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# **Research Methods and Performance Analysis**

**Edited by Mike Hughes, Henriette Dancs, Katalin Nagyváradi, Tibor Polgár,  
Nic James, Goran Sporis, Goran Vuckovic and Mario Jovanovic.**

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## **Sport and Society**

# Sport as Cultural Product in Tourism

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## Abstract

*Our everyday life is entwined with the material way of thinking present in the various aspects of society, pushing aside the quality features of life. Quality, as a philosophic concept is the entirety of essential features that characterise a thing. Quality represents a certain positive value, and this positive shift makes the difference between certain ways of life, the way we live*

*According to the World Health Organisation, by 2022 tourism and the health industry will have been the largest industries. The available money is increasing in certain classes, while health and physical wellbeing is becoming a priority to consumers at the same time. As the number of the elderly is growing, the need for quality life, for living the everyday life in good health is becoming more relevant. Tourism products on the supply side change accordingly, they become wider and more varied. This tendency is good both for health and sport tourism.*

*The relationship between culture and tourism has gained ground primarily with the increase of leisure time. The right to rest and leisure (UN General Assembly, 10 December 1948), as well as the need for a change of environment and the facilities available due to the technical development make the active participation in tourism possible. In parallel appears our national consciousness, the representation of our nationality and culture, along with the due respect for and acceptance of the culture of the destination country. This fact also reflects, that besides its financial potential, tourism plays an immense role in the representation of the national culture. In other words: it is becoming a product in the market of tourism.*

*In our research we were looking for the answer to what extent the conscious improvement of the mental and physical aspects of health, that is the sport element of health culture is present in a market segment, namely among the guests of Bükk Spa.*

## 1 Introduction

Our everyday life is entwined with the material way of thinking present in the various aspects of society, pushing aside the quality features of life. Quality, as a philosophic concept is the entirety of essential features that characterise a thing. Quality represents a certain positive value, and this positive shift makes the difference between certain ways of life, the way we live. This has an outward manifestation, which is normally triggered by the (social, economic, etc.) environment, and is mostly standardised.

According to the World Health Organisation, by 2022 tourism and the health industry will have been the largest industries. Thanks to social wellbeing, the available money is increasing in certain classes, while health and physical wellbeing is becoming a priority to consumers at the same time. As the number of the elderly is growing, the need for quality life, for living the everyday life in good health is becoming more relevant. So among this age group health-consciousness, healthy eating are more present on the demand side of tourism than before, and they are more interested in activities other than what they normally do, which they often wish to find in tourism. Tourism products on the supply side change accordingly, they become wider and more varied. This tendency is good both for health and sport tourism.

The quality of life cannot be described merely by economic figures. It is also affected by the events that take place within the soul, which are often reflected on the people's faces. One-folded activities deprive this age group from these special experiences, especially from those they can gain while travelling. Thus their way of life becomes monotone, boring. It is well-known that our soul also needs new impulses from our environment, which makes us (as said in sport language) more resistant and less vulnerable. And thus, we already take care of the mental side of our health. So these new impulses influencing our inner health come from our environment. The everyday impulses do not have a positive effect on people after a certain time, but a change of environment, with other words: 'the different' acts as a catalyst for the body and makes our everyday activities more effective. Gaining experience with a change of environment - which is the most basic aspect, the aim of tourism - has an indirect effect on the tourist's health. Thus tourism can have, and actually has an immense role in improving the quality of life. However, it is not influenced only by mental wellbeing, but also by our physical condition. If we pay attention to the physical components as well, than we have already done a great deal in order to live a healthier, better quality life, thus enriching our culture, as well as our material and spiritual values.

## **2 Culture – body culture – health culture – way of life**

Culture is the entirety of our knowledge, our behaviour models, customs, our beliefs, which we acquire implicitly while living in a family, in a society, so while socialising. Culture thus becomes part of our personality, and is manifested in our relationship with our environment.

The relationship between culture and tourism has gained ground primarily with the increase of leisure time. The right to rest and leisure (UN General Assembly, 10 December 1948), as well as the need for a change of environment and the facilities available due to the technical development make the active participation in tourism possible. In parallel appears our national consciousness, the representation of our nationality and culture, along with the due respect for and acceptance of the culture of the destination country. This fact also reflects, that besides its financial potential, tourism plays an immense role in the representation of the national culture. In other words: it is becoming a product in the market of tourism.

Body culture is part of our culture. The result of our activities to achieve and maintain our health defines our body culture, partly our health culture as well, and above all their quality. The concept and the content of culture change along with humanity. The material and spiritual sides cannot be separated, so culture includes not only the phenomena of art, science and spiritual activities, but that of the everyday life. For example the way we live, eat, work, or the way we spend our free time. The culture of leisure, recreation is a popular topic nowadays, not only in the life of the individual, but also among scientific researchers. Tourism, as a leisure activity together with travelling, is an excellent possibility for cultural exchange. We travel to get to know other cultures, while taking our personal, and in most cases our national culture. Body culture is part of our culture, which simply means the education of the body. It reflects our genetic inheritance, and means to keep our body in a good condition, to improve or eventually to correct it. This can be achieved by various effects, activities. To mention some: e.g. to make use of the powers of nature, by various sport activities, sport equipment, or with the knowledge of educating the body, sport sciences.

## **3 Demographic changes – quality of life – new tendencies in tourism**

The average age of people has considerably increased by the 21st century, and the quality of this longer life is not indifferent. The change of environment due to travel can greatly improve our quality of life, which is reflected not only in the tourist's health condition but indirectly also in society. F. Kennedy said that the power of a democracy lies in the health of its citizens. So when we speak, think about tourism, we can mention not only its importance in and positive impact on economy, but also its beneficial effects on health.

Tourism trends are affected by the demographic changes. The changes of the values, attitudes of people, their way of life result in these new tendencies. These changes are formed by the growth of population, increasing life expectancy, different household structures, and expanding migration. This change is traceable in the destinations (where people go from where), and in the activities at the destinations. As people live longer, they wish to live this longer life in good health conditions, living a quality life. Thus they are going to live in a more health-conscious way. The health-conscious way of life includes –among others – a more active participation in tourism and physical and sport activities pursued at the destination.

There is a considerable number of researches studying the physical activity, health-conscious attitude and way of life of elderly people, and the effect of the above on their health condition, and as a consequence on the quality of their life. Monitoring and complying with the activity needs of the growing number of elderly tourists at the destinations, providing services that could improve their quality of life could be a part of the new tourism tendencies, allowing an advance for the service provider in the competition.

## **4 Hypotheses**

In our research we were looking for the answer to what extent the conscious improvement of the mental and physical aspects of health, that is the sport element of health culture is present in a market segment, namely among the guests of a spa.

We supposed that the vast majority of the surveyed arrived at the spa for recovery and medical treatment.

We supposed that the approach of the foreign guests to sport activities (frequency in doing sports, intensity and regularity) is better than that of the Hungarian ones.

## **5 Methodology**

As our primary research method of data collection we have chosen the questionnaire in the second biggest medicinal spa in Hungary, namely the Medicinal Spa of Bükk. The survey by the questionnaires (filled by the surveyed) was conducted during the winter period (between November 2008 and March 2009), the participants were chosen by random sampling. There were both closed and open ended questions. In spite of the considerable efforts of the Medicinal Spa to counterbalance the seasonal differences by widening the variety of services in the past few years, there is still remarkable difference between the summer and winter turnout indices. During the surveyed period services were mostly used by elderly guests looking for more peace and quiet, and by ill people making use of social security coverage. Significant difference can be traced in the composition of the guests, as two-thirds arrive from foreign countries, a vast majority of whom come from German-speaking areas (Table 1.). It is a positive tendency that the number of guest arriving from the Czech Republic is increasing progressively, which must be taken into consideration in the diversification of supplies.

Data were analysed by SPSS for Windows 17.0 statistical method, as well as with the help of Excel figures and tables.

Table 1. Nationality of the surveyed.

Nationality	number
Hungarian	194
German-speaking (German, Austrian,)	90
Czech	96
<b>Total:</b>	<b>380</b>

## 6 Findings

The present findings reflect only the presence of sport activities of the guests during their visit at the spa and at home in their permanent environment, without the intention of specifying the sport activities in question. We wished to investigate to what extent the guests participate in sport activities, which influence the quality of life, thus health culture. Pursuing sport activities at tourism destinations may bring along a continuation of sport activities at home, thus improving the quality of life.

When interpreting the findings we must keep in mind the fact that the guests of the surveyed medicinal spa were participants primarily in health tourism, thus this time they represented primarily the market segment of health tourism.

In case we wish to examine the sports motivation of those participating in health tourism, we need to find out 'how' the surveyed guest has arrived at the spa.

Concerning the entire Hungarian sample, 51,3% arrived with social security referral, 9,3% with tourism cheque, and 39,4% were self-financing. (Figure 1.).

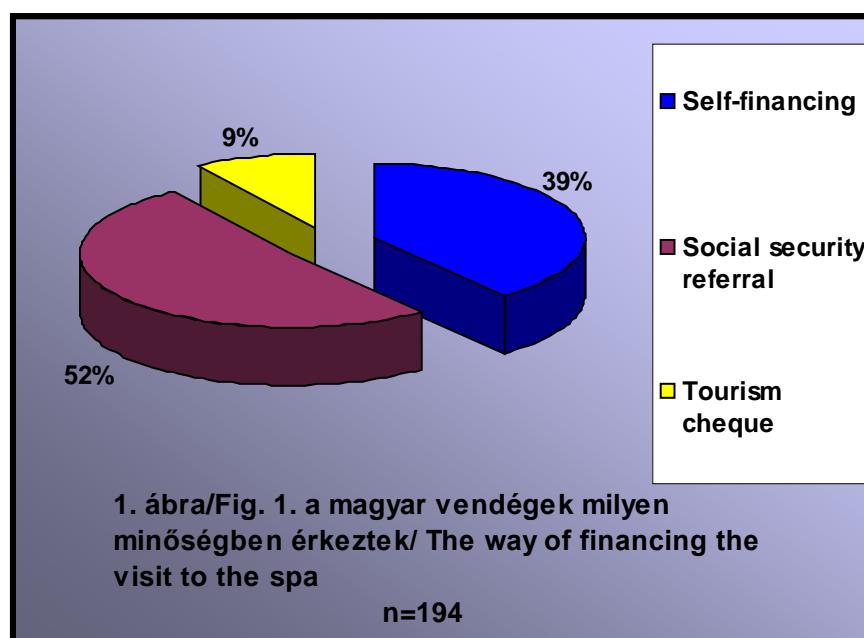


Figure 1. The way of financing the visit to the spa

The above proportions projects the activities of the surveyed Hungarian guests during their stay, as it is less probable that the large number of guests arriving with social security referrals would seek after sports facilities in the spa. Figure 2. shows that the main reason of the Hungarian for visiting the spa was recovery.

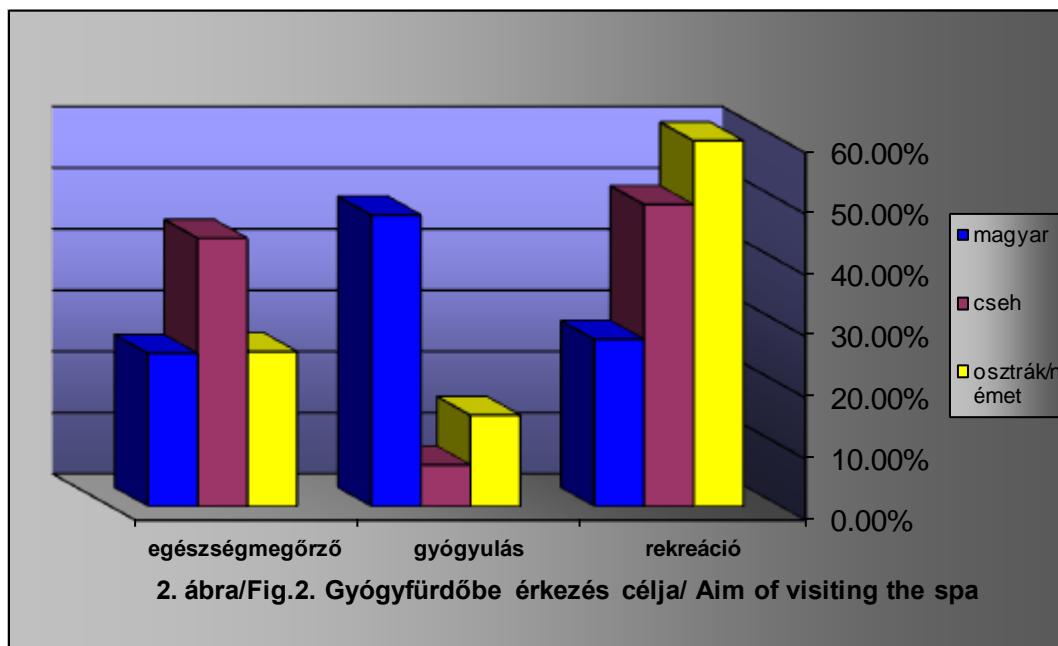


Figure 2. Reasons for visiting the spa.

Free sport activities for health preservation were the most popular among the Hungarian guests (Figure 3.), while their number was the smallest in relation to participation in fee-paying sport programs (4.ábra). The spa unfortunately is unable to meet such demand, as they provide only one free program, as opposed to the nine fee-paying ones.

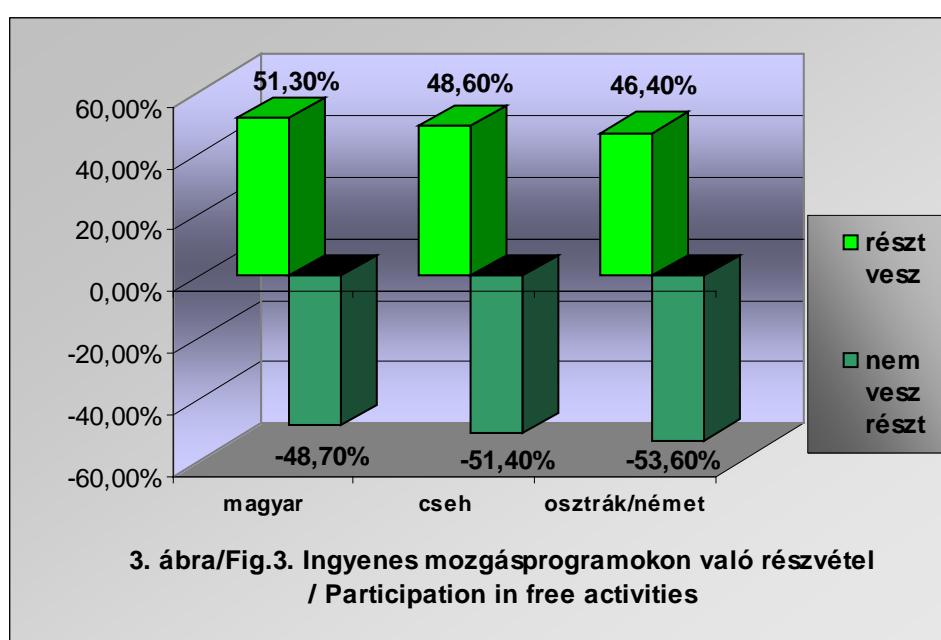


Figure 3. Participation in free sport programs.

