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[Symposium: Biomechanics]

Optimal Use of Muscles in Sports

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Introduction

Skeletal muscles have three distinct properties that affect instantaneous force: the force-length relationship, the force-velocity relationship, and the force-history relationship. The force-length relationship describes the effect of muscle (sarcomere) length on the maximal isometric force, and is directly related to the amount of actin-myosin filament overlap. The force-velocity relationship shows the association between the speed of muscle shortening and the maximal, steady-state force for that shortening speed. Finally, the force-history relationship describes the dependence of force on the muscles contractile history. These basic properties of muscle are relevant in sport performance optimization because they can be changed by chronic training, and they can be optimized in sports performed with a piece of equipment, such as a bicycle, a rowing shell or the poles in cross-country skiing.

Applications in Sport

Sprint Cycling: In sprint cycling, the qualification event is a 200m time trial with a flying start. The cyclist has a fixed gear, thus each pedal revolution corresponds to a precise distance travelled, and the

speed, and thus the time for the 200m time trial, is exclusively determined by the pedaling frequency. Optimal position of the rider on the bike, proper gear choice and crank length are of utmost importance and they determine directly the excursion of the propulsive muscles and their speed of shortening, and thus the maximal power output. We found that cyclists' muscles adapt to the chronic training and that the primary propulsive muscles work at optimal length in properly adjusted cycling positions independent of the effort produced. Interestingly, the predicted pedaling frequency for maximal power output is approximately 150 revolutions per minute, which coincides with what athletes actually do, but is in stark contrast to laboratory tests which predict maximal power output at pedaling frequencies of about 100-120 revolutions per minute.

Cross-Country Skiing: Gait transitions in cross-country skiing go from the so-called 2-skate technique at slow speeds, to the 1-skate technique at intermediate speeds, and back to the 2-skate technique for fast speeds in skate skiing. This gait transition from the intermediate to the high speed of skiing, where a gait pattern that is rejected at a slow speed is taken up at a fast speed, is unique in the

four-legged animal world, and can be explained with the power output of skis and poles and associated muscle function. Specifically, the poling action, which is very effective at slow and intermediate speeds, becomes mechanically inefficient at high speeds, which explains the surprising gait transitions in skate skiing. Other aspects of cross-country skiing, such as the coordinated breathing patterns with the poling

action of the arms is reminiscent of breathing coordination observed in horses and dogs and can be explained with the natural expansion and collapse of the chest with the poling action.

These examples in track cycling and cross-country skiing will serve as examples to explain optimal use of skeletal muscles in sport performance optimization.

Common Features of Shoulder Joint Movements in Various Sports Techniques

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Introduction

The shoulder, consisting of three true articulations and a functional joint, links the upper arm to the trunk of the body. Limited bony constraints allow a large range of motion at the expense of stability. In many sports, performers make the best use of this dynamic and mobile joint for maximizing the performance outcome. In some overhead activities, however, the arms apparently move beyond the normal range to damage the joint. One example is seen in the whip-like motion of throwing arm; the arm is "lagged behind" severely at the end of the arm cocking. Due to the apparent excessiveness, such movements are often claimed to be a risk factor of developing shoulder injuries. A question arises: Are these movements really excessive and result in shoulder injuries?

Analysis of glenohumeral joint motion in sports

Baseball pitching: The baseball pitching uses rapid arm movements to generate high ball speed. Vigorous shoulder internal rotation, which comes immediately after a countermovement of the shoulder complex, contributes greatly to accelerate the arm. The shoulder configuration at the end of the countermovement appears to exceed severely the normal range of shoulder external rotation. We found, however, that the glenohumeral joint was not excessive in abduction ($83\pm 11^\circ$) or horizontal abduction ($7\pm 8^\circ$), and the maximum external rotation angle ($115\pm 13^\circ$) was substantially smaller than its appearance (approx. 160°). Internal impingement has been assumed to occur at this

instant, but none of the data obtained from 50 pitchers support this prevailing assumption.

Swimming: Shoulder pain is frequently reported by competitive swimmers and repeated shoulder movements over the large range is claimed to be an etiological factor. Apparently, swimmers elevate the arm excessively in the streamlined position and during the initial stretch of front-crawl stroke, which seems to cause subacromial impingement. We measured the glenohumeral joint motion of swimmers performing "resisted front-crawl swimming" and found that the maximum glenohumeral elevation angle was $106\pm 10^\circ$ which was not excessive by itself, but it exceeded the functional range when the shoulder was rotated internally and horizontally abducted at the same time.

Weightlifting jerk technique: After the barbell is lifted to the height of clavicle with the clean, the jerk is used to lift the barbell above the head until the arms are straight. Generally, the arms of experienced weightlifters are located far behind the neck at the end of the jerk so that the barbell can be prevented from toppling over. The shoulder joints seem to be excessively flexed in this position. Careful measurements of the glenohumeral joint configuration revealed that it was not excessive in horizontal abduction ($6\pm 7^\circ$) or external rotation ($-37\pm 9^\circ$) at this position. The glenohumeral abduction angle was limited to $93\pm 6^\circ$, substantially smaller than its appearance.

These analyses suggest that the apparently

excessive shoulder motions observed in sports performances may not be excessive due to scapular motions, and the idea that these motions are the risk

factor of developing shoulder injuries should be re-examined quantitatively.

