (2006). The role of effort in moderating the anxiety – performance relationship: Testing the prediction of processing efficiency theory in simulated rally driving. Journal of Sports Sciences, 24 (11), 1223-1233.

JOURNAL of outdoor activities

Volume 7 No. 1/2013

Journal of Outdoor Activities is a scientific magazine concerning with problems of all fields of outdoor activities, not only from the point of view of kinanthropology but also from the point of view of related fields. The magazine is published in the English language. The abstracts of individual contributions are published also in the Czech language. The magazine is included in the EBSCO database.

FIELDS THAT THIS PERIODICAL WILL DEAL WITH AND RESEARCH:

Historical reflection of outdoor activities
Philosophical reflection of outdoor activities
Psychological reflection of outdoor activities
Physiological aspect of outdoor activities
Outdoor Activities and Health
Environmental Aspects of Outdoor Activities
Management of Outdoor Activities

JOURNAL HEADINGS:

Teoretical studies - original scientific papers concerning new findings and observations, eventualy review papers surveyining particular scientific problematice written in accurate and factual style
Scientific nad research studies - original scientific studies reporting on a concrete research and its outcumes written in accurate and factual style
The magazine has been published since 2007, twice a year. Deadline for the articles is always on 1st April or 1st October.

SEND THE CONTRIBUTIONS FOR THE NEXT ISSUE BY 1st October 2013

www.pf.ujep.cz/joa

ISSN 1802-3908