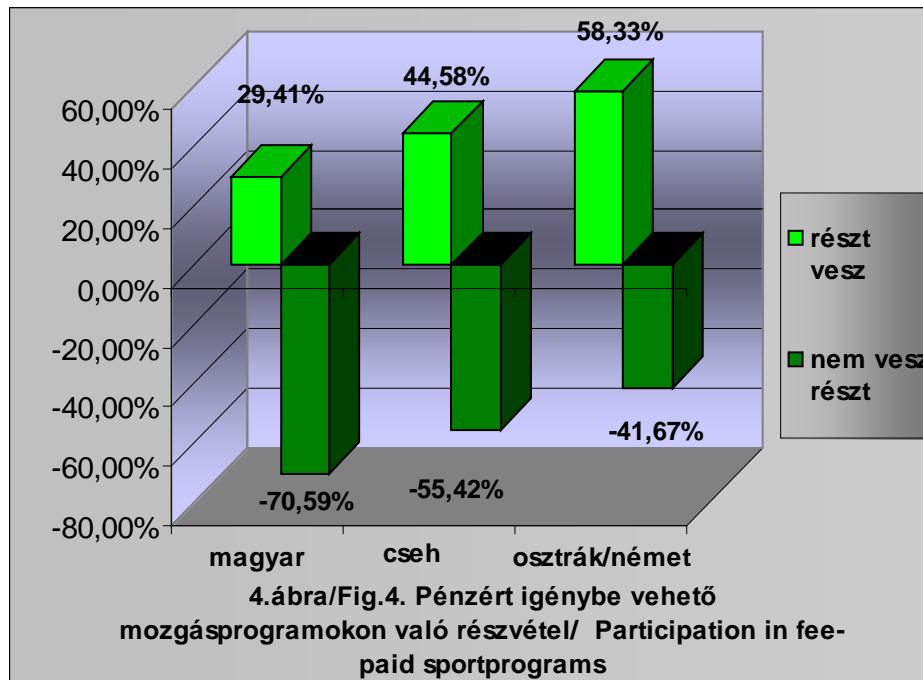


Figure 4. Participation in fee-paying sport programs.

Besides the lack of financial resources, other reasons are also possible for not participating in the fee-paying programs. As when sport is part of our everyday activities, of our way of life, we do not mind spending money on it. If it is not, it is easy to resist. Figure 5. shows the guests' sport activities at home.

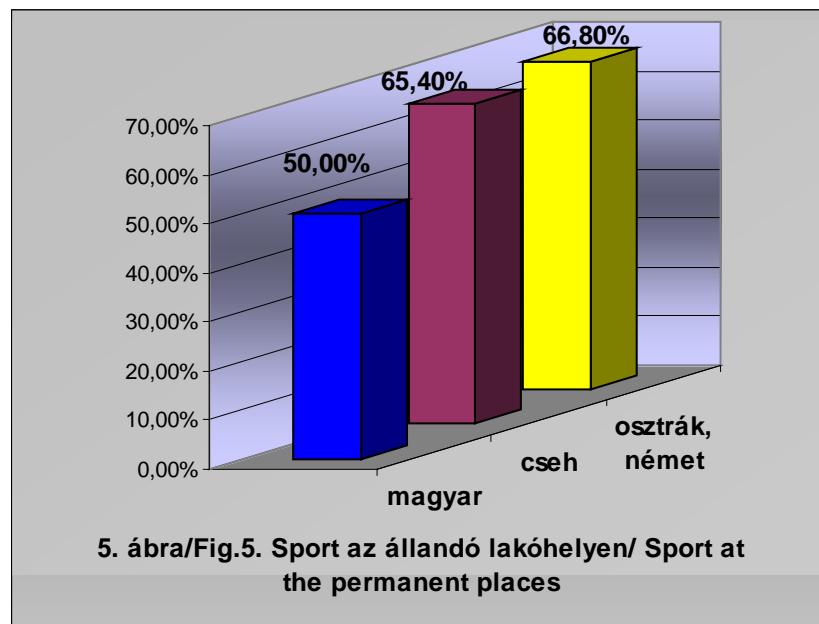


Figure 5. Sport activities at home.

Doing sports for health is maybe more important at an older age, in order to retain our locomotor mobility, general wellbeing, good physical condition and quality of life. Figure 6. shows that the majority of the Hungarian surveyed have come for medical treatment. It is true that we do not do sport when we are ill, however quite a few sport activities can help to cure illnesses. A health-conscious person seeks the possibility for recovery even with sport activities.

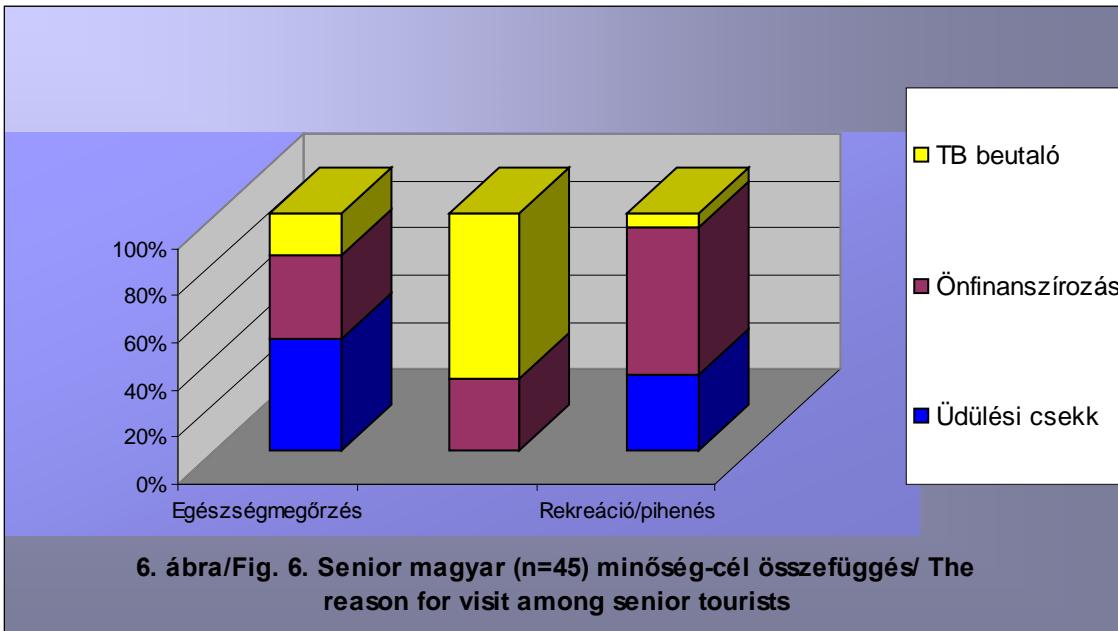


Figure 6. The reason for visits among senior tourists.

## 7 Conclusions

Participation of the Hungarian guests in sport activities is far below in every respect that of the foreign guests. The reason for this can be of financial nature or other, but it is very likely that the Hungarians have a simpler concept of health, how to reach it and by what means. According to certain figures, the number of health-conscious people has increased lately, yet concerning sport activities the Hungarian guests are behind the foreign ones based on the findings.

This statistic figure could be improved by a change in the approach, but even tourism, with its sport elements on the supply side, could implicitly help to change the way of life.

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## **Sporting and Sports Equipment Purchasing Habits of University Students in Szombathely.**

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West – Hungarian University, Szombathely, Hungary.

### **Abstract**

*One of the deciding factor of the effective sport supplements is to measure the student's sporting habits, because they are happier to do what they actually like. It was found from the survey, that the generality of the young adults hike, make a trip, dance or race-sport very rarely, and only do some leisure sport just once a week. In addition to the results of those who get exercise daily, only 28,5% of the students do sports regularly.*

*From the ranked sport equipments the training shoes and the sportswear are exceeded. Fitness and swimming pool season tickets got numerous nominations as well. In point of genders less man choose indoor cycle and sportswear, while*

*significantly more women choose Fitness season tickets. Sportswear and indoor cycle are not so significant for man as for woman.*

**Keywords:** students, sport, sport equipments

## 1 Introduction

The issues of healthy lifestyle and workout are occurring more and more frequently nowadays. Health behaviour and health value are culture-dependent factors so the systems of norms and values in a society greatly contribute to the formation of them (Ferron, 1997). A regular physical activities have very good physiological and psychological effects on health. (Brukner and Brown, 2005).

The topic has a great impact on everybody, since health, which we do not achieve by various therapies, medical interventions, but by health promotion, is fundamental to our life. The lifestyle of those young people who regularly do exercise is healthier, than those doing other activities in their spare time (Burke, 1997). It is estimated that only thirty percent of the 15-85-year-old age group take part in physical activity on a regular basis in Hungary and this rate is significantly decreasing by age. (Gáldi, 2002.)

Realizing the values of a health-conscious lifestyle is essential for taking conscious steps. As for exercise, we can come to the same conclusions: it is proved that lack of exercise is detrimental to health, but at the same time we also know the positive effects that regular exercise can have on health and the quality of life.

As it is known that regular exercise has preventive, maintaining and healing functions, its importance is indisputable taking into consideration the whole society, including children, adults and the elderly, of course.

## 2 Method and subjects

The sample is made up students of the West Hungarian University, Savaria Campus. We're using random sampling method, examined sample: 274 students (34% men, 66% women). We're using mathematical statistical method. SPSS 15.0 for Windows statistical software.

## 3 Results and discussion

### *Sporting Habits*

Table 1. The interviewed students had preference for the following leisure activities.

Frequency	Hiking	Excursion	Dancing	Competitive Sport	Leisure Time Sport
Never	7.8	3.3	18.6	54.9	2.8
Rarely	61.3	57.5	32.7	25.7	20.5
Monthly	25.6	32.1	18.4	5.7	14.6
Weekly	5.1	6.4	25.5	9.0	38.3
Daily	.2	.7	4.9	4.7	23.8
<b>Total</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>
Significance	p<0.05	P<0.05	p<0.05	p<0.05	p<0.05

A vast majority of the interviewed young people rarely go Hiking ( $\text{Chi}^2=752.219$ ), rarely go on excursions ( $\text{Chi}^2=715.211$ ), rarely go Dancing ( $\text{Chi}^2=126.543$ ), rarely do Competitive Sports ( $\text{Chi}^2=543.012$ ), and do some kind of Leisure Time Sport on a weekly basis ( $\text{Chi}^2=201.920$ ). Adding up the results of those doing exercise daily (Competitive Sport 4.7%; Leisure Time Sport 23.8%), it shows that it is only 28.5% of the students who regularly do sport.

Table 2. Popular sports activities done in free time considering independent variables.

<b>Independent Variables</b>	<b>Hiking</b>	<b>Excursion</b>	<b>Dancing</b>	<b>Competitive Sport</b>	<b>Leisure Time Sport</b>
Girl-Boy	P<0.05	-	p<0.05	p<0.05	p<0.05
Mother's Qualifications	-	-	-	-	-
Father's Qualifications	-	-	-	-	p<0.05
Does Sport 0-2 Times/Week	-	-	-	-	p<0.05
Does Sport 3 or More Times/Week	P<0.05	-	-	p<0.05	-

Except for going on Excursions, there is a significant difference considering the results of each question. Girls go Hiking less frequently (Pearson  $\text{Chi}^2=12.653$ ), they go Dancing more (Pearson  $\text{Chi}^2=61.866$ ), fewer of them do Competitive Sport (Pearson  $\text{Chi}^2=81.892$ ), and they do less Leisure Time Sport activities than boys (Pearson  $\text{Chi}^2=65.402$ ). As regards gender, the results demonstrate that girls are more inactive than boys in case of both Competitive and Leisure Time Sport. The children of fathers with higher education qualifications do significantly more Leisure Time Sport than the others (Pearson  $\text{Chi}^2=15.813$ ).

Among those doing sport regularly, it is more common that they do activities that are to do with Competitive Sport, and students who do sport less frequently tend to do activities that are to do with Leisure Time. The number of students who do Competitive Sport is lower than that of students who do Leisure Time Sport.

### *Purchasing Sports Equipment*

Table 3. Purchasing sports equipment from gift money.

<b>Sports Equipment</b>	<b>Opted for</b>	<b>Not Opted for</b>	<b>Total</b>	<b>Significance</b>
Sports shoes	28.7	71.3	100	p<0.05
Stationary Bike	7.7	92.3	100	p<0.05
Swimming Pool	16.1	83.9	100	p<0.05
Season Ticket				
Skateboard	3.8	96.2	100	p<0.05
Tennis Racquet	4.9	95.1	100	p<0.05
Skis	5.4	94.6	100	p<0.05
Fitness Season Ticket	19.1	80.9	100	p<0.05
Hiking Boots	7.1	92.9	100	p<0.05

Skates	9.2	90.8	100	p<0.05
Sportswear	29.9	70.1	100	p<0.05

Table 4. Heterogeneity test of those having ranked the sports equipment considering gender and parents' qualifications.

Sports Equipment	Gender	Mother's Qualifications	Father's Qualifications	Sporting Habits	
				0-2 times a week	3 or more times a week
Sports shoes	-	-	-	-	-
Stationary	p<0.05	-	p<0.05	-	-
Bike					
Swimming	-	-	-	-	-
Pool Season					
Ticket					
Skateboard	-	-	p<0.05	-	-
Tennis	-	p<0.05	-	-	-
Racquet					
Skis	-	-	-	-	-
Fitness	p<0.05	-	-	-	-
Season Ticket					
Hiking Boots	-	-	-	-	-
Skates	-	-	-	-	-
Sportswear	p<0.05	-	-	p<0.05	-

Sports shoes and Sportswear are high on the top of the list of the ranked pieces of sports equipment. The sum of the percentage that the 2 items amounts to (58.6%) is more than the total of the other eight pieces of equipment altogether. Having information about their dressing habits and knowing the percentage of those who do sport, the students presumably purchase sports shoes and clothing not solely for sporting purposes, but for everyday street use. The two items that come next on the list are the Fitness Season Ticket (19.1%) and the Swimming Pool Season Ticket (16.1%).

As for gender, fewer men opt for a Stationary Bike (Pearson Chi<sup>2</sup>=7.000) and Sportswear (Pearson Chi<sup>2</sup>=9.281), while there are significantly more women who will choose a Fitness Season Ticket. (Pearson Chi<sup>2</sup>=33.217). Men do not consider Sportswear and Stationary Bikes as important as women do.

Taking parents' qualifications into consideration, a student being the child of a mother with a higher education qualification tends to buy a tennis racquet (Pearson Chi<sup>2</sup>=6.189), while Skateboards, showing a considerable difference, would be purchased by students having a father with higher education qualifications (Pearson Chi<sup>2</sup>=7.309). As regards the positive value of choosing a Stationary Bike, it is the children of less educated fathers where there is a significant discrepancy. (Pearson Chi<sup>2</sup>=6.319).

#### 4 Conclusions

From the ranked sport equipments the training shoes and the sportswear are exceeded. Fitness and swimming pool season tickets got numerous nominations as well. In point of genders less

man choose indoor cycle and sportswear, while significantly more women choose Fitness season tickets. Sportswear and indoor cycle are not so significant for man as for woman. Health is the unity of our physical, mental, intellectual, social and emotional life. Our health is only complete if we live in harmony with the natural and social environment surrounding us. Since it is more difficult, though not impossible, to start a more health-conscious life at an older age, the goal would be to start education for a healthy lifestyle at an early age, during childhood. (Polgár, 2008.)

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## **Researching factors which influence the sport career among Hungarian elite volleyball players.**

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### **Abstract**

*Volleyball is in a difficult situation in Hungary. There are only few junior players. Getting into the sport often happens by chance. The youngster or junior age-groups often fall into pieces just before they could get into the adult team. This fact is also proved by research. The aim of the research is to find the answers to the question whether there is a certain way in Hungary nowadays on which somebody can reach the front line and can be among the best volleyball players, or not. The research of our selected men and women volleyball players' past and present in sport (N=36) deals with four issues. Details of getting into the team, skills or maybe specialities needed for playing volleyball, the quality of years spent with playing volleyball connected to age-group and circumstances of getting into the front-line. The problem was researched with the help of questionnaires, in which open format questions and closed format questions (with one or more choices) appeared. It was found that 63% of the respondents had already done sports before started playing volleyball (athletics 28%, basketball 21%) or started playing volleyball because they were encouraged by their parents or P.E. teachers. Of the respondents, 45 % wanted to be a famous sportsman, or the purpose was just simply recreation. Only 10 % of them started playing this sport because of the chance of earning money with it. According to our selected players' opinion, their self-development (59%) and the presence of their mental abilities (leader-like personality, cooperation, strength of will) contributed to the fact that they are in the Hungarian National Volleyball Team today. It can be concluded from the research that deciding on someone's suitability or the measurement of the physical and cognitive abilities' presence is not continuous. It appears typically in the adult age-group, where coaches apply also combined (psychological and motor) tests. In other countries (e.g. Italy) their objective selection systems work well, whereas in Hungary the principle of "the coach's eye" is still dominating.*

### **1 Introduction**

In the last few years several researches have been made about selection and nursing talented players. Based on the background literature, the objectives of the surveys were to give some practical advice and define which factors can influence the realization of the talent. In order to get closer to the topic within this sport, we have to study the period lasting from the choice of the sport to the becoming of an elite player. The sport career, which takes at least 10 years, is influenced by many factors. They are the following: the choice of the sport and the connected objectives, motivation, the personality of the coach, the spirit of the trainings, experiencing success or failure, factors from the close social environment (family, friends, school, profession), unpredicted factors (injury, accident), special psychological factors needed for volleyball, motor abilities and the existence of physical features (Biróné, 2004: 241-242).