Optimal Technique, Variability, Control, and Skilled Performance

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Computer simulation modelling is a powerful tool in Sports Biomechanics that allows the researcher to investigate the underlying mechanics of technique. Optimisation is often used in conjunction with simulation modelling in an attempt to explain the technique adopted in skilled sport performance. This might take the form of minimising joint torques in an expectation that the optimum technique will resemble the actual performance. Many tasks in everyday life may be based on minimising such variables, however, in the field of sport effort is often maximised in order to achieve the performance outcome. Therefore, while optimal technique should lie within the constraints of realistic strength characteristics there must be other criteria that explain the athlete's technique. Where more than one technique exists for performing the same skill, for example, identifying suitable optimisation criteria may give some insight into the adopted techniques. However, optimal technique, by definition, can be sensitive to perturbations. For example, small errors in timing an optimal technique may lead to a sub-optimal or even failed performance. Since in all human movement there is inherent variation so that

no two performances are exactly the same, skilled technique needs to be successful in a noisy environment and so optimised technique also needs to be robust to the inherent variation in coordination. This requires the measurement of human movement variability so that it can be incorporated into the optimisation procedure. In movements in which there is sufficient time for feedback control to operate it is to be expected that there will be greater variation in technique in those phases that adjustments are made. It is also to be expected that there will be little variation in technique for those phases where accurate coordination is crucial to the success of the movement. The aspect that often governs elite technique is that of achieving consistent success rather than some biomechanical measure of movement. The presentation will demonstrate, through a number of case studies, how computer simulation modelling and optimisation may be used to gain an insight into the important aspects of gymnastics techniques and the importance of including aspects of motor control when investigating limiting movements.

KEY WORDS:

simulation, optimisation, motor control, variability

[Symposium: Keynote Lecture]

Physical Activity and Health: opportunities and challenges

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In recent decades, life expectancy has increased in many countries around the world. This has led some to predict that most babies born since 2000 in developed countries will celebrate their 100th birthdays (Christensen et al 2009 *Lancet* 374: 1196-1208). This is obviously good news and a tribute to improvements in standards of living and quality of health care provision but this trend brings challenges. Age is a major risk factor for a variety of chronic diseases and conditions including heart disease, stroke, hypertension, cancer, kidney disease, obesity, diabetes, arthritis, depression and dementia. With increases in life expectancy, more people are living with these diseases and conditions leading to reductions in quality of life for the individuals concerned, uncertainty and anxiety for the families of those affected and increased health care costs for individuals and their families and for society. One factor, which may exacerbate the risk of disease with ageing, is physical inactivity. Many studies have documented a decline in physical activity throughout the human lifespan and it seems highly likely that modern living facilitates this trend. A rapidly expanding body of research suggests that physical inactivity increases the risk of a variety of illnesses including most – possibly all – of those mentioned

earlier. This evidence is not without its limitations and much of the evidence is observational and hence of insufficient quality to prove cause and effect. That said, an increasing number of randomised controlled trials, across a wide variety of health conditions, suggest that physical activity can be effective in lowering the risk of disease and in assisting in the management of existing illness. Evidence is particularly strong for diseases such as heart disease and diabetes but evidence is accumulating to demonstrate a benefit of physical activity for less well-studied diseases including cancer and dementia. Hence, physical activity appears to offer great opportunities not just for lowering the risk of disease with ageing but also for assisting in the management of disease. There are also great challenges, however, not least of which is developing effective strategies for increasing physical activity levels among populations. In addition to this major challenge, there are also risks of physical activity including the risk of heart attack in those unaccustomed to vigorous exercise and the risk of injury due to overuse or due to accidents. This lecture will highlight recent evidence in the area of physical activity and health and will comment on the challenges and opportunities presented.

[Symposium: Neurophysiology of Motor Control]

Context Dependent Formation and Retrieval of Human Motor Memories

Daichi Nozaki

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Human can perform graceful movements using various tools under a wide variety of dynamical environments. This tremendous ability is achieved by the brain's function of constructing feed-forward movement controller (i.e., motor memory) based on the action experiences. In this talk, I will demonstrate that human can form and retrieve multiple motor memories for identical movements depending on different behavioral contexts (Ikegami et al., J Neurosci 2010; Hirashima & Nozaki, Curr Biol 2012) and that this redundant nature of motor memory enables us to perform flexible actions. For example, partly distinct motor memories are formed for identical reaching movements according to whether the opposite limb is stationary or moving (Nozaki et al., Nat Neurosci 2006; Nozaki & Scott,

Exp Brain Res 2009) or with the movement directions of the opposite limb (Yokoi et al., J Neurosci 2011), which might contribute to compensate for the possible mechanical interaction between limbs when performing bimanual actions. Our current hypothesis is that the neural representations of identical movements are sometimes different among distinct behavioral contexts, and the motor memories are developed for each representation. I will also show the strong evidence that supports this idea: distinct motor memories can be artificially formed and retrieved for a reaching movement when the neural representation are manipulated using noninvasive brain stimulation.

**X-treme EEG - Studying the Neurophysiology of Motor Control in Extreme Conditions:
space, deep water and during maximal exercise**

Stefan Schneider

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Assessing brain cortical activity while being exposed to extreme conditions has been a challenging task and only in the past few years first attempts have been successful. In my talk I will present three studies trying to assess the underlying neurophysiological processes of human motor control while being exposed to extreme conditions: (1) Space, (2) deep water and (3) maximal exercise. This talk aims not only introduce up-to date neurophysiological methods, but also encourage students to go beyond current scientific barriers.

(1) Although several previous studies have shown that motor control seems to be impaired while being in weightlessness, there is good reason to speculate that, from a neurophysiological point of view, the redistribution of blood volume leading to an increase in brain oxygenation during weightlessness, positively impacts neural processing.

(2) The neutral buoyancy facility at the European Astronaut Centre in Germany allows astronauts to prepare for extra vehicular activities by providing a 1:1 model of the international space agency (ISS). Although this allows a number of simulations, it is questioned whether the underwater atmosphere is a transferable equivalent for a space walk. In a pilot

study we assessed the neurophysiological response to a complex decision task. Results let us assume that central processing is not impaired in deep water.

(3) Whereas previous experiments trying to identify the neurophysiological correlates of motor control were limited to hand or finger movements in an fMRI scanner, electroencephalography in combination with electrotomography allows to identify central processes even during maximal exercise. We were able to show that the pedaling cycle during biking is represented by a specific oscillation pattern in the motor cortex, which keeps stable during different stages up to submaximal exercise intensity. This might be an important finding for future studies differentiating between central and peripheral fatigue.

To sum up, this talk is dedicated to demonstrate the ability to record motor control related brain cortical activity in extreme conditions. Although just the results of a number of pilot studies is presented, the ability to assess brain cortical function in extreme conditions will help us to further understand the underlying neurophysiological correlates of physical activity and allow to identify central nervous in previously inaccessible conditions.

Neuromotor Adjustments to Physical Activity and Exercise in Humans

John G. Semmler

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There is growing evidence that physical activity and exercise produces adaptations within the central nervous system (CNS) that may be beneficial for motor function. To support this view, I will describe two separate examples of the neural mechanisms that mediate adjustments experienced by humans in response to physical activity. The first line of evidence suggests that regular physical activity may be beneficial for brain plasticity and learning. With the use of transcranial magnetic stimulation (TMS), I will show that motor cortex plasticity is enhanced in physically active people compared with sedentary subjects. I will also show the results of a recent study demonstrating that motor cortex plasticity is enhanced after an acute bout of low-intensity exercise in young healthy subjects. These studies suggest that physical activity increases neuroplasticity in human motor cortex, which may be beneficial for the learning of new motor skills and for recovery from brain injury. The second line of

evidence involves adaptations in the CNS after damage to the muscle with repetitive lengthening (eccentric) contractions. At the level of the spinal cord, substantial changes in single motor unit (MU) activity were found immediately after eccentric exercise, which included an increase in MU recruitment and correlated MU discharge (synchronization). These changes in MU synchronization remained elevated 7 days after exercise, suggesting that they may contribute to the repeated bout effect, where less muscle damage is known to occur after a second bout of eccentric exercise. At the cortical level, recent evidence with TMS suggests that eccentric muscle damage influences intracortical inhibition, indicating that muscle damage has widespread effects throughout the neuromotor system. Taken together, these studies show that physical activity and exercise induce adaptations in the CNS that may be beneficial for motor function under some circumstances.

Context Dependent Constraint during Interlimb Coordination

Tetsuro Muraoka

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In this talk, I will highlight the context dependent constraint during interlimb coordination. It may be stated that science is to look at some aspect of the world in detail. Thus, scientific results that were revealed through observation and experiment can be true at least in that limited specific world, but may not be true in the rest of the world. Accordingly, it should be important to identify what aspect of the world is looked at in each scientific procedure. In other words, I think that the obtained results cannot be understood properly until the context for that is identified correctly. The importance of identifying context will be introduced through findings from economics and psychology. Then I will discuss the controversial results about constraints during interlimb coordination (i.e., movement direction and muscle activation coupling) in the context of a movement's goal. Since Mechsner and colleagues published a paper entitled "Perceptual basis of bimanual coordination" in *Nature*, the question whether a predominant constraint during interlimb coordination is purely perceptual or not is hotly disputed. There is a general agreement that interlimb coordination is founded on a coalition of constraints of perceptual/cognitive and musculoskeletal/neural origins. Although previous

findings seem to indicate that what kind of constraint is predominantly working during interlimb coordination depends on the movements adopted in an experiment, I will try to show that perceptual/cognitive constraint always predominantly works. Next, what kind of reference frame is used in a directional constraint during interlimb coordination will be discussed. In motor control research, it has been intensively investigated in which reference frame neural activities encode spatial parameters. Though direct evidence about reference frame can be obtained mainly from animal studies, indirect information can be extracted from human studies by assuming that behavioral patterns reflect neural function. Through the methodology to find the reference frame for the directional constraint, I will propose a new context to be considered in determining intrinsic and extrinsic reference frame. Although we sometimes face unexpected or undesired experimental data against hypothesis, this is the chance to think about the context of experiments. Even when we obtain expected or desired experimental data, considering the context of experiments may help us to set more attractive research question.

[Symposium: Keynote Lecture]

Sport and the European Union: historical and current aspects

Walter Tokarski

German Sport University Cologne

In 2009, after many years of working on the development of cooperation between sport and the EU, sport was finally included in the EU legislation. It could be assumed that the organized sport has finally reached one of its goals: its recognition in the European Union.

However, this recognition of sport is only one of several motivational factors of the sport movement and the European Union to achieve closer cooperation.