Consequently, do those ones who want to be desperately prominent volleyball players, supported by the family and environment, have proper motor and mental abilities, furthermore good build and do not get permanent injuries during the sport career become an elite player surely?

The aim of our research was finding an answer to this question. We analysed the factors which influenced our elite players' career from the beginning to the selection. We studied whether all the top-players went through on the same path until reached the top or not.

### **Hypotheses**

H1: In our opinion, most of the players became a volleyball player consciously and not by chance.

H2: The selected players mark out from their mates mainly because of their mental abilities.

H3: We think that members of the selected team got on well with the coaches of their age-groups.

H4: We assume that the self-improvement and extra work of the players also contributed to their success.

## **2 Method**

In our research those men and women volleyball players filled in a questionnaire /N=36/ who were selected in the years of 2008/2009 and 2009/2010. Those players, who were part of the selected team in both league years, filled in the questionnaire only in the first year.

The questions deal with the factors which influence the career of the players, abilities which are needed for players to become selected and chances which help the preparation.

The questionnaire contained one or more-option based closed format questions and open-format questions, as well.

## **3 Results**

In our study we dealt with such factors which could positively or negatively influence a player's time and its quality spent at sport. Based on it, we studied the circumstances of selection, the players' sports background and their objectives in connection with volleyball. We analysed the players' opinion about abilities needed for volleyball and about their own speciality. Finding out their relationship with their coaches and those processes by which their competence in elite line could be detected. According to the background literature, starting playing volleyball is the best between the ages of 9-11 (NÁDORI, 1991: 275). On the average, our selected volleyball players started the sport at around the age of 10 (Table 1).

Table 1. Time of starting playing volleyball.

	N	Minimum	Maximum	Mean	Std. Deviation
Time of starting the sport	36	5	16	10,94	2,777
Valid N (listwise)	36				

Certain sports (artistic gymnastics, rhythmic gymnastics, Goliat football) start the children's training early. By the ages of 9-11, most of the children have already tried some sports in which they probably reached success, too. So, directing them towards another sport – at present, towards volleyball – is the duty and responsibility of parents and experts.

It can be seen on the diagram (Figure 1) that 63 % of the players (23 persons) did some sports before playing volleyball. Among the sports, athletics, martial arts, swimming and basketball (Figure 2) appear. These are sports, which opposed to volleyball, offer sport facilities for kindergarten and primary school students, as well. It is also worth mentioning that most of the players had played basketball and done athletics before. These sports could serve as good basics for their later volleyball career.

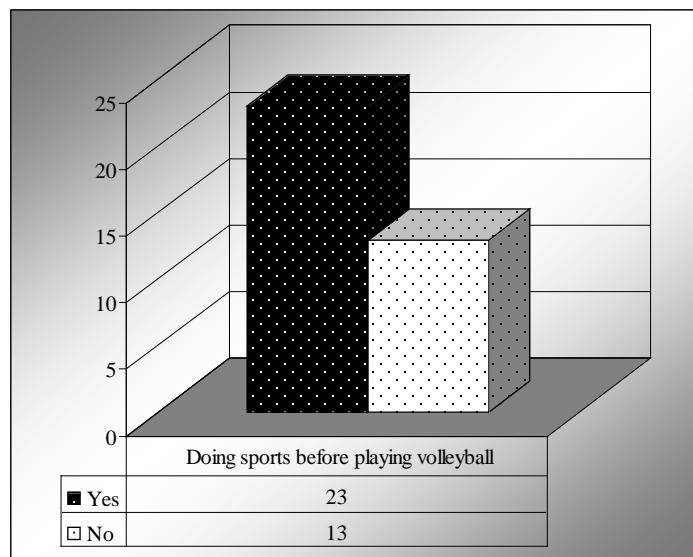


Figure 1. Doing sports before playing volleyball.

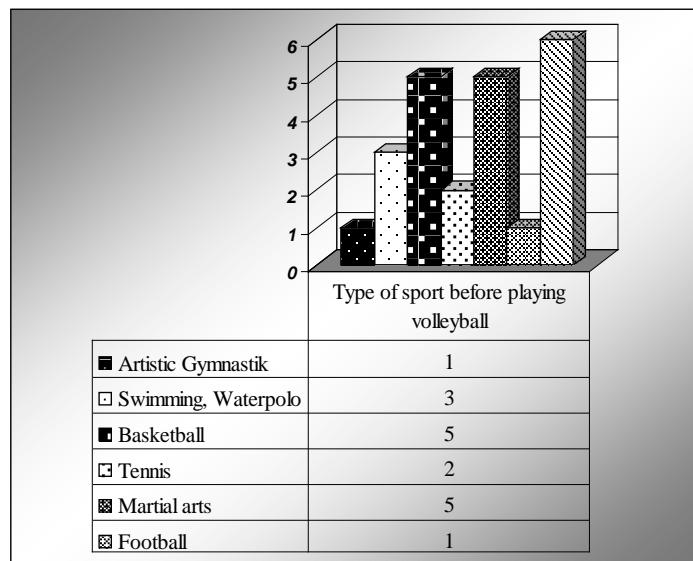


Figure 2. Type of sports.

In volleyball, the application happens during recruitments, where the children usually appear not because of their own free will. Basically, their parents' dedication towards the sport, the friends or the P.E. teacher's influence is in the background of their choice.

A further influential factor can be the results of the local volleyball team or spectacular, exciting matches on TV, as well. It turned out that the choice of the sport had been basically influenced by the P.E. teachers and parents of the players (Figure 3). According to each background literature which deals with selection, the role of the P.E. teacher is vitally important in the process of training junior players. There are several measurements and observations which help to direct children towards the most proper sport, based on their aptitude and skills. The children of those parents, who also play volleyball, tend to start this sport willingly, too.

Many of their parents are still active at the sport or have already finished their sport career but still love going to volleyball matches and events. Thus, the volleyball court and the proximity of players seem to mean a straight line towards the love of this sport.

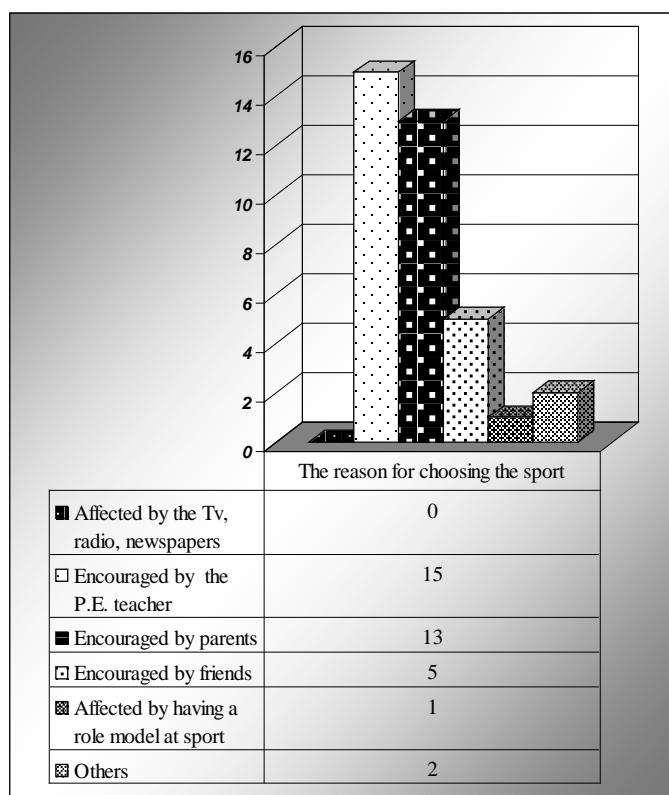


Figure 3. The reason for choosing the sport.

Interest towards the sport is aroused by the movements, the love of playing together, the novelty and excitement. After a short time, a further motivating factor can be the possibility of becoming an elite player or making a living with the sport. We received a partly surprising answer to the question of 'What was your objective with volleyball?'(Figure 4).

We presumed that players were preparing for their career on a conscious way (H1) and wanted to become famous players or earn money with the sport. Behind both motivations, determined ideas and conscious, ambitious behaviour appears which can result in desperate preparation. Opposed to it, only 17 respondents wanted to become famous sportsmen and a further 17 respondents said that volleyball was "only" a useful past time activity. One respondent was motivated by the possibility of earning money with the sport and another one

player did not give an answer to this question. So, our hypothesis was not proved but we found an interesting connection.

Those players, who were motivated to play volleyball by the P.E. teacher, answered in great numbers (exactly 71 % of them) that the sport is just a pleasure, useful pastime activity for them; while 69% of those respondents who were motivated by parents, wanted to become famous sportsmen.

The game has speeded up by the development of techniques, tactics and the modification of rules. The players can get the better of the opposing team with quick decisions, unexpected, sudden solutions. For this, they need outstanding aptitude, special abilities. An elite volleyball player is visibly tall and has long limbs. He endures monotony well but has a little scoundrelism, as well. We hypothesise that he can work in a good team, so has the ability of cooperation but is also able to solve the tasks on his own.

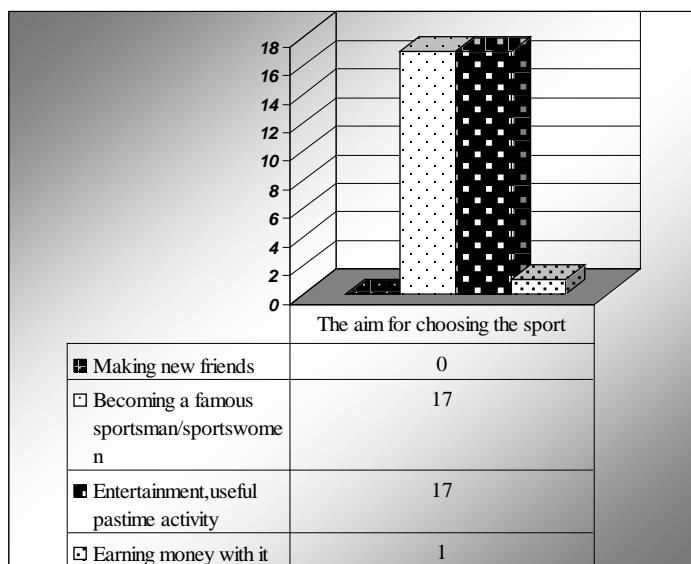


Figure 4. The aim for choosing the sport

As the consequence of the momentary ball touches, the player can solve sudden situations, long rally, and sustained tasks under five-set matches.

In order to be able to analyse which players could be among the elite ones, we have to define the abilities and features for that.

Based on the background literature (Harsányi, 2000: 106-107, 82-83; Nádori, 1991: 274-293; TRZAKOMA-BICSÉRDY, 2009: 265; Hancik et al., 1990: 83-85) and our own experiences, the following abilities and features are important and needed for reaching the elite line: good physical-, coordination- and conditional abilities, psychological and environmental factors. It means the followings at volleyball:

1. Physical abilities: high build, long limbs
2. Motor abilities: ball mastery, quickness, flexibility, joint suppleness, strength, stamina, balance
3. Features of personality, psychological factors: courage, discipline, game-intelligence, motivation, firmness, ambition, helpfulness, fighting spirit, endurance, long-lasting attention, tolerance of monotony, sense of space, anticipation, importance of humility, self-discipline, fast reaction time, power of will, moderation, leading personality, load ability.
4. Environmental factors: parental background which support the sport.

We asked the respondents' personal opinion about which abilities are needed for volleyball. We asked them to choose the five most important ones from the list.

Furthermore, they had to write down what they thought about how they could become selected players, what kind of abilities could help them in it and what their specialities are (Figure 5).

Many (6) of the 8 mostly mentioned factors belong to the mental abilities. Our players think that physical and build factors are also important, however, the psychical preparedness plays the most important role in the efficiency of a player /H2/. 65% of them say that their own mental abilities (leading personality, humility) helped them, too to become selected players in volleyball. Our second hypothesis /H2/ could be proved, as well. Based on it, the players mark out from the others mostly by means of their mental abilities. To be the best at volleyball (two players' responds were not evaluable), 39% of them did extra trainings, 29% of them did maximum training work, 17% of them took the coach's advice and 15% of them prepared mentally. So, our hypothesis /H4/ was proved.

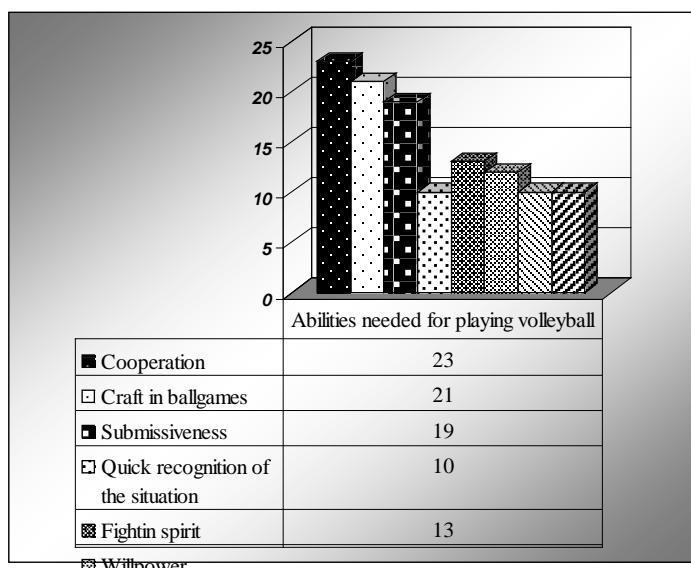


Figure 5. Abilities.

Detecting the abilities and the best knowledge is the role of the coach. A beginner player has and works with three or even four coaches until he becomes an adult player. The personality and aptitude of the coach can influence the player's later career a lot. He is responsible for the thing that every single factor in the young players' life should be in harmony: the family, the career, the company of the peers and free time (SIGURD, 2006: 135-135). The cheer of trainings, the sufficient number of matches which can uphold motivation, the attention and proximity of the adult team all help the players to stay in sport and guarantee the continuous preparation. Most of our elite volleyball players liked and respected their coaches in all the three age groups. 28 respondents out of 36 had already played volleyball in the child age group.

Twenty subjects (71.5%) had a really good relationship with their coaches, 17.9% of them accepted the coaches and only 10.6% had changeable relationships with them, that is neither bad nor good (Figure 6).

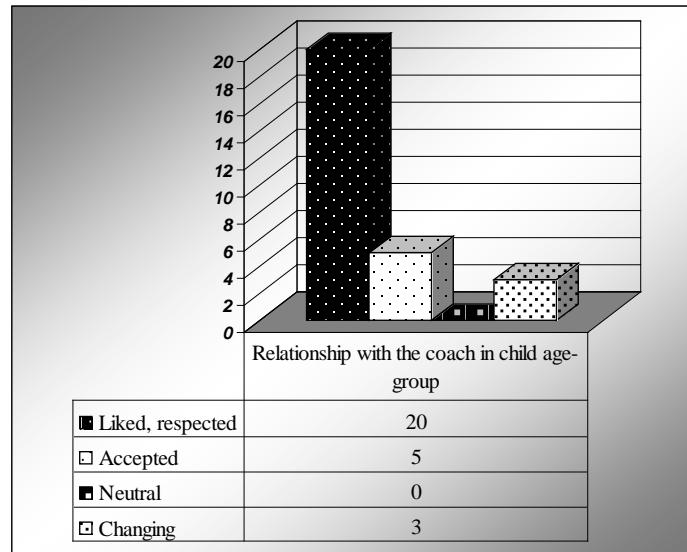


Figure 6. Relationship with the coach.

The relationship between the coach and players is similarly satisfactory in the puberty age group, too. 19 out of 35 respondents liked, respected the coach. 12 players (23%) accepted him or her, 1 player had neutral connection with the coach and 3 people had changeable relationship with him or her (Figure 7).