Looking at the long process towards cooperation and especially the advances and the setbacks during this process gives an informative insight into the relationship between sport and the European Union. After having disregarded the matter of sport for many years, the European Union started discussing sporting issues in the mid-eighties, when the Adoninno-Report was published. The EU's perception of sport can be illustrated on the basis of the reports and documents of the European Commission and the European Parliament as well as the decisions of the European Court of Justice. However the expectations

of the sport movement towards the EU are not always congruent with this perception.

The Commission's White Paper on sport, published in 2007, portrays the framework of action that the EU sets itself for the next years. Thereby the European Commission does not only outline what they are planning to do; it also documents the limits of action of the European Union. Against this background the question is what impact Article 165 of the Lisbon Treaty will have for the future relationship between EU and sport.

The activities within the programme "*preparatory action in the field of sport and for the special annual events*" from 2009 till 2013 of the European Commission give a first impression how the involvement of the European Union could look like in the future. From 2014 on the multiannual financial framework of the European Union will therefore contain a subtitle for the financing of sport-related projects.

[Symposium: Sociology and Sport Management]

The Meaning of Program Satisfaction in School Sport Club in the Republic of Korea

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The Ministry of Education, Science, and Technology of the Republic of Korea selected 50 schools as 'School Sport Promotion Group (SSPG)' in 2011. The 50 schools were granted with \$40,000 a year for three-year term. The schools were recommended to spend the budget on expanding and improving their sport club programs. Although it has been two years since the program started, no study has examined the effectiveness of the SSPG schools. The main objective of the study was to examine the effectiveness of SSPG. The effectiveness was examined in three ways. First, the study attempted to see whether program satisfaction determined students' future intention to participate in school sport club. Using previous studies, this study included two antecedents of future intention to participate, which were students' intrinsic motivation and satisfaction with school sport club program. The MEST recommended the SSPG schools to spend the budget on developing their school sport club programs but not on building or renovating their facilities. Thus, our first objective was to see if program satisfaction played an important role in the relationship between intrinsic motivation and future intention to participate. If program satisfaction worked as a mediator in the relationship between intrinsic motivation and future intention, program satisfaction should contribute to students' intention

to participate in sport club apart from their intrinsic motivation. Second, the study attempted to see if students in SSPG schools were more satisfied with their school sport program than the ones in non-SSPG schools. In addition to program satisfaction, the group difference on future intention to participate in school sport club was also examined. Third, the study examined the effectiveness of the SSPG by looking at the causal path between intrinsic motivation and program satisfaction. If SSPG schools were able to provide better sport club programs and, thus, satisfied students' intrinsic motivation, the path coefficient between intrinsic motivation and program satisfaction in SSPG schools should be stronger than the path in non-SSPG schools. The data were collected from 20 SSPG schools (men: 304; women: 259) and 22 non-SSPG schools (men: 413; women: 160). The results indicated that program satisfaction fully mediated the relationship between intrinsic motivation and future intention to participate in school sport club. The mean values of program satisfaction and future intention among SSPG schools were statistically higher than those of non-SSPG schools. Lastly, the path coefficient between intrinsic motivation and program satisfaction among SSPG schools was statistically higher than that of non-SSPG schools. Policy related ramifications are also provided in the study.

**Examining the Latent Market for Professional Sport Organizations
as a Sociocultural Resource.**

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Experts have argued that sports render significant changes to society. Sporting events and clubs create social capital and contribute in solving various community problems (Nicholson & Hoyer, 2008; Okayasu et al., 2010). The community value of professional sport has been identified in previous research (Zhang et al., 1996). When a new professional team is established, economical and socio-psychological impacts are observed in the community and among fans and spectators (James et al., 2002; Lock et al., 2009; Nigel et al., 2011). Matsuoka, Koto, and Yanagi (2011) explored the important pieces of evidence that a newly established sport team has a positive influence on spectators' perceptions on the community value of the sport team; data from spectators of professional basketball showed the psychological commitment of fans to their hometown. These findings prove the significant value of professional sport teams as well as the role of professional sport to encourage community participation among sport fans. Such social impacts may apply to not only spectators but also non-spectators in a community who can be included in the latent market of professional sport

organizations. However, limited empirical research has been conducted to investigate the impacts of professional sport organizations from multiple perspectives. Particularly, perceptions of non-spectators have not been examined because of the difficulty in collecting data. By using data from citizens living in five different hometowns of professional sport clubs and teams in Japan, the present study examined respondents' perceptions on the benefit of watching professional sports and the extent of clubs' and teams' contributions toward their community. Internet survey was conducted in five cities in which professional baseball teams and/or soccer clubs were located. A total of 1,445 respondents answered all the question items. The respondents consisted of those who had experiences in attending games of professional sport teams or clubs and those who had never attended any games during the last two years or more. Findings prove the significant value of professional sport clubs and teams and the role they play in encouraging community involvement. Specific findings and their implications for the academic field and for sport marketers will be presented.

Recent Developments and Prospects of China's Sports Industry

Dongfeng Liu

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Sport has always been a popular recreational activity, but now it is much more than that. Globally sport has turned into big business and rising industries in many countries, and has been identified as a growth area offering job potential.

With 30 years of fast economic growth, the living standard of Chinese has greatly improved. For many, sport industry in China is a sun-rise industry that is going to grow rapidly for decades to come. But until 2010, there was no official figures released regarding the size of China's sport industry. Shanghai University of Sport (SUS), entrusted by China's Sport Ministry and China's Statistics Bureau, had been working on the establishing of economic model and framework for sport industry calculation since 2006. SUS finished the theoretical research by 2007, providing the official methodology framework for calculating the economic value of China's sports industry.

From 2008-2010, commissioned by the Sport Ministry, we were involved in the sport industry survey by sampling 15 provinces based on previous study and collected sport industry statistics, producing the authoritative figures for China's sport industry(2006-2007) for the first time in history. Based on the industry survey, in combination of the

second national economic census of 2008, the economic value of 2008 was also assessed. The latest figure now is as of year 2010 (forecast based on previous data).

In terms of economic significance, the sport industry in China was estimated to be worth 222 billion RMB (US\$35 billion, 1/6th of US) in 2010, 13.44% higher than previous year, accounting for 0.55 % of total GDP and providing 3.37 million jobs. (SUS report 2010)

The present article also examined strengths and challenges of China's Sport Industry by three sectors: Elite sport, Participation sport, and Sporting goods. On the one hand, it can be argued that China's sport industry is faced with serious challenges: it is relatively small, still in its infancy stage, and development is imbalanced. On the other hand, many believe China's sport industry also has a great future. For many, small means potential, and actually risks and opportunities coexist as in Chinese translation for crisis. As sport industry is positively related with national economy, China's sport industry is expected to grow at a fast rate for many years to come, as some has predicted that the world's 2nd largest economy will grow with an annual growth of 8-10% for a foreseeable future.

The Genealogy of Taiwanese Baseball (1951~2013)

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Today's news is tomorrow's history. This research applied textual analysis and used the keywords, "baseball" combined with three kinds of keywords that includes little league baseball team's names (like "Maple Leaf" (紅葉), "Golden Dragons" (金龍) etc.), political crisis (like "UN" (聯合國) and "US severed diplomatic relations to ROC" (中美斷交) etc.) and national sport ("Kuo-Chiu" (國球), "Kuo-gia-yun-don" (國家運動), "Kuo-Chi" (國技)), to search in the database of the Udn newspaper group (聯合報系) from 16, Sep. 1951 to 6th, 2013, to construct genealogy of Taiwanese baseball and analyse how and why it became "Kuo-Chiu" in last decade. The findings are as follow: When the Chinese Nationalist Party (國民黨/GMD) "recovered" Taiwan in 1945, baseball gradually changed its name from colonial Japanese Yakyu(野球) to the Chiang Kai-Shek (蔣介石/CKS) regime's Chinese Ban-chiu(棒球). The anticipation of the coming legitimacy crisis

of "withdrawing from UN" (1971), US severed diplomatic relations to ROC etc. led the CKS regime implemented the little league baseball to build up the national identity and loyalty, in the late 1960s and 1970s. This political move decided the destiny of Taiwanese baseball. The game became a carrier of national identity. With the democratization process of Taiwan, the legacy of little league baseball was used by ex-president Chen, Sui-bian (陳水扁) who replaced the Chinese identity of baseball to Taiwanese identity and made baseball become Kuo-Chiu. The convergence and contingency of these historical processes have led to the production of political activism that applied the mass-mediated Taiwanese baseball's performance as a cultural symbol differences. Baseball became a necessary and favoured means of political mobilization on and off the field, inside and outside of Taiwan.

KEY WORDS:

genealogy, baseball, political crisis, legitimacy, UN

[Young Investigators' Symposium]

**Using Pattern Recognition Techniques to Identify Group-Specific Movement Patterns
During Running**

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Groups with different movement patterns require group-specific sport shoes to improve comfort, enhance performance, or reduce sports injuries. In order to analyse and identify groups with distinctive movement patterns, previous studies had to pre-group individuals using specific characteristics (e.g. age or gender). This manual pre-grouping may, however, bias the analysis so that some of the groups with group-specific movement patterns might be disregarded.

The objectives of this study were to identify groups using their distinctive movement pattern, to determine gender and age of these groups, and to investigate whether these groups require group-specific sport shoes to improve comfort.

Kinematic data of 88 healthy subjects during five running trials were collected. Using these data, pattern recognition techniques were conducted to identify groups using their distinctive movement

pattern. The number of males and females and the average age of each group were determined. Finally, the footwear comfort preferences of each group were compared.

Eight groups with different movement patterns could be identified. Some of the groups did not differ either in gender or age. The essential part of this finding is that these groups would not have been identified using pre-defined groups based on age or gender. Interestingly enough, some of the groups that did not differ in these characteristics had different comfort preferences and, therefore, group-specific shoe requirements to improve comfort.

In conclusion, using pre-defined groups can bias the analysis. Therefore, applying pattern recognition tools to automatically separate different movement patterns should be considered as a new way to identify groups.

Kinematical Analysis of Phases of Double-push of In-line Speed Skating

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Purpose:

Through the description and analysis of the kinematical features of double-push, the structural regularities of the movement is revealed; the correct technical concept of double-push is established; the analysis demonstrates the rationality of the technique and offers theoretical basis for the training methods.

Method:

The image measurement is employed, the representative athletes of double-push are taken as research subject, and the kinematical parameters are taken from the double-push athletes in experiment. The image is digitally processed by the Ariel recording analysis system and an Excel data base is established and analyzed by SPSS. The significance of the statistic: $P < 0.05$.

Results:

1. A single step of double-push can be divided into 4 phases.

2. As the velocity increased, the proportion of the double-leg-support duration decreases and so does the proportion of gliding duration.
3. Push plays a dominant role in the technique of double-push.
4. In the phases of push and under-push, the inner-side and outer-side muscles of the supporting leg work alternately, which produces more force and contributes to relaxing muscles, compared with traditional techniques.