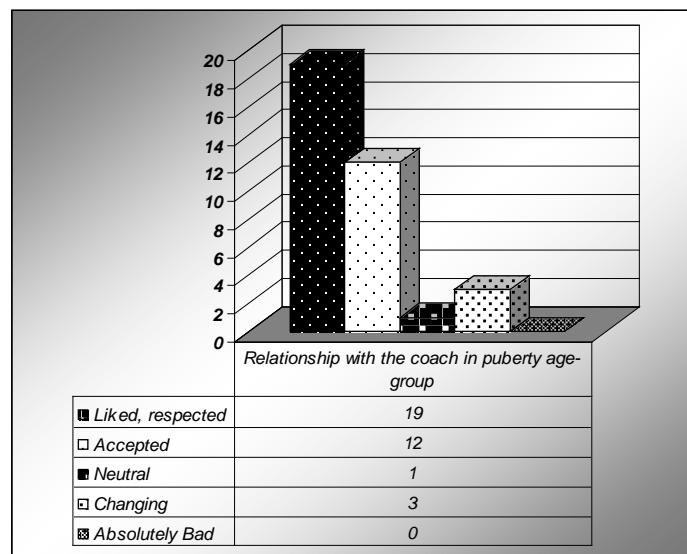


Figure 7. Relationship with the coach.

In Hungary each volleyball team (except universities and colleges) is obliged to have a junior team. It means a problem for almost all the associations. Because there are not enough players, junior players necessarily get into the adult team many times where they might meet failures continuously. The personality of the coach and his or her relationship with the players may be the most important in this case. On the diagram (Figure 8) it can be seen clearly that also in this age group most of the players had a good relationship with their coach, which fact also determines the preparation and performance a lot.

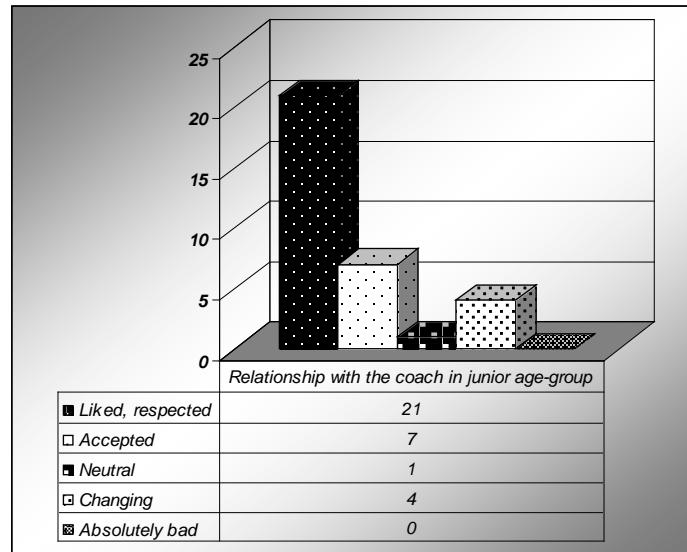


Figure 8. Relationship with the coach.

Consequently our hypothesis was proved /H3/. Based on it, most of our players had a really good relationship with their coaches. During the time of preparation the coaches continuously monitor their own players and the opponent team's players; and based on the players' proficiency and performance they draw conclusions. These conclusions and monitoring are useful but do not involve the whole personality and complex features of the youths. It can happen that by neglecting the fact of improvement and early maturity the coaches draw wrong conclusions. In order to avoid from that, the solution would be a selection based on continuous, complex measurements. In volleyball, selection is mostly based on the players' performance on the matches. Only few coaches apply complex measurement for proving a player's suitability. During the career of our elite players, only 19.4% of them were regularly measured (Figure 9).

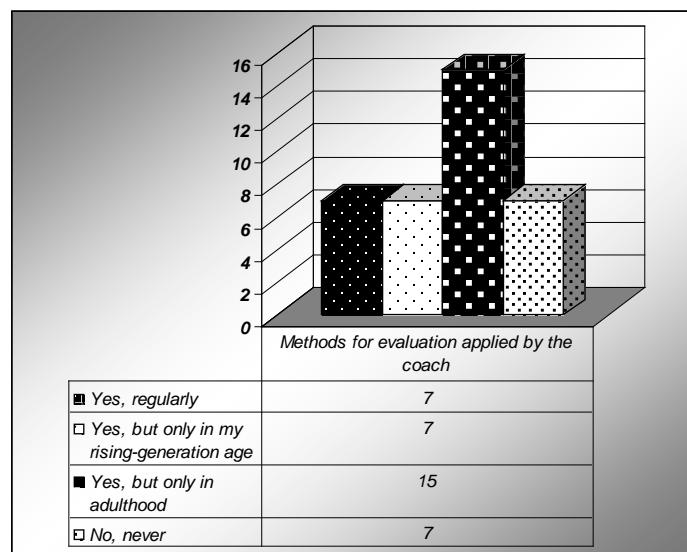


Figure 9. Selection.

The most common measurement methods are motor tests and height measurement.

These methods are applied compulsorily since joining the Herakles program and players are measured by regional leaders.

Known, but less often applied methods among volleyball players are the psychological tests, sociometric measurements which measure the character, moral and volitional skills (Hancik et al., 1990: 83-84).

#### **4 Conclusions**

The aim of our study was to find the answer to the question whether there is a certain way in Hungary on which someone can reach the front line and can be among the best volleyball players, or not. In our survey we studied the sport career of our selected male and female volleyball players. It turned out that the answers of the players are very similar and show only slight differences. More than half of the players have switched to volleyball from another sport because of their parents or P.E. teachers' suggestion. The bulk of these encouraged young players had already known that they wanted to be famous players, so prepared consciously to their career. Based on the analyses it can be said that those volleyball players who have suitable motor abilities needed for the sport and regarding the mental field are strong players or have good or acceptable relationship with the coach, can get into the front-line with good chances beside sufficient preparation.

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## **Sport Pedagogical and Psychological aspects**

# **“Self”- conception formation at future specialists in sphere of physical culture and sport.**

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## **Abstract**

*In sphere of physical training and sports many scientists are engaged in a problem of personal-professional development of the future experts, because now in the course of change of the higher educational system have increased requirements to quality of preparation. We supposed that the system of the students' psycho-pedagogical support is based upon a new students' and lecturers' interaction during educational process. It was revealed that the students trained in the system of psycho-pedagogical support had the level of the development of communication skills more than 59%, empathy -52%, tolerance – 59%, reflection – 72%, emotional flexibility – 53%. These indicators are more than 14% higher than at students not involved in the experiment. The analysis of the received results has allowed to allocate a number of the basic tendencies of the student's personal-professional development of sport academy. The analysis of the received results has allowed to allocate a number of the basic tendencies of the student's personal-professional development of high school of physical training.*

## **1 Introduction**

In sphere of physical training and sports many scientists are engaged in a problem of personal-professional development of the future experts, because now in the course of change of the higher educational system have increased requirements to quality of preparation.

Modern requirements to the specialists make active a task of preparation of the purposeful, independent, creative person showing high level of culture, structurally overcoming arising stressful situations in life and activity (Khazova, 2008; Mitina, 2003; Toschenko, 2004).

Many psychologists suggest that the educational process in high school influences much on developing “self”-conception in the whole. The certain life standpoint and professional position defining the level of competence of the personality and professional are formed during the educational process (Byorns, 1986; Khazova, 2008; Mitina, 2003).

However, the result of a traditional professional training in this area is the expert with the standard thinking, focused on narrow understanding of the problems in the field of optimization of pupils' state of health, their physical activity, poorly showing the initiative and creativity in professional work.

One of possible ways of solving this problem can be purposeful psycho-pedagogical support of students, providing efficiency of the professional-personal becoming from the point of view of preparedness for professional work (Ershova, 2004).

We define “support” as complete process of studying, forming, developing and correcting the person's professional becoming in the situation of high school training. It is focused on the change of students' educational activity. It promotes the creation of conditions of improvement of educational quality.

## **2 Method**

### **2.1 Subjects**

The subjects were 163 students of Velikie Luki State Academy of Physical Culture and Sport (age 17-23). The investigation was based on questionnaires. In the analysis categories were coded and grouped in themes according to their characteristic features and then non-parametric statistics were used.

## **2.2 Purpose**

The purpose of our study was to reveal the developed of “self”-conception at the future sports specialists at different level of studying at high school and to define the organizational-pedagogical conditions promoting its development.

## **2.3 Tasks**

- a) To study the students' ideas their ideal level of developed professionally important skills necessary for the sports specialists.
- b) To study “self”- conception of developed professionally important skills, at sports specialists at the 1<sup>st</sup>, 3d, and 5<sup>th</sup> courses.
- c) To reveal the distinctions in developed components of “self”-conception at different grade levels of the sports academy.

## **2.4 Methods**

### **2.4.1. Special literature analysis.**

### **2.4.2. Psychodiagnostics methods.**

- a) The questionnaire for revealing of formation "Self" – concepts at the future teachers-psychologists.
- b) The Technique of revealing of communicative and organizing abilities.
- c) The Questionnaire of revealing of communicative tolerance (V.V.Bojko).
- d) The Test questionnaire of motivation affiliation measurement (The test-questionnaire of A.Mehrabiana modification).
- e) Estimation to stress resistance (Medical center of Boston University).
- f) The definition of emotional intelligence (Holl, N.).

### **2.4.3. Pedagogical experiment.**

### **2.4.4. Methods of mathematic statistics.**

## **3 Results and Discussion**

Such qualities as empathy, reflection, tolerance, communicative skills, emotional flexibility, stress tolerance, affiliation and organization skills were examined. We can see (Fig.1) that the most significant professional quality for the 1-st year students is objectivity and the least significant is affiliation. For the students of the 3-d course the most significant is communicative skills and the lesser is tolerance. Students of the 5th course put on the first place stress stability and the last place occupies affiliation.

At studying of an image "I"-real (Fig.2) it was revealed, that at students of the 1<sup>st</sup> course communicative abilities are the most expressed, the less is tolerance; at the 3-d year students communicative abilities have 8,95 and the less one is stress stability with 7,1. For the students of the 5<sup>th</sup> course the most expressed are such qualities as stress-tolerance and emotional flexibility 9,1 pts accordingly, and affiliation has only 7,2.

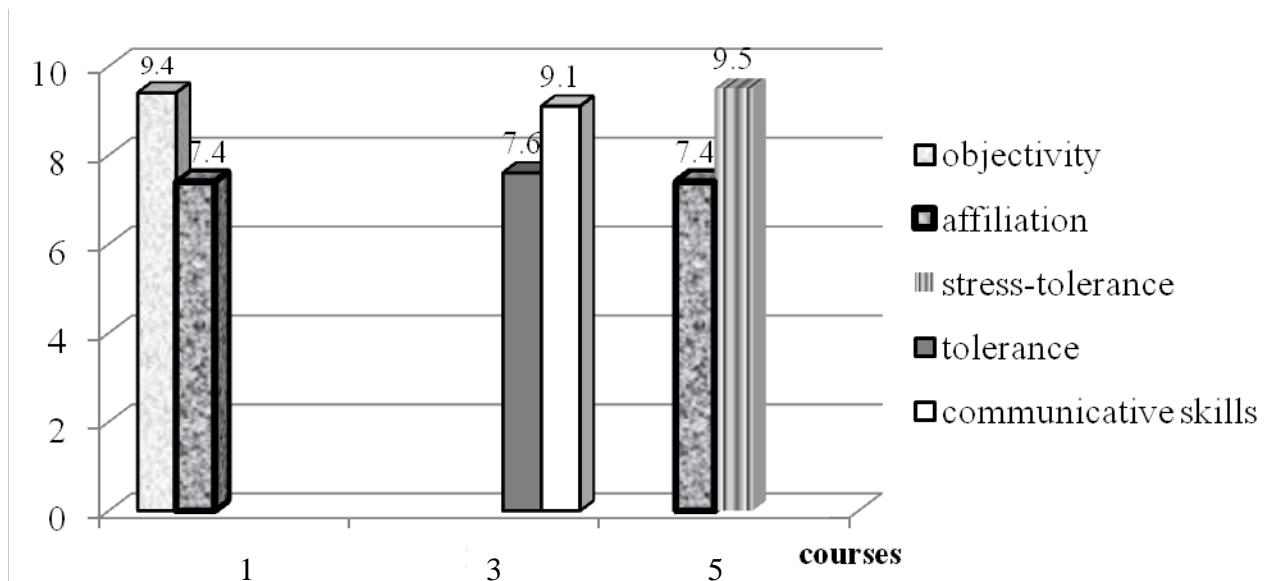


Figure 1. The average indices of the “Self”- ideal at students.

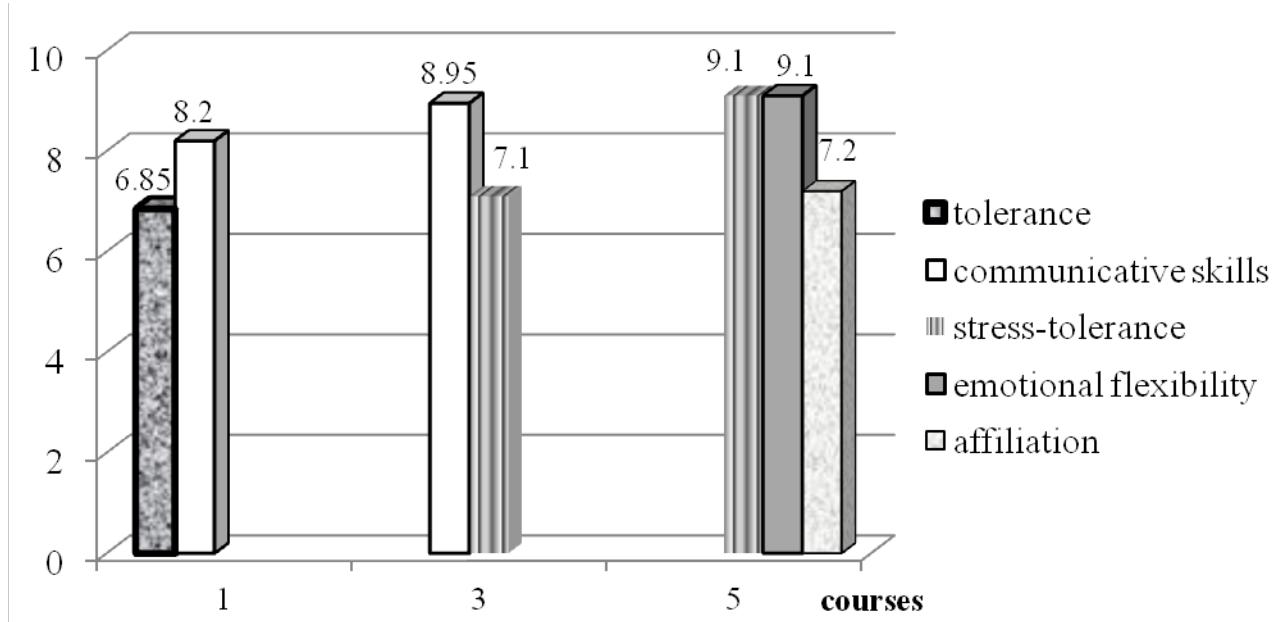


Figure 2. The average indices of the “Self”- real at students.

Having studied communicative skills (Fig.3), it was revealed, that at 35 % of students of the 1<sup>st</sup> course and 50 % of students of the 3-d course the level of development of these skills are high. It allows to make the conclusion, that to the 3-d course, they got professional knowledge helping to come into contacts and to communicate with other people; easy to behave in new collective; to defend the opinion. Besides they prefer to make independent decisions.