Discussion / Conclusion:

1. Double-push has two effects on movement, high efficiency and saving-energy, and therefore great importance should be attached to the biomechanical researches on this technique.
2. The revelation of its regularities may contribute to other skating techniques and offer references for training.
3. Due to the diversity of distance and style, there are variations of double-push for individuals but the basic principles are similar.

Effects of High-intensity Training on Bone Mass in Adult Female Rats

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Background:

Women have become increasingly physically active in recent decades. While exercise provides substantial health benefits, intensive exercise leads to an increased risk of skeleton.

Purpose:

To examine the effects of long-term high-intensity training on bone mass in adult female rats, and explore the mechanism of bone loss by high-intensity training.

Methods:

A total of twenty 3-months female Sprague-Dawley rats were randomly divided to exercise group (n=10) and control group (n=10), and exercise rats fulfilled 15 weeks exercise. The exercise rats fulfilled 15 weeks increasing load treadmill exercise. All rats received vaginal swabs for everyday. Dual X-ray absorptiometry (DXA) was used to evaluate the bone mineral density (BMD) of whole body, and estradiol levels (E2) were

determined by a solid phase radioimmunoassay kit. Histomorphometry was performed in the proximal tibial. Biomechanical testing of the femur was determined by three point bending test.

Results:

Fifteen weeks of exercise significantly decreased body weight, BMD, maximum force and E2 compared with control group, and BMD were positively correlated with E2 ($r=0.484$, $p<0.001$), and all exercise rats lost regular estrous cycle. The exercise group showed a significant decrease in cancellous bone volume (BV/TV, Tb.Th, Tb.N), with decreased bone formation (MS/BS, MAR, BFR/BS) and increased bone resorption (Oc.N, Oc.Pm).

Conclusions:

The findings suggest that intensive exercise had a negative effect on bone of rats, and the reproductive abnormalities may be an important determinant of bone loss by suppressing bone formation and stimulating bone resorption.

**Inferior Muscularity of the Rectus Femoris to Vasti in Varsity Cyclists:
Cross-sectional and longitudinal observations**

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Our cross-sectional study on oarsmen hints to a notion that chronic participation in sport activities that require repetitive leg extensions (simultaneous extensions of knee and hip joints) does not induce muscular hypertrophy of the rectus femoris unlike vasti (vastus lateralis, vastus medialis, vastus intermedius). We hypothesized that this also applies to cyclists. In the first experiment, T1-weighted magnetic resonance (MR) images of the thigh were obtained from 8 experienced (experience: > 4 years) varsity male cyclists and 8 untrained male students. In the second experiment, MR images of the thigh were obtained from 7 varsity male cyclists (experience: 0.5-13 years) twice (6 months in-between; cycling training: 16 hours per week on

average). From the MR images, the volume of each muscle of the quadriceps femoris was determined. The muscle volumes of the vasti were significantly greater in the experienced cyclists than in the untrained students, whereas that of the rectus femoris was comparable for the two groups. In the second experiment, significant increases in volume of the vasti were observed after 6 month training, while the rectus femoris volume did not change. The current findings support our hypothesis and indicate inferior muscularity of the rectus femoris compared to vasti in the cyclists, which are due to muscle-specific adaptation to the repetitive leg extensions in their competitive and training activities.

Combined Strength and Endurance Training: perspectives for recreational endurance runners

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Chronic and acute neuromuscular, cardiorespiratory and hormonal responses and adaptations to combined strength and endurance training were examined in recreational endurance runners using longitudinal and cross-sectional study designs. In the longitudinal study, men and women were divided into specific strength training groups following a short preparatory period. Men: maximal (M), explosive (E), Men and women: mixed maximal and explosive (MM, MW) and circuit training control (CM, CW). Groups completed an 8-week strength training intervention after which M, E and CM completed 14 weeks of marathon training. Periodized maximal, explosive, and mixed strength training were more effective than circuit training in improving maximal and explosive strength as well as maximal muscle activation of the lower extremities despite increased running volume. Overall

endurance performance improved (peak running speed, S_{peak}) in all groups. After the 14-week marathon period, only M made further gains in S_{peak} and running economy (RE). The cross-sectional study showed that when mixed strength and endurance were combined into a single session, the order of loadings, (endurance followed by strength (ES) or strength followed by endurance (SE)), led to different acute responses and recovery patterns. At recovery of 24 and 48 h, suppressed testosterone concentrations were observed in SE men while a delayed decrease in explosive strength was observed in ES women. The present results suggest that periodized maximal, explosive, and mixed strength training combined with endurance training lead to improvements in neuromuscular running characteristics while the order of exercises should be considered for optimization of training and recovery.

Influence of Non-Circular Chainrings on Physiological Parameters in Handcycling

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Handcycling is a sport that exists since the mid-1980s, and it is a sport for individuals with lower limb disabilities - mainly spinal cord injuries (SCI). The handcycle is a three wheeled cycle powered by the upper extremity. The purpose of this study was to examine the influence of a non-circular chain-ring compared to a conventional circular chain-ring on maximal and submaximal parameters of handcycling performance. Twelve male able-bodied participants with no handcycling experience initially completed an exhaustive, incremental exercise test. Thereafter, participants completed a series of two 20-s sprint tests, followed by a 20-min aerobic test and finally another two 20-s sprints. A non-circular chain-ring (CC) and a circular chain-ring (NCC) were used in a random order on two separate occasions. Data were analysed by using separate 2-way ANOVAs (sprint and aerobic-tests) for repeated measures. Power during the first 20-s sprint test were significantly higher using the NCC, respectively ($p < 0.05$). On

average the highest maximum power production was achieved during the third of four 20-s sprints ($p < 0.05$). During the 20-min endurance test no significant differences ($p > 0.05$) were observed for selected physiological parameters after 10-min and 20-min. Values of gross mechanical efficiency after 10-min and 20-min of the aerobic test were also similar ($p > 0.05$) using the NCC compared to the CC after 10 and 20-min of the aerobic test. Using the NCC participants' ratings of perceived exertion were lower after 20-min of the aerobic tests. In the context of physiological parameters and performance the use of a NCC only improved handcycling sprint capacity during the first test. However, as maximum power achieved during the third sprint was higher than values achieved during all other sprints during both exercise trials it would appear that an intensive warm-up should be considered as being necessary to optimize such explosive efforts.

Fighting Against Cognitive Decline: Exercise makes your brain brighter

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The proportion of elderly people aged 60 and over in the world is expected to increase drastically over the next few decades, and it accompanies major financial impacts on the healthcare system. Maintenance of independence in elderly individuals has been linked to the concept of “successful aging”. Previous studies indicate that physical activity can increase the cognitive reserve capacity of the brain and decrease the risk of cognitive decline and cognitive impairment in old age. Studies from neuroscience perspectives, physical activity can induce changes in hippocampal structure, neurotrophin increment (BDNF, IGF-1), greater white matter integrity, greater gray matter volume and increased neurogenesis in the dentate gyrus.

Those provide potential mechanisms to account for the cognition-enhancing effects of physical activity. Moreover, the positive impact of physical activity on cognition has been evidenced by empirical studies, including high/low fitness comparison, acute and chronic physical training interventions. The facilitative effects are demonstrated in not only aerobic physical activities can benefit elders, but also resistance exercise. In general, the benefits of physical activity have been proven, and future studies can target on the exercise prescription. Besides, physical activities should be promoted and it is required to motivate some sedentary elders to be more physically active and stay physical active.

How Professional Sports Impact on Subjective Well-being: case of Korean baseball

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This study contributes to the literature on happiness by focusing on the effects of watching professional sports by visiting stadium or through media consumption on happiness in terms of subjective well-being (SWB). Data obtained through survey from baseball fans in Korea were utilized as the main source. Using multiple regression method, this study primarily analyze the relationship of watching professional game and happiness and examine the impact of motivation factors of watching sports on the SWB in secondary study.

This research presents empirical evidence of positive relationship between visiting ballpark and SWB especially life satisfaction and positive affect while cannot find information of impact of watching ballgame through media on SWB. Additionally,

among the 7 main sports motivation factors were offered from Wann (1995), group affiliation increase happiness level while escape alleviate the degree of SWB. For the other motivation factors of professional sports, local identity positively influence on the happiness. To find out the difference impact of visiting frequency, the authors split sample into two groups which are high and low frequency group. Aesthetic factor has positive impact of SWB through fans who visit stadium frequently, perceived performance of team is important to happiness for fans who does not visit stadium often.

In conclusion, visiting the stadium of professional baseball can increase happiness level of baseball fans and group affiliation in the stadium and local identity is positively impact on subjective well-being.

Constraints of Spectator Sport - Focusing on the J League spectators -

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For the professional sport teams, it is important to understand what factors attract the spectators to come to the venue because the gate money is one of the largest incomes for the team. Although there are many research papers focusing on the spectators "attendance," only a few paid attention to the "constraint."

In Japan, "J. League," the first professional soccer league, in which team represents their hometown, was established 20 years ago. In the beginning, the number of spectator grew rapidly, but after hitting the peak, the total number started to decrease. Maruyama (2002) considered organization should maintain the existing customers, rather than using managerial resources for acquiring new customers. Therefore, the purpose of this study is to reveal what the constraint factors for the soccer spectator's

continuous attendance are and verify the differences according to the demographics.

The survey was taken at the official game of J. League Division 2. The items introduced in this survey were used in the leisure studies, and improper for sport spectator scene was erased. 829 surveys were given to the spectators in two teams and 612 were valid responses. The samples were divided into two. Factor analysis was used to clarify the factors reflecting spectator's constraints and reveal the differences according to the demographics.

In conclusion, several factors emerged explaining spectator constraints. It also comes to conclusion that, there are existing significant differences among, gender, age, length of time as a fan, annual frequency of spectating games.

**Tourism and Economic Development through International Sports Event Hosting?
A case study from the Volvo Ocean Race in Sanya, China**

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Mega sporting events have typically been viewed by host cities/countries as opportunities to boost the tourism and grow their economies. This paper analyzes the experience of Sanya as a sponsor and home for one leg of the 2011-2012 Volvo Ocean Race. Sanya is the southernmost city in China with beautiful coastal scenery. It is considered by local residents and tourists to be the “Hawaii of the Orient.”

This study aims to:

- analyze the economic impact of hosting the Volvo Ocean Race on the Sanya’s tourism and economy.
- discuss reflections on perspectives of international sports sponsorship from tourists, citizens and the government.
- explore what the Sanya experience in the 2011-2012 Volvo Ocean Race means for other

Chinese cities and regions contemplating the sponsorship of professional sports events.