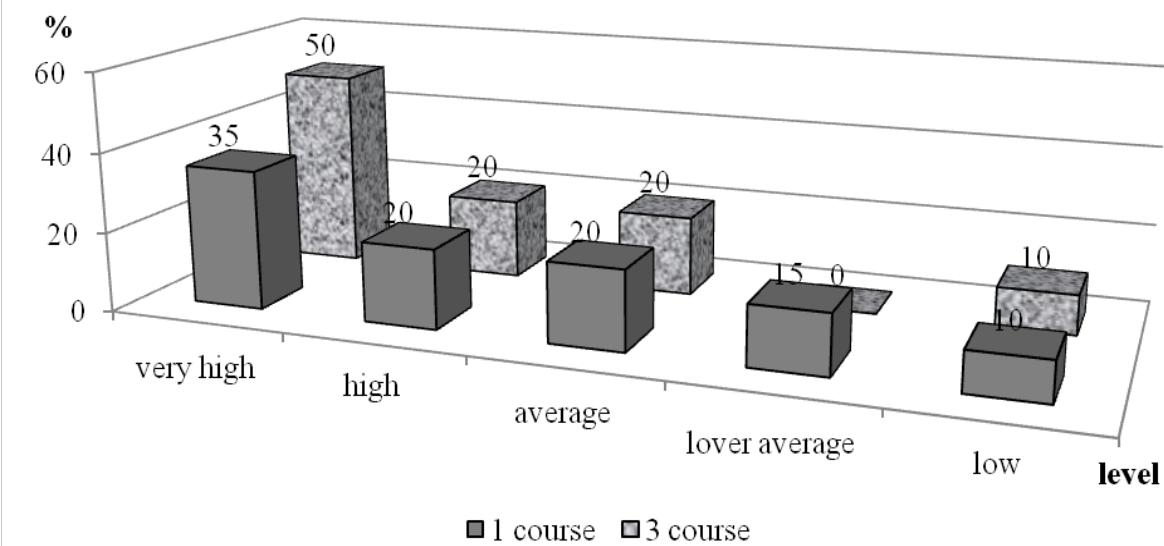


Figure 3. The level of communicative skills developed at the 1<sup>st</sup> and the 3d year students.

One of the basic skills, allowing to solve professional problems, there should be a tolerance. At diagnosing of a level of tolerance development (Fig.4) it was established, that at 70 % of examinees of the 1<sup>st</sup> course the low level of development of the given skill prevails. It testifies that the dominating part of students does not possess professional abilities to show tolerance.

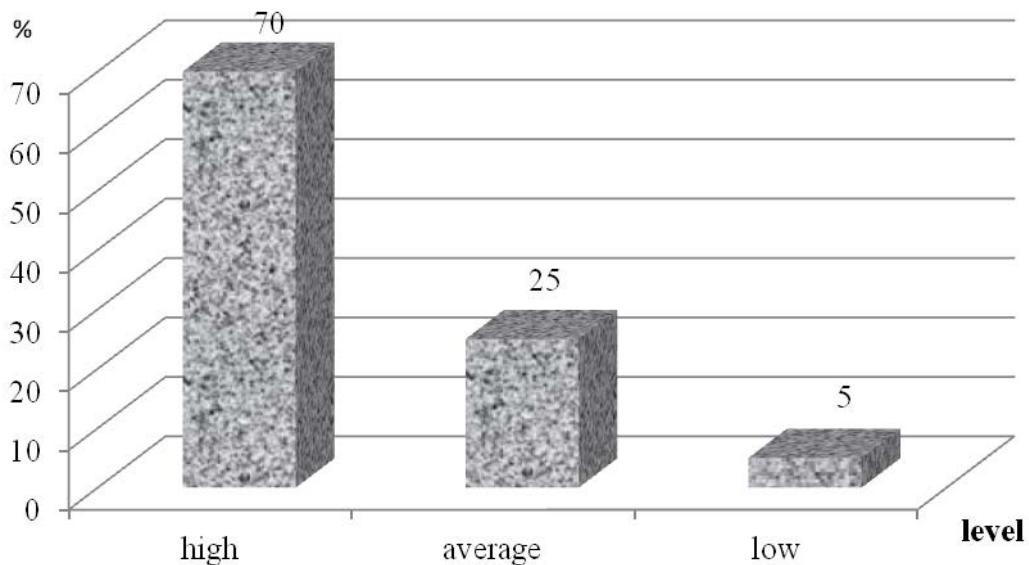


Figure 4. The level of communicative tolerance developed at students of the 1<sup>st</sup> course.

Studying stress stability (fig.5), it has been established, that at 60 % of the 3-d year students this skill is on a low level development, while at 64,3 % of students of the 5<sup>th</sup> course its level is high. It is possible to assume, that students by the end of the high school have necessary professional knowledge and qualities which help them to resist to stressful situations, to overcome difficulties, to suppress the emotions, to understand human moods.

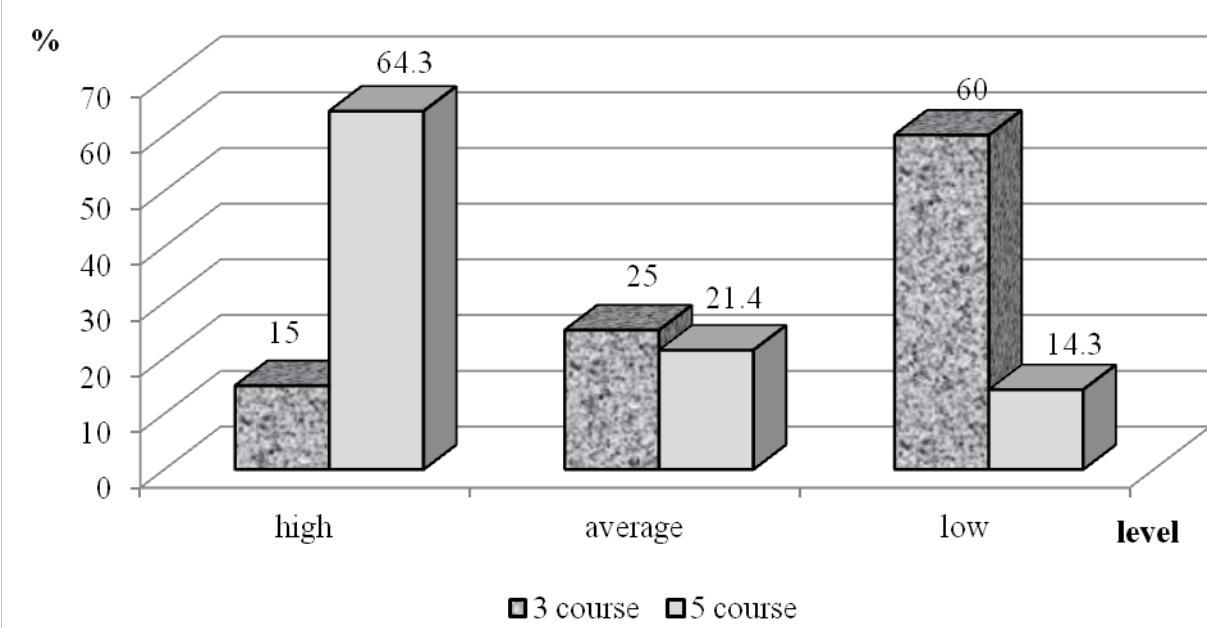


Figure 5. The indices of stress stability at the 3d and the 5<sup>th</sup> year student.

One of the important qualities for the future sports specialists is the emotional flexibility. The level of its (Fig.6) development at 64,2 % of examinees of the 5<sup>th</sup> course is high enough. It allows to tell about the ability of good understanding of own emotions and emotions of other people, responsiveness and emotional stability.

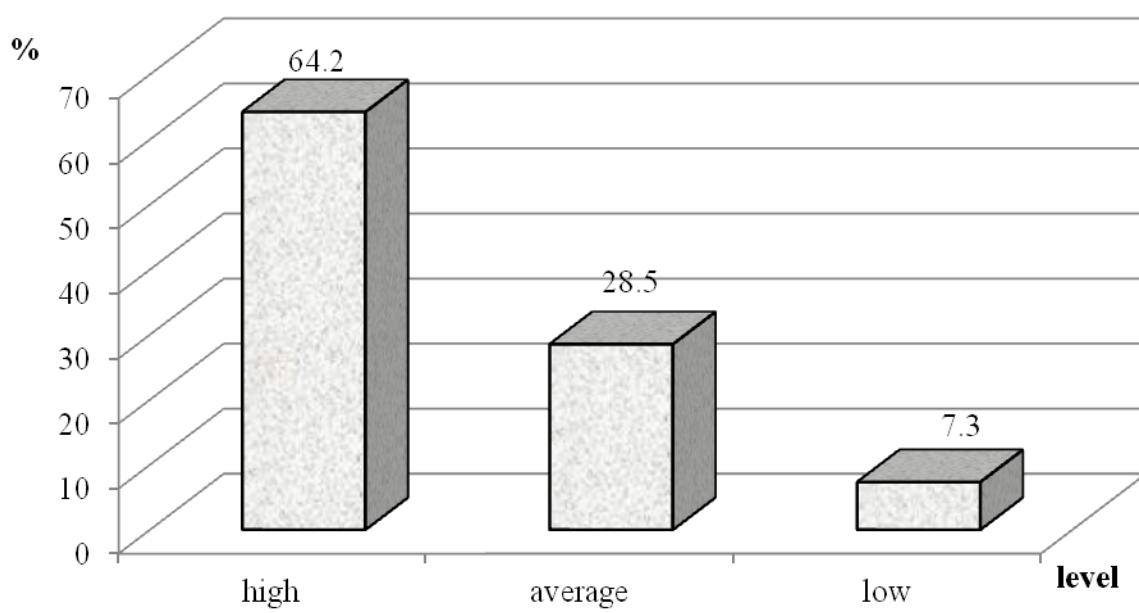


Figure 6. The indices of emotion flexibility at students of the 5<sup>th</sup> course year student.

It was established that the level of formed of components of “self”-conception and components’ development at different steps of training is unequal and has nonlinear character. The comparative analysis has shown that there were not reliable distinctions among “I”-ideal

and “I”-real estimated at the students of the 1<sup>st</sup> course; there were reliable distinctions at students of the 3d course in such skills as: communicative and organizational. As for the 5<sup>th</sup> year students there were reliable distinctions between “I”-ideal and “I”-real in all qualities estimated. These results testify that the students receive necessary professional knowledge, get some experience greatly influencing on “self”-conception developed.

It was revealed that the students trained in the system of psycho-pedagogical support had the level of the development of communication skills more than 59%, empathy -52%, tolerance – 59%, reflection – 72%, emotional flexibility – 53%, stress tolerance 64%, affiliation 55% and Organization skills 58%. These indicators are more than 14% higher than at students not involved in the experiment.

#### 4 Conclusions

The analysis of the received results has allowed to allocate a number of the basic tendencies of the student’s personal-professional development of sport academy. The analysis of the received results has allowed to allocate a number of the basic tendencies of the student’s personal-professional development of high school of physical training. They are:

- level of the students’ professional-personal development depends on forming its integrated characteristics;
- process of professional-personal development is caused by a complex of psycho-pedagogical conditions, main of which the technology of psycho-pedagogical support is;
- technology of realization of the psycho-pedagogical support, including pedagogical and psychological methods of influence on the student, promote harmonization of students’ personality of high school of physical training, development of their need for self-knowledge, self-improvement.

Thus, the application of the theoretical seminars, seminar-practical works, problem lectures, different kinds of games and problem tasks, individual consultations, psycho-pedagogical support and personal-focused approach promoted the professional becoming in the sphere of physical culture and sports and as a whole the development of “self”-conception.

The process of purposeful forming and developing of professionally important qualities, and first of all such as empathy, reflection, tolerance, communicative skills, emotional flexibility, stress tolerance has direct influence on the process of “self”-conception development.

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## **Comparison of motor performance and social anxiety of 10-12-year-old PE class and music class children.**

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### **Abstract**

*Methods/Subjects: motor performance (static hanging with bent elbow/sec, standing long jump /cm, number of sitting up during 30 sec), and social anxiety measures (social anxiety and distress in new situations /SADN, fear of negative evaluation/FNE, and social anxiety and distress in general/SADG) were compared for PE class and music class school children of 10-12 year of age (N=132, PE student group=79, music student group = 55). BMI served the differentiation of slim(G1), average (G2) and overweight(3) boys and girls according to Mészáros (2005). Basic statistics, Pearson correlation, ANOVA, and linear regression analysis had been done with SPSS 15.0 for Windows. Cronbach alpha and part-whole correlation.*

*The only sex difference was found in BMI. It was significantly higher for boys than girls. Calendar age correlated only with standing long jump for boys. There was no statistically significant difference between PE class and music class students neither in the motor performance tests, nor in social anxiety.*

*The most significant differences occurred for body weight subgroups with different feature in boys and girls. ANOVA revealed longer static hanging with bent elbow and more number of sitting up in group 1/2 than in group 3 for boys. Standing long jump results differ significantly for groups ½ from group 3 (boys), and group 1 from group 3 (girls). The regression analysis, in the groups of boys, supported the causal relation between static hanging with bent elbow and FNE, and between the calendar age and standing long jump.*

*It was concluded that the students of different specialized classes do not differ from each other in motor performance and emotional characteristics.*

**Key words:** motor performance, social anxiety, PE – music class comparison

### **1 Introduction**

The Hungarian law of education § (8) says:

Those schools that have special classes (teaching faculties in higher amount of lessons), can prepare their own educational program according to the children's interests, preparedness or future plans; and with this own program they can teach with a higher level curriculum than in the normal (non-special class) schools.

*Hypotheses:*

We assumed that hypothesis number one is that

- H.1. Differences in the emotional test will be found between the two types of classes
- As a second hypothesis we supposed that

- H.2. Significant differences in the motor performance will be found between the two classes

And thirdly we thought that

- H.3. At least one of the measured variables will show that the boys and girls had significant differences in motor/emotional results

## 2 Method

In this research we used the SASC (Social Anxiety Scale for Children) test elaborated by A. H. La Greca. Our motor test came from the Eurofit tests, we used 3 tests of them. We used SPSS 15.0 for data processing.

Children of classes four (4), five (5), and six (6) took part in the examination from the Elementary School of Music and Physical Education, Budapest (n=134) The number of the examined pupils was 134.

It was deemed important for the same teacher using the same methods, in both class types.

*Other:*

SASC test (Social Anxiety Scale for Children) test questions.

### Development of the Social Anxiety Scale for Children: Reliability and Concurrent Validity

**Authors:** Annette M. La Greca ; Susan Kraslow Dandes ; Patricia Wick ; Kimberly Shaw , Wendy L. Stone  
**DOI:** 10.1207/s15374424jccp1701\_11  
**Publication Frequency:** 6 issues per year  
**Published in:** Journal of Clinical Child & Adolescent Psychology, Volume 17, Issue 1 March 1988 , pages 84 - 91  
**Formats available:** PDF (English)  
**Previously published as:** Journal of Clinical Child Psychology (0047-228X) until 2001  
**View Article:** View Article (PDF)

Item	Factor	
	1	2
<b>FNE</b>		
1. I worry about doing something new in front of other kids.	.38	.30
2. I worry about being teased.	.59	.23
5. I worry about what other kids think of me.	.76	-.01
6. I feel that kids are making fun of me.	.68	.05
8. I worry about what other children say about me.	.76	.10
10. I am afraid that other kids will not like me.	.65	.11
<b>SAD</b>		
3. I feel shy around kids I don't know.	.18	.41
4. I'm quiet when I'm with a group of kids.	.12	.55
7. I get nervous when I talk to new kids.	.17	.51
9. I only talk to kids that I know really well.	-.03	.34

*Note:* An italicized factor loading indicates an item's placement on the factor.

Item	Factor	
	1	2
<b>FNE</b>		
1. I worry about doing something new in front of other kids.	.38	.30
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7. I get nervous when I talk to new kids.	.17	.51
9. I only talk to kids that I know really well.	-.03	.34

*Note:* An italicized factor loading indicates an item's placement on the factor.

There are 3 main parts of this test.

SADN – social anxiety and distress in new situations

FNE – fear of negativ evaluation

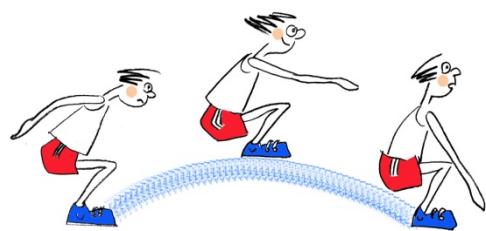
SADG – social anxiety and distress in general

These are the illustrations of the 3 motor tests we were interested in.

1. Static hanging with bent elbow



2. Standing long jump



3. Sit ups for 30 seconds. (30 sec)



### 3 Results and Discussion

Table 1. The results of the examined groups can be seen here in the first table, such as hanging, long jump, sit-ups, body mass index etc.

#### Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
DECIM. AGE	134	9,57	13,34	11,1840	,9403
HANGING	134	,00	62,10	14,4358	14,3988
LONG JUMP	134	100,00	200,00	150,4627	22,3794
SIT-UPS	134	,00	32,00	21,4478	5,1293
BMI	134	12,40	32,00	21,4478	5,1293
SADNSUM	134	6,00	30,00	16,6791	4,7424
FNESUM	134	8,00	39,00	18,8731	6,6597
GSUM	134	4,00	17,00	8,0970	3,2302
Valid N (listwise)	134				

Table 2. In the second table we can see the 3 main factors of SASC (Social Anxiety Scale for Children) test and Chronbach Alfa values in the bottom line, which show validity and reliability of the test. N= 134.

	SADN	FNE	GSUM
MEDIAN	16,68	18,87	8,09
SD	4,74	6,66	3,23
CR $\alpha$	,62	,80	,58

Table 3. Differences between emotional test results I. Comparison of anxiety indices of the two classes with a two-way t-test.

	1=PE class 2=music class	N	Mean	Std. Deviation	Std.Error Mean
SADNSUM	1,00	79	17,2532	5,0140	,5641
	2,00	55	15,8545	4,2314	,5706
FNESUM	1,00	79	18,3671	6,5284	,7345
	2,00	55	19,6000	6,8383	,9221
GSUM	1,00	79	8,1392	3,1204	,3511
	2,00	55	8,0364	3,4100	,4598

The results of the SASC (Social Anxiety Scale for Children) test show that there are no statistically significant differences between the children of PE (Physical Education) and music classes.

Table 4. Comparison of boys and girls in music class with a two-way t-test.

	gender	N	Mean	Std. Deviation	Std. Error Mean
Decim. age	1,00	24	11,3392	1,11205	,22700
	2,00	31	11,3442	,89687	,16108
Hanging	1,00	24	15,9042	17,86825	3,64734
	2,00	31	9,3677	11,29154	2,02802
Long jump	1,00	24	145,5000	22,82447	4,65903
	2,00	31	137,0645	16,93701	3,04198
Sit ups	1,00	24	21,0833	4,32301	,88243
	2,00	31	18,8387	4,45044	,79932
Sadnsum	1,00	24	14,5417	4,83627	,98720
	2,00	31	<u>16,87*</u>	3,44230	,61826
Fnesum	1,00	24	18,6250	6,84494	1,39722
	2,00	31	20,3548	6,84859	1,23004
Gsum	1,00	24	7,2500	3,17942	,64900
	2,00	31	8,6452	3,50760	,62998

p < 0,043 (t= -2,087; df= 53; N =55).

This result is very interesting because in the case of children going to music classes we found significant difference between boys and girls in Social anxiety and distress in new situations. (SADN). The result means that girls have greater fear in new situations than boys..

## Motor differences between BMI groups.

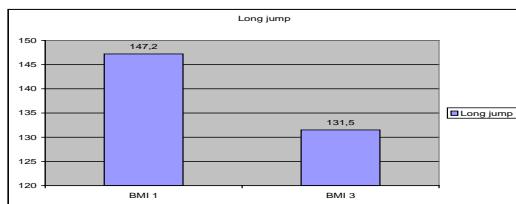


Figure 1. thin (low weight) group

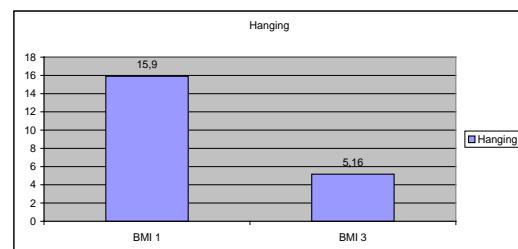


Figure 2. average group (normal weight)

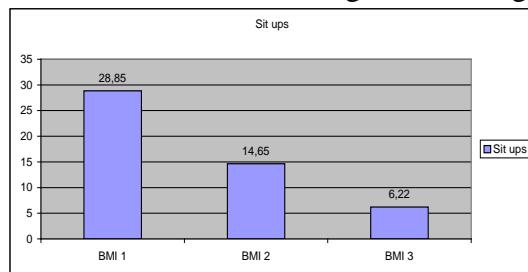


Figure 3. Overweight group (fatty).

The results were significant in the motor differences, in the diagrams.

Table 5. Comparing the results of the motor and anxiety tests produced by different classes.

	CLASS	N	MEAN	STD. DEVIATION	STD. ERROR MEAN
DECIM. AGE	1	79	11,0741		,1009
	2	55	11,3420	,9867	,1330
HANGING	1	79	15,9785	14,0375	1,5793
	2	55	12,2200	14,7487	1,9887
LONG JUMP	1	79	157,2278	21,5585	2,4255
	2	55	140,7455	19,9770	2,6937
SIT UPS	1	79	22,5823	5,2614	,5920
	2	55	19,8182	4,4973	,6064
BMI	1	79	22,5823	5,2614	,5920

	2	55	19,8182	4,4973	,6064
SADNSUM	1	79	17,2532	5,0140	,5641
	2	55	15,8545	4,2314	,5706
FNESUM	1	79	18,3671	6,5284	,7345
	2	55	19,6000	6,8383	,9221
GSUM	1	79	8,1392	3,1204	,3511
	2	55	8,0364	3,4100	,4598

Key: 1=PE class      2=Music class

Comparing the motor and anxiety results of the two classes, we haven't found statistical differences.

## Results of Motor Tests of the Classes

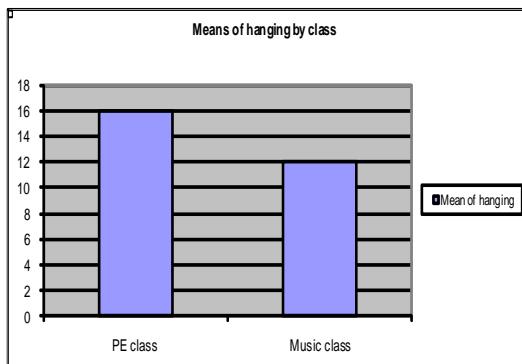


Figure 4. Comparison of means hanging by class.

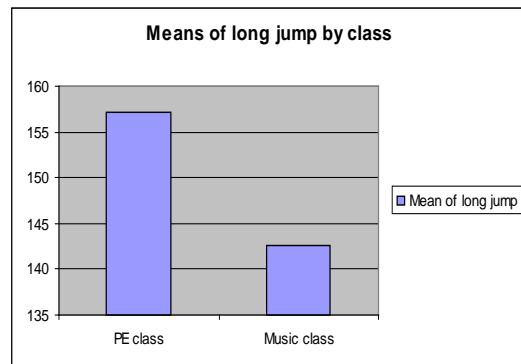


Figure 5. Comparison means of long jump by class.

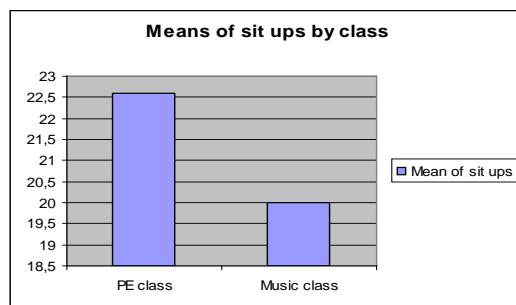


Figure 6. Comparison of means sit ups by class.

In these figures shows that although there were differences in motor performance between the two classes, these differences were not remarkable statistically.

Table 6. Comparing the results of the motor and anxiety tests by gender.

	GENDER	N	MEAN	STD. DEVIATION	STD. ERROR MEAN
DECIM. AGE	1	83	11,0902	,9221	,1012
	2	51	11,3367	,9587	,1342
HANGING	1	83	17,2723	15,9638	1,7523
	2	51	9,8196	9,9223	1,3894
LONG JUMP	1	83	157,0602	23,0431	2,5293
	2	51	139,7255	16,4792	2,3075
SIT UPS	1	83	22,8434	5,1855	,5692
	2	51	19,1765	4,1699	,5839
BMI	1	83	22,8434	5,1855	,5692
	2	51	19,1765	4,1699	,5839
SADNSUM	1	83	16,3253	5,3536	,5876
	2	51	17,2549	3,5034	,4906
FNESUM	1	83	18,0602	6,7794	,7441
	2	51	20,1961	6,3024	,8825
GSUM	1	83	7,6988	3,1728	,3483
	2	51	8,7451	3,2468	,4549

Key : 1=boys; 2=girls

Comparing the results of the motor and anxiety tests by gender, haven't found any statistically significant differences either.

## Results of Motor Tests of the Classes by Gender

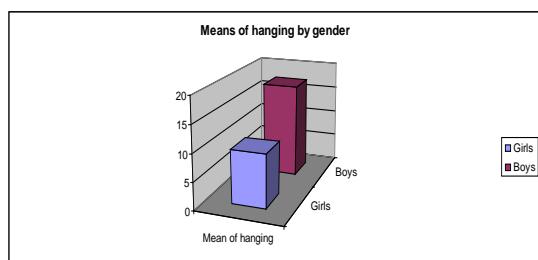


Figure 7. Comparison of means hanging by gender.

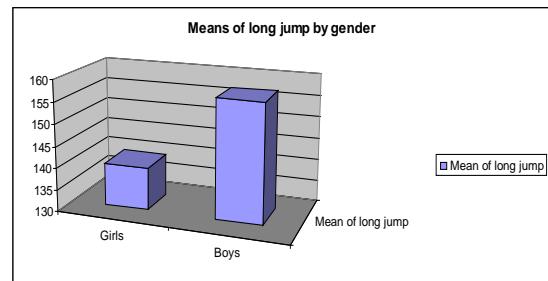


Figure 8. Comparison of means long jump by gender.

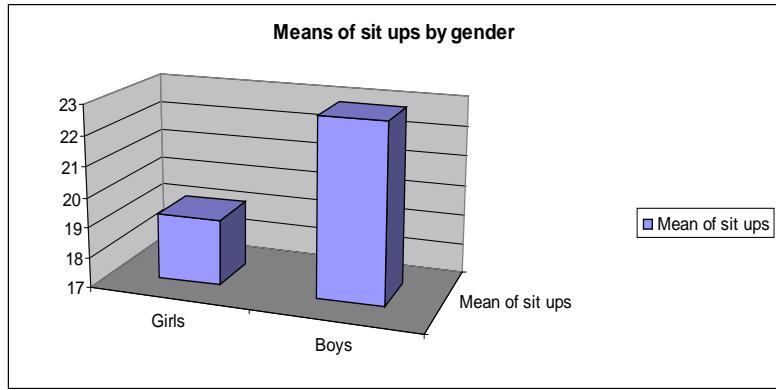


Figure 9. Comparison of mean numbers of sit ups by gender.

In these figures shows that although there were differences in motor performance between the two genders, these differences were not remarkable statistically.

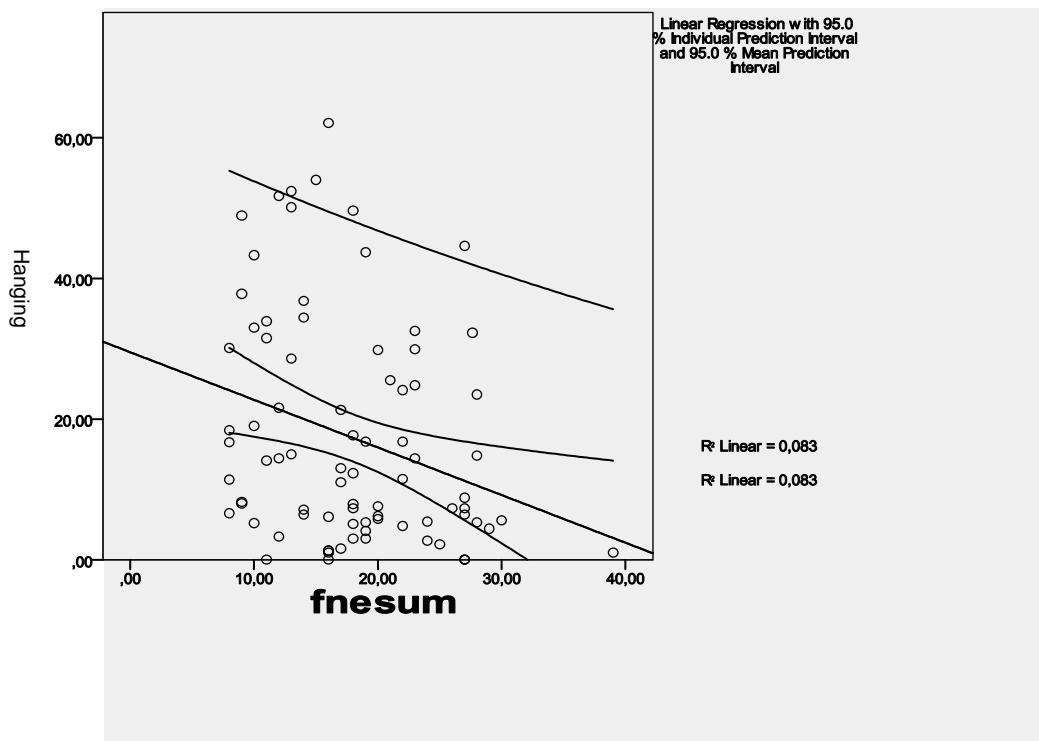


Figure 10. Correlation of variables.

We applied regression analysis to examine how the variables relate to each other. Variables signed by stars have effects on each other. This means that if the value of one variable changes, the other variable's value changes as well. For instance, the strength of correlation is 0.288 between hanging and fear of negative evaluation (FNE).

In Figure 10 the correlation between static hanging and fear of negative evaluation (FNE) among boys. There is a negative correlation between the two variables.

Table 7. Relations of the variables (Variables that take effect on each other).

### Correlations

		DECIM. AGE	HANG ING	LONG JUMP	SIT UPS	BMI	SADNS UM	FNESU M	GSUM	*
HANGING	Pearson Correlation	1,000	-,047	,169(*)	,048	,048	-,003	,093	,021	Correlation is significant at the 0.05 level (1-tailed).
	Sig. (1-tailed)	,	,293	,025	,292	,292	,486	,142	,403	
	N	134	134	134	134	134	134	134	134	
LONG JUMP	Pearson Correlation	-,047	1,000	,532(* *)	,490(** )	,490(** )	-,087	,288(** )	-,236(**)	
	Sig. (1-tailed)	,293	,	,000	,000	,000	,158	,000	,003	
	N	134	134	134	134	134	134	134	134	
SIT UPS	Pearson Correlation	,169(*)	,532(* *)	1,000	,581(** )	,581(** )	,003	-,111	-,120	
	Sig. (1-tailed)	,025	,000	,	,000	,000	,484	,100	,083	
	N	134	134	134	134	134	134	134	134	
BMI	Pearson Correlation	,048	,490(* *)	,581(* *)	1,000(* *)	1,000	-,068	-,165(*)	-,140	Correlation is significant at the 0.01 level (1-tailed).
	Sig. (1-tailed)	,292	,000	,000	,000	,	,217	,028	,053	
	N	134	134	134	134	134	134	134	134	
SADNSUM	Pearson Correlation	-,003	-,087	,003	-,068	-,068	1,000	,532(** )	,429(**)	
	Sig. (1-tailed)	,486	,158	,484	,217	,217	,	,000	,000	
	N	134	134	134	134	134	134	134	134	
FNESUM	Pearson Correlation	,093	,288(* *)	-,111	-,165(*)	-,165(*)	,532(**)	1,000	,576(**)	
	Sig. (1-tailed)	,142	,000	,100	,028	,028	,000	,	,000	
	N	134	134	134	134	134	134	134	134	
GSUM	Pearson Correlation	,021	,236(* *)	-,120	-,140	-,140	,429(**)	,576(** )	1,000	
	Sig. (1-tailed)	,403	,003	,083	,053	,053	,000	,000	,	
	N	134	134	134	134	134	134	134	134	

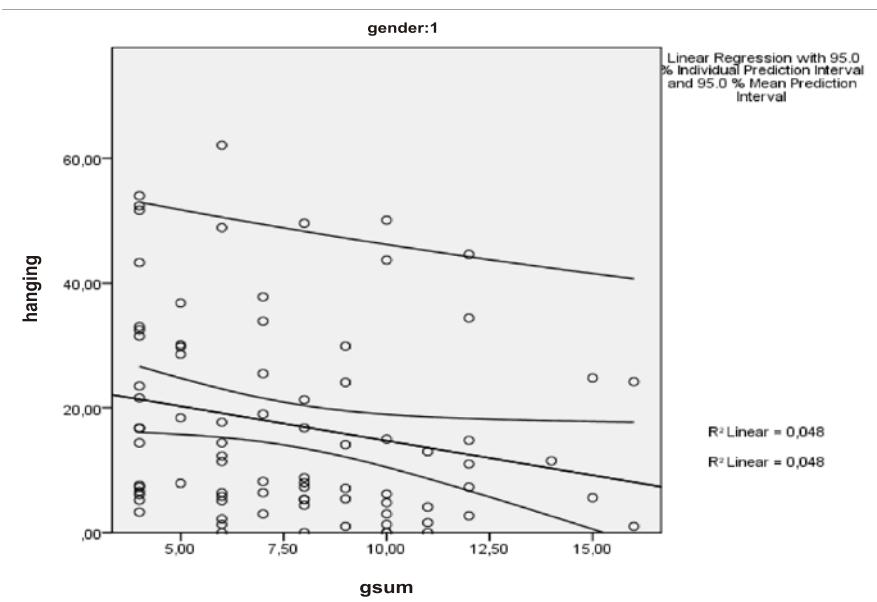


Figure 11. Correlation of variables II.

This figure (fig. 11.) show that there is negative correlation between hanging and general sum (GSUM) among boys.

#### *Answers for the hypotheses*

Our hypotheses have partly been confirmed.

- H. 1: Differences in the emotional test were found between the children of the two different classes.
- H. 2: In case of motor results our hypothesis didn't prove true, because no significant differences were found between the children of the two classes.
- H. 3: The third hypothesis was verified, because we found significant differences in motor and emotional results between the two genders.

## 4 Summary

In the school, which we examined the children of the two classes had quite similar results both in motor and in emotional tests.

We recommend that the number of schools with special classes should be increased rather than reduced. The purpose of increasing the number of PE lessons in schools is not just specializing in sports, but it creates the basis of a healthy way of life. We think that anxiety that appears in children's behaviour leads to problematic situations, and the aim of our work is to teach the pupils to handle these situations without fear.

## 5 Conclusions

Our final conclusion is the following: the personality of the teacher is the determining factor in the teaching process. Our results show that the same teacher, using the same methods in both class types, reached similar results.

In the future we are planning to extend the research to other schools, and other classes and we also want to apply additional motor and emotional tests.

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## **The use of the calorimetric system to measure factors related to the competence of teachers of primary school.**

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### **Abstract**

*In Italy the family doctor, who is not necessarily a specialist in sports medicine, according to the Ministerial Decree of 28.2.1983, is called to certify the state of health that allows the person to participate in non competitive sports and motor activities. At school, in Italy is required the practice of motor and sports activities from the first grade of primary school and the Decree of the President of the Republic n.403 of 20.10.1993 , in Article 10, states that the family doctor should authorize with a certificate (valid for one year) the participation in non-competitive sports activities at school. The medical examination for children of primary school does not require tests of the reaction of the cardiovascular system to physical effort during intense physical activity. In this sense, the physical activities and school sports are configured as light physical activities that do not require the use of intense effort, not appropriate for students aged from 5 years and six months to 10 years. The physical and sports activities in the Italian primary school should therefore be "light" activities to enable pupils to build a true well-being through the gradual understanding of the impact of the movement, its benefits and drawbacks of the intense practice during childhood and pre-adolescence in the absence of adequate health checks. The latest Guidelines of the Italian Ministry of Education (2007) in the section on "Body, movement and sport", motor and sports activities contribute to" ... the knowledge and awareness of the body's identity as well as to the need to take care of one's own person and welfare". In particular, the "wellness recalls the need that in the curriculum of education shall be included experiences that lead to healthy lifestyles. The goals for the achievement of the competences stated in the Italian Ministerial Documents require that the Italian students attending primary school, in the first three years, acknowledge "some basic principles relating to the mental and physical well-being depending on the care of his/her body "and in the fourth and fifth year of school is able to "recognize the relationship between diet, physical exercise and health, taking appropriate behaviors and healthy lifestyles."*

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*Italy has progressively tried to meet the expectations of the Italian Ministry of Education on the safeguarding of health through movement activities with the training of primary schools teachers since 1998 setting a four-year course of study at University. The hypothesis of the research is that the low number of teachers trained in the teaching of motor activities, which in 2007 was only 6.8% (Sibilio et al.), still affects the practice of motor and sports activities not satisfying the parameters of safety and not always related to the category of light physical activities" guaranteed by the medical suitability for non-competitive sports activities.*

*To assess these factors it has been chosen to monitor the energy expenditure of primary school students during the execution of a light physical activity (warm-up activity) conducted according to the teaching methods freely chosen by the teachers and consequently comparing the data emerged with the standard classification of the energy expenditure of physical activities.*

## 1 Introduction

Several studies conducted at the international level in recent years have highlighted the importance of teachers training in physical and sports activities for the development of healthy and effective motor habits in children attending primary school (Stewart et al., 2004; Fairclough et al., 2006, Bailey et al., 2009).

It is therefore evident the importance of the didactics of motor activities aimed at the prevention of diseases.

In response to this need of teachers' qualification in motor activities, in Italy it has been paid more attention in motor and sports activities practice. The definition of primary school teachers training in Italy has in fact followed a long process that began to produce its effects only in 1998. The Ministerial Decree 26/05/98 (G.U. 3/07/98) no. 153, establishing the Degree course in Sciences of Primary Education, started the new university formation of teachers targeted, for the first time, to the academic qualification of infant and primary school teachers creating, at the same time, an institutionally recognized training dimension of physical education.

The updating of teachers training has not been followed by an updating of the rules to manage this matter in the school system. If to practice agonistic and professional sports, there are rules to protect health through medical visits and tests to define the suitability or unsuitability to practice sports, it is not required any medical certification to practice motor and playful activities in the infant school. It is only required in primary and secondary schools in the following cases:

- 1) physical and sports activities planned by School for extracurricular activities;
- 2) preparation activities for National Students Games. The teacher is then alone to manage many issues inherent to motor education such as the assessment of the physical activities and the health of its students.

### 1.1 Aim

The aim of this research was to assess whether the teaching methodology used by teachers in primary school during physical education lessons is consistent with the current National Guidelines of the Ministry of Education and whether they can be included in specific categories of "light physical activity" whose practice is authorized by the medical certification required by Italian primary schools. To assess these factors it has been chosen to monitor the energy expenditure of students during the practice of a light physical activities, specifically warm-up activities using teaching methods freely chosen by teachers comparing the collected data with the standard classification of the energy expenditure of physical activities.

## **2 Methods**

The methodology used has envisaged the following phases:

Planning of an agreement school-university to share the aim, methods and procedure of the research.

1. Arrangement of an informative report to collect data on age, weight, height, diets, or any sports practiced as well as information about students' lifestyles;
2. Training to teachers on how to use the portable multi sensor monitoring system (calorimeter).
3. Request to perform a warm-up physical activity to the students of a total duration of 15 minutes;
4. Required physical activity collecting data of the caloric consumption of each student;
5. Analysis and processing of data related to the calorimetric recordings made with the production of a vertical bar graph showing the average total energy expenditure and the actual average expenditure for the practiced physical activity.

### **2.1 Sample**

The research was carried out using as a sample students attending the primary school of Campania Region (Italy) formally agreed with the Department of Educational Sciences of the University of Salerno for a total of 76 students from 5 classes including 2 year-three classes and 3 four-year classes.

### **2.2 Standards**

According on the intensity and duration of gesture, physical activities can be classified according to energy expenditure requested. To evaluate the energy expenditure is increasingly being used the MET unit. MET = O<sub>2</sub> consumption per unit of time linked to basal metabolism. The MET is therefore a measure of the intensity of exercise. 1 MET is approximately equal to oxygen consumed for basal functions of various organs by a man at rest. Therefore can be considered of mild intensity physical activities, those activities that have energy expenditure around 3 METs, moderate-intensity physical activities than those involving energy consumption between 3 and 6 METs, medium and high intensity physical activity those that cause high energy consumption more than 6 METs.<sup>1</sup>

### **2.3 Instruments**

As a calorimetric monitoring system was used the portable metabolic holter BodyMedia that enables the recording and analysis of accurate data on energy expenditure, physical activity and lifestyle. The system is made of a clinically validated portable calorimeter, the SenseWear Armband, and a software for viewing and analyzing data. The Armband continuously records a series of physiological data of the body. The collected data are then analyzed, graphically displayed and presented by the software on a report that clearly shows the energy expenditure of the subject.

## **3 Results**

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<sup>1</sup> Macchi C, Molino Lova R., Cecchi F., Sibilio.M (2008), Attività fisica dieta e salute, Firenze:Le Lettere

Table 1 shows the standard of energy expenditure for light, moderate and intense physical activity, and Table 2 shows the effective expenditure of the detected METs.

Table 1. The standard of energy expenditure for light, moderate and intense physical activity.

<b>mild intensity physical activities</b>	<b>moderate-intensity physical activities</b>	<b>medium and high intensity physical activity</b>
<b>&lt; 3.0 METs</b>	<b>3.0-6.0 METs</b>	<b>&gt; 6.0 METs</b>

Table 2 shows the effective expenditure of the detected METs.

	<b>Height</b>	<b>Weight</b>	<b>Kcal</b>	<b>METs Average</b>	<b>METs Dev.St</b>	<b>Cff var</b>
<b>3a</b>	134,56	34,79	62,50	6,53	0,47	7,14%
<b>3b</b>	131,24	34,36	52,47	5,90	0,47	8,00%
<b>4a</b>	143,29	45,19	75,64	6,26	0,41	6,54%
<b>4b</b>	138,71	37,48	58,43	6,00	0,46	7,67%
<b>4c</b>	137,60	39,33	63,33	6,19	0,80	12,89%
<b>TOT</b>	<b>136,79</b>	<b>38,00</b>	<b>62,09</b>	<b>6,17</b>	<b>0,57</b>	<b>9,24%</b>

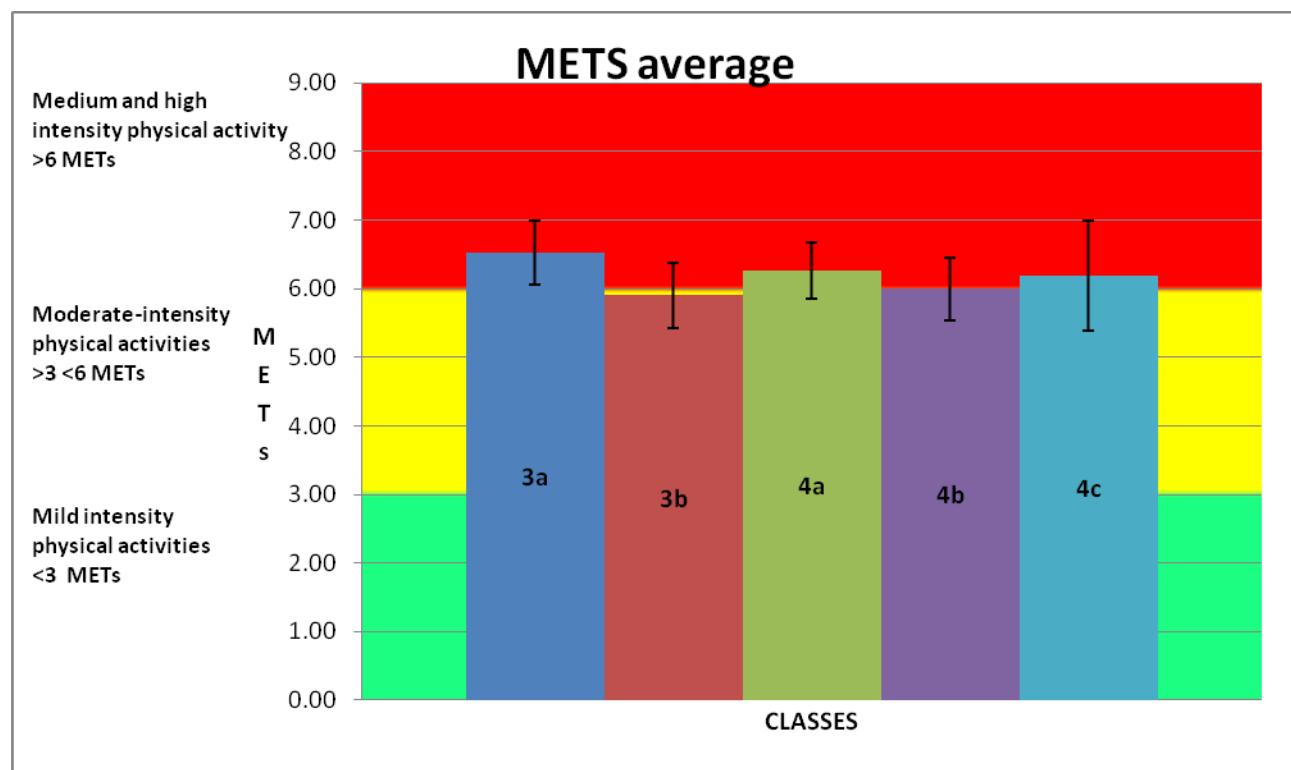


Figure 1. The actual consumption

As can be seen from Table 2, energy expenditure in detected METs is not in the standards that define physical activity as light as that of warm-up.

In particular in 100% of examined cases energy expenditure is over 3 METs and in 55% of energy expenditure observed is over 6 METs falling within the average expected values for heavy physical activity. The variability of the observed phenomenon expresses a relative homogeneity in Energy consumption, as shown in Table 2, however, the average energy expenditure stood at 6.17 METs, exceeding the value of 3 METs requirements for light physical activity. Figure 1 shows how the actual consumption is relatively homogeneous in each class and how it exceeds the expected energy expenditure.

Figure 2 shows a comparison between the energy expenditure standards for light activities such as warm-up and the energy expenditure that was observed, highlighting that the activity effectively practiced by the pupils can not be considered light physical activity.

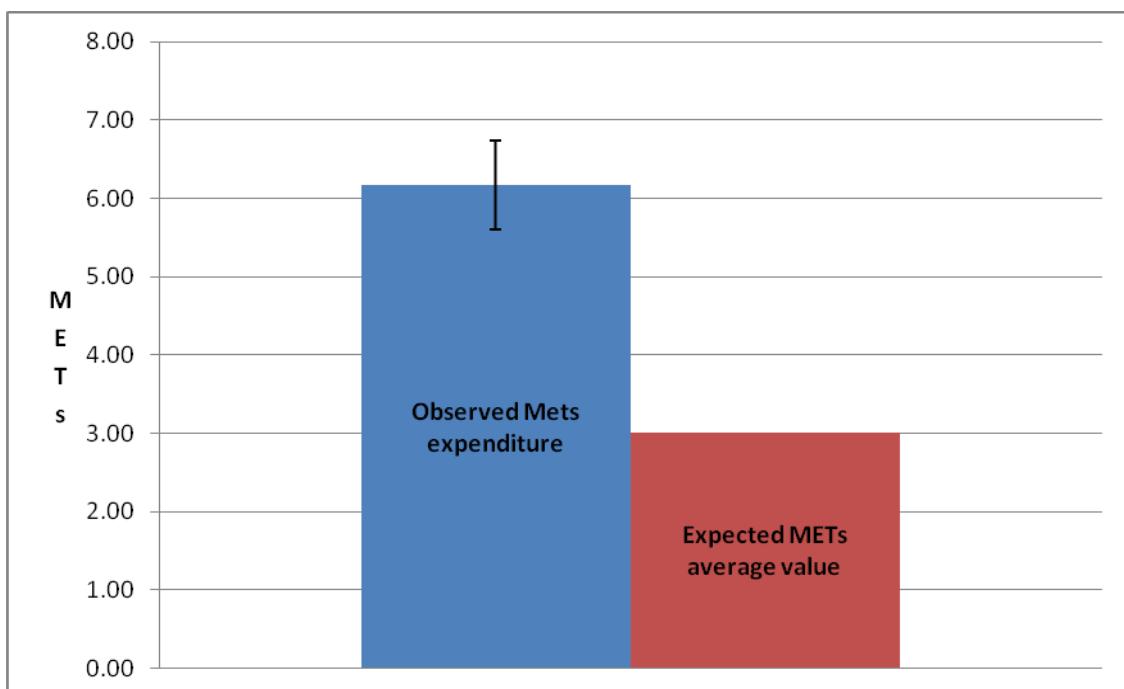


Figure 2. A comparison between the energy expenditure standards for light activities.

#### 4 Discussion and conclusions

The collected data show that the teaching methodology used by teachers appear homogeneous but not suitable to the teaching of "warm-up" physical activities. The data also show that the activities, even if defined as non-competitive activities, are considered *performances* that normally require a further medical examination with "stress test" to determine the suitability to practice competitive sports.

This highlights the lack of knowledge by teachers about the effects produced by the applied teaching methods and the proposed activities providing the possibility of a further deep analysis of the training needs of teachers. Nowadays despite the attention paid to their training at academic level, it is still very weak in terms of teaching methodology and assessment. The data can also be interesting to prevent the risks on health stressing the importance of the capacity of teachers to estimate the energy expenditure and the physical effort required by their proposed motor activities

preventing the risk that movement activities considered "light" by teachers are too intense to be potentially unhealthy for the students.

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## **PE project**

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### **Abstract**

*The everyday-like form of the project can be fixed into the education-pedagogical process of P.E. lessons very well. Firstly, because the arrangement of the material, which is based on project-logic, deals with a certain topic or curriculum within 3-4-6-week-long periods, is a common practice on the P.E. lessons. On the other hand, the project can be renewed on the P.E. lessons also from different aspects. Approaching the chosen topic from different point of views can activate children to individual, creative work. It makes the measurement possible, more over, inevitable in the beginning and the end of the project work, which can be used for checking the individual development and progress. Associating the movement materials of the project topic with other kind of information can help us with identifying and understanding connections between cause and effect. So, beyond the actual motivation, it can be the tool of attitude- and lifestyle formation.*

**Key-words:** project, motivation, self-expression, connection with other subjects

### **1 Introduction**

Among the duties of P.E. we can mention the establishment of needs for movements needed for the healthy- and movement-rich lifestyle and for the good fitness condition (NAT, 2007). Its goal is reached if all these objectives are fulfilled in the case of every student. However, our students strongly differ from one another, both physically (Vajda et all, 2010) and psychically, socially (Mihály, 2007; Németh Gáborné Doktor, 2008). Thus, monitoring the motivation, differentiation and individual progress period is a more currant issue in P.E. than it used to be.

Increase in the number of P.E. lessons as a positive change can be only effective by reforms of content and methodology. One possible way is the project-based learning. This kind of learning requires interdisciplinary approach by which the often isolated curriculum becomes much more lifelike. Many times the project-oriented learning happens outside school or with the help of private people, which strengthens further the relation of the learned material and real life. The projects form the real and natural learning process, so they are suitable for educating the easy-to-handle, talented children and also for hard-to-handle, so called problematic children within the ordinary educational frames (M. Nádasi, 2003). Advantages of the project-method can affect the teachers, too as this kind of learning changes the role of teachers. But they have to be prepared for this role. So, the methodological material is part of the P.E. lesson project in our Institution which is presented in this project, as well.

In most of the cases we can hear about big and long projects which deal with more subjects or even the whole school or at least with one certain grade. Such kinds of projects are connected to many sports or physical education, for example health week, Olympic project, circus project (Hajagos & Hamar). However, our experiment deals with shorter projects which aim to renew the methodology of the P.E. lessons.

### **2 Method**

*Research period:* February 2010 – May 2010

*Sample:* 32 PE teachers took part in the research. They teach Grades 3-12 and have spent 1-25 years in teaching so far. They formed 5 groups (3x6 persons, 2x7 persons) in the experiment where beginner teachers took part in the same rate as teachers with more than 10 years experience.

The objective of the experiment:

- spreading the project-type curriculum processing in Physical Education
- presenting the phases of already tested P.E. projects
- getting to know the opinion of P.E. teachers who lead the project

*The process of experiment:*

a.) Preparation for the experiment (February 2010): we dealt with basic questions about the theory and practical side of project teaching on P.E. lessons in the form of consultations. After discussing it, the participant groups chose project topics. These were: 6:3; Vizes hetes (Wet Sevens); Futsal; Erdei Zsolt and Testépítés (Bodybuilding). The groups agreed on the starting point and the main direction of the topic (brainstorming).

b.) Experimental phase (February-May 2010): Teachers, who were involved in the research, carried out the project in an optionally chosen class of their own school. Common parameters of the project: setting of the topic, forming the process of the project work based on the students' ideas, dividing the tasks, defining the measurements, measuring the level of the starting point, working on the project (2-4 weeks), final measurement, summary, evaluation. Each P.E. teacher wrote a diary about the process of the project and also collected own documentation.

c.) Final phase (May 2010): The groups had a final discussion and evaluation with the following subtasks: making a project map, measurement, evaluation in the project, listing the performed work, connected subjects and persons.

### 3 Results

a.) Phases of the Physical Educational project and its characteristics

*Project map*

Working on most of the topics happened with the help of project maps which were created by teachers and students together. The project map is a collection of the connected ideas. This is the basic for defining the project objectives, choosing and dividing the tasks and duties, preparation of the time schedule.

In the case of a P.E. project it is worth mentioning – during the making of the project map – that most parts of the project must serve the movement, movement learning, skill development and practice. We must take care that the rate of the lots of interesting associated areas (other subjects, extra-curricular programs) and the movement activities should not collapse.

*Activities*

One of the advantages of the project-based learning is that getting the knowledge, learning and practice happen throughout activities, with the active participation of students. The 6:3 (the famous soccer triumph of the Hungarian national team against the British one) project was held up as a model. In this project such usual, topic-related movement activities can be found as practising the technical and tactical elements of football on lessons and trainings, and home-made school competitions.

However, these usual movement activities are surrounded by such circumstances which draw and maintain attention. These are lessons or trainings with the leadership and participation of football players, coaches; and school competitions with teams of parents, teachers, and professional players. Movement activities were supplemented by collection of information about the Golden Team, the present Hungarian selected team, the rules and officiating. During this work children used diverse

information sources. Parts of the information were collected during interview making or conversations. So, they got in touch with persons connected to the heyday of football or the present-day football. While going to the trainings and football matches, they could become acquainted with the duties of the masseur and sport doctor. On the one hand, exhibiting and presenting the collected material and the documents of their own activities helped the interest to be kept alive. On the other hand, they gave emergence and the experience of success for the smart students in different fields.

#### *Curricular/scientific relations:*

During the 6:3 project children got in touch with many kinds of subjects and sciences. Firstly, we have to emphasise the cognition of training and the theory of P.E. – trainings, warming up, technique and tactics of football, its rules, etc. – and making it real. Realizing regularities, relations between cause and effect in movement activities and on trainings can lead the children to the voluntarily chosen, active lifestyle. Based on the sportsmen's diet and lifestyle we could gain biological information and by studying the era's remnants (material-, written- and film documents) we could get historical data. Arts also appeared in the projects. Based on the topic, students made drawings in many classes and their work of art was exhibited. The original record of the 1953 match was watched in every class which was also interpreted from the point of view of sport and also film. The famous sport reporter, György Szepesi's commentary also affected many people greatly and encouraged the “commentary” of the school matches. Some features about the topic also appeared in the projects. By watching them, students could see the history of the 1960s. A film and several photos were also made of the school competition. By making each team individual (creating emblems, flags, team-song, and battle cry), children could be also creative.

Lastly, I mention informatics as searching on the Internet means almost a routine activity for the students.

#### *Personal relations:*

Getting to know other adults apart from the P.E. teacher during the project work meant a great experience for the children as specialists within a certain sport (masseur, referee) and their job was very inspiring for the children.

Becoming acquainted with the active sports participants of the 1960s or collectors of sport relics is also an interesting program.

The power of sporting with parents is well-known for everybody. Students also got into contact with teachers of other subjects in new kinds of situations (common sporting, learning information about subjects based on the students' questions), which fact could arouse their motivation towards sport and the given subject.

#### b.) Measurement, evaluation

There should be a state- or level condition survey in the beginning of the projects in order to monitor the individual progress. Of course, its methods and devices match to the nature of the evaluated material. In many cases, the P.E. teacher colleagues who lead the project rely only on their observations. If it was possible – as for example during the 6:3 project – skill levels and sport technical tasks were measured in the beginning and end of the project.

Evaluation happened in two ways. Activity and the standard of the concrete movements during the project activity were usually only positively evaluated. Evaluation happened by marks (5-mark scale), prizes and also orally in front of the audience (sometimes in front of bigger, out of class communities).

## **4 Discussion**

The objective of the project experiment was to try out the project-based education in the process of the everyday P.E. education. We aimed to find out whether the small projects which serve as tool for the curriculum processing, work in physical education or not. Furthermore, we were also interested how teachers who are used to the traditional teaching methods can take advantage of this method.

The reaction of those colleagues who took part in the experiment has changed radically during the 4 months. In the beginning of the experiment they did not understand the necessity of it and were absolutely sceptical. However, changes appeared during their preparation and on group discussions which were about the project topics. It became clear to every P.E. teacher that certain parts of the method – 3-6-week-long material separation along with a main material, making biomechanical or physical regularities in sports movements realized, relation with actual sport events, etc – appeared also on P.E. lessons so far, though mainly now and then. The real breakthrough in the attitude of our colleagues happened during operating projects and project processes. The ideas itself, and its novelty, curiosity, versatility provided motivation for all the students. So, on the final discussion meeting we could hear the evidently positive opinion of teachers about the project-based educational on P.E. lessons.

The activity of students undoubtedly increased in the fields of movements and other activities, too. As other kinds of curricular activities appeared on the P.E. lesson, too, those children also became active who were not previously. In the case of many types of activities and also in movement activities, differentiation resulted from itself. So, varied activities of the project proved the experience of success for many students.

Self-sufficiency, separate work process, cooperative solutions among each other and building of out-of-school relationships also described the process. However, the autocratic behaviour of teachers is still needed to be changed on.

The isolation of subjects was dissolved by the project activity. Connecting the coherent parts of different fields of sciences helps the comprehension, the consciousness and the relation of studies with the real life.

The less effective part was the measurement/evaluation. Individual placement testing and its user-friendly devices are needed to be created, not only in the field of skills but also about movement knowledge.

In case of certain projects, the rate of activities which are connected to the movement activities (performances, visits, drawings, etc.) exceeds the expected norm. We should not forget that the objective of the project is the Physical Education and the sport.

As individual work and planned work is one of the leading motives of the project, students' individual work even at home should get more important role. In the case of adequate motivation and systematic measurement of the individual progress, movement activity can be continued at home as "homework". Hereby, we would be much closer to the aim of Physical Education which is the movement-rich, active, healthy way of life.

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**Research into pedagogical impacts on the movement development of crèche children.**

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## **Canoe sport and positive psychology.**

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### **Abstract**

*In our study we compared the psychology immune competence values of two groups. The participants are former kayak-canoe sportsmen, and teachers who don't do any sports. 50 former sportsmen and 50 teachers participated in our study. The participants filled four questionnaires.*

*It is very important in the life of a top competitor and his trainer to make a good decision at the right time. It can be determinant in the later career and can influence private life too. It concerns of course every field however it is even more important in our profession. Work of a trainer is about that we are who consider alternatives and determine the right way instead of the competitor as well. I am sure in one thing that is we can only achieve our aims if we have enormous humility towards the trainer profession and the sport itself. It is necessary to indoctrinate our competitors with this ethical attitude in order to they become world class competitors. Among the several circumstances the most important is maybe the creation of the training system based on performance, in which the competitor can belong in and endure the load fitting for his age. I build this system from the tradition of this sport, experience and the specific training methods. One of the problems concerns how we can build the talented young competitors in the world famous adult team. Present-day successful trainers often get into a situation like this and in these matters we absolutely shirk for ourselves. Of course, class competitors are provided with everything by the Kayak Canoe Association which is necessary for their preparation but this is not the case with the second line. It is a thankless task to decide who should be promoted for the future Olympic athletes and this decision is made by trainers. It does not always pleasure for older aged world class competitors and that is why conflict can arise against a less experienced but talented young person.*

*The main goal of my study was to entrance trainer's pedagogical profiles. It could be proved my statistical analyses that professional sport could help in coping strategies. and its also important sheto assess the effect of the new method could you measureal.*

*Antonowsky (1979) has studied that: How be people could healthy in the fall of their problems? Batta (2004) has found that them are differens in characters of personality betwen active and non-active people. Csikszentmihályi and Seligman (2000) developed the possibility to use the psychology of people and talent to strengthem.*

## **1 Introduction**

The latest trend of coaching is to enhance productivity as well as mental capacity. Therefore this study is based on two models, that is, the Flow theory of Mihály Csíkszentmihályi and that of Antonovsky's.

During training, the body should be strengthened so as to be able to tolerate and bear strains and stress. A special tailor made training plan will enable competitors to cope with this flow while preparing sportsmen for competitions. It is evident that this stress and hard work bring about other personal/individual problems (Csíkszentmihályi , 2009).

*Aims*

- To map up the protective factors developed by doing sports
- To change trainers' attitudes on the basis of the outcomes
- To work out methods supporting sportsmen/women to be able to adapt themselves into civil life.

## **2 Methods**

*Population of the research:*

- 50 kayak-canoe professional competitors
- Control group with: 50 teachers

To gain data in relation to psychological immune competence the Questionnaire of Psychological Immune- system ( PIK Oláh 1996) was used. The 16 scales attempt to identify the interviewees' stress-resistance. Each scale has 5 items and the participants can indicate to what extant they think.

*The questions may be relevant for them*

- Valid outcome can be gained only in the state of flow
- Each successful professional has already experienced flow
- This psychological immune system strengthened by trainings and competitions will support the individuals' life and career.

## **3 Results**

In case of educators there is a significant difference within the feeling of coherence due to the strict rules of sports. Sports do not support sportsmen/women in the third dimension of education, namely to acquire skills enabling them to act autonomously . Actually rules will control their life (Gombócz, 2007). Bearing this fact in our mind indicate that we should develop the educative and pedagogic strategy of trainings. It is also crucial to make a plan that focuses on enhancing the awareness of the importance of experiencing FLOW as well positive thinking.

scale	sportsmen	teachers	szign.
Positive thinking	15,36	14,84	-
feeling of growth	14,91	15,41	-
emotional control	13,14	13,41	-
feeling of control	16,05038	13,9304919	0,00001
feeling of coherence	14,18148	15,4133708	0,035813
Self-esteem	15,59645	14,9512208	-
challenge, flexibility	15,56575	15,1545048	-
ability of social monitoring	14,05276	13,6325841	-
Inventiveness	14,69425	14,0734705	-
feeling of self efficiency	15,1595	15,0455628	-
ability of social mobility	14,20229	14,2191835	-
social creativity	14,85873	13,2407515	0,004537
the skill of synchron	14,20444	14,2046364	-
Stamina	13,76274	14,0519058	-
Impulse control	14,73597	13,5181567	0,014494
quick temper,inhibition	12,5463	13,1694178	-

Figure 1. Outcomes of

PIK scale.

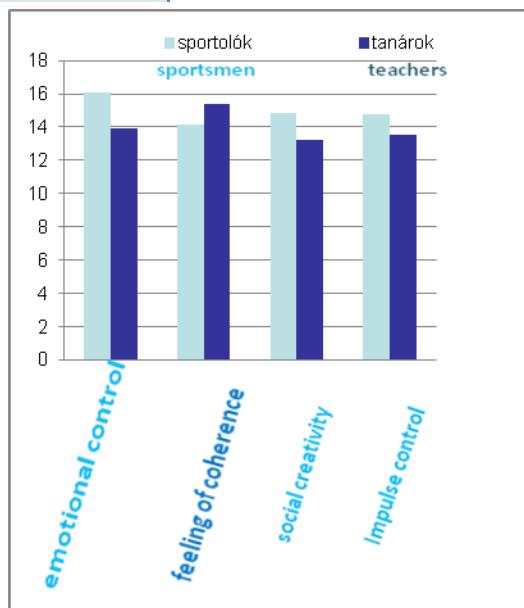


Figure 2. Significant outcomes of the 4 factors