This paper uses a strategic case study and secondary data to test whether the Volvo race has a measurable effect on tourism and economic development in Sanya. The research specifies the ways in which Sanya’s hosting of the 2011-2012 Volvo Ocean Race resulted in social and economic outcomes. A quasi-experimental research design is used, with surveys and interviews of local residents both before and after the event. Critical analysis is also conducted of official government data and reports, as well as newspapers and periodicals, and relevant internet sites. Practical implications and future research directions are suggested.

Sports Participation and Psychological Integration for Sedentary People

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We explored the relationship between sports participation and psychological integration for sedentary people in real-estate companies ($N=116$). Demographic information of the participants, and data about their sport participation and psychological integration in companies were collected. Perceived trust scale and cognitive identification scale were

used to measure psychological integration. Online questionnaires and hard copy were sent out. Those who participated in group sports in their companies demonstrated higher psychological integration than those who didn't. Further implications were discussed.

Key words:

sports participation; psychological integration, trust, identification

**Cardiorespiratory Fitness Modifies Genetic Risk of Hyperlipidemia:
Analysis of gene-fitness interaction**

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Decreased blood levels of HDL cholesterol (HDL-C), increased LDL cholesterol (LDL-C) and triglyceride (TG) are risk factors of coronary heart disease. Although the blood lipid levels are determined by genetic factors, cardiorespiratory fitness is also associated with these levels. The purpose of this study was to examine whether cardiorespiratory fitness modifies the effects of genetic factors on blood lipid levels. Subjects were 180 Japanese men (age 20-79 yr). Cardiorespiratory fitness was quantified as a peak oxygen uptake (VO_{2peak}), and subjects were divided into high- and low- fitness groups according to the measured VO_{2peak} . We analyzed the 20 single nucleotide polymorphisms (SNPs) associated with blood levels of HDL-C, LDL-C, and TG. Based on the analyzed SNPs, we calculated

the genetic risk score (GS) of each lipid trait, and subjects were divided into low-, moderate-, and high-risk groups according to the tertile of GS. HDL-C was lower in the high-risk group than the low-risk group regardless of the fitness levels ($p < 0.05$). LDL-C was higher in the high- and moderate-risk groups than the low-risk group in the both fitness groups ($p < 0.05$, $p < 0.05$). On the other hand, there was a significant interaction effect of fitness and GS on TG ($p < 0.05$). Only in the low-fitness group, TG was higher in the high- and moderate-risk groups than the low-risk group ($p < 0.01$, $p < 0.05$), whereas there was no significant difference in TG among the GS groups in the high-fitness group. These results suggest that cardiorespiratory fitness modifies the influence of genetic factors on blood TG levels.

Cartilage Intermediate Layer Protein and Asporin Polymorphisms are Independent Risk Factors of Lumbar Disc Degeneration in Male Collegiate Athletes

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Objective:

Lumbar disc degeneration (LDDG), recently reported to have strong genetic determinants, is a major cause of discopathy and lower back pain. However, most studies have only evaluated the effects of a single susceptibility polymorphism. Our purpose was to examine the effect of two susceptibility polymorphism for LDDG in Japanese collegiate athletes.

Design:

We investigated 2 susceptibility genes for LDDG—cartilage intermediate layer protein (CILP) and asporin (ASPN)—in 516 collegiate athletes, and genotyped the risk allele of CILP (1184T/C) and ASPN (D14). LDDG was evaluated using T2-weighted magnetic resonance imaging.

Results:

By using logistic regression analysis, we found that the ASPN D14 allele and CILP genotype were associated with an increased risk of LDDG in male but not female athletes [CILP CT: odds ratios (OR), 1.77; 95% confidence interval (CI), 1.07–2.93; CILP CC: OR, 4.38; 95% CI, 1.42–13.54; ASPN D14: OR, 2.17; 95% CI, 1.10–4.28]. We also found that CILP C and ASPN D14 were independent variable. The ORs with more than 2 risk alleles were largely increased.

Conclusions:

The CILP and ASPN polymorphisms are independent genetic risk factors for LDDG in male but not female Japanese collegiate athletes.

Key words: Disc degeneration, Polymorphisms, Athlete, CILP, ASPN

The Effects of Exercise during Haemodialysis

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Patients with chronic kidney disease are an inactive population. There has been a recent growth in research into exercise and activity levels in patients who require haemodialysis treatment to live. Regular exercise is purported to have numerous benefits to these individuals, these include improved exercise capacity, muscle function and strength, quality of life and various other health benefits. Exercise 'rehabilitation' in this population is challenging due to low physical capacity and function and numerous complications associated with the disease and treatment and due to low compliance to outpatient clinics. Cycling exercise while the patient is dialysing offers an alternative option.

The haemodialysis procedure is extremely invasive and consequently has various metabolic, hormonal, inflammatory and haemodynamic implications.

Haemodialysis is reported to have pro-inflammatory and anorexigenic effects, cause immune dysfunction, increase the risk of infection and frequently causes a transient fall in blood pressure. Exercise itself has been shown to alter concentrations of circulating inflammatory factors, suppress appetite hormones, influence immune function, and has profound effects on blood pressure both during the activity and after the activity is completed. However, the effect exercise has when performed during haemodialysis is unclear.

This presentation will highlight findings from recent research comparing 15 haemodialysis patients who completed a treatment with and without an exercise session. Changes in blood pressure, circulating inflammatory factors, immune function and appetite will be reported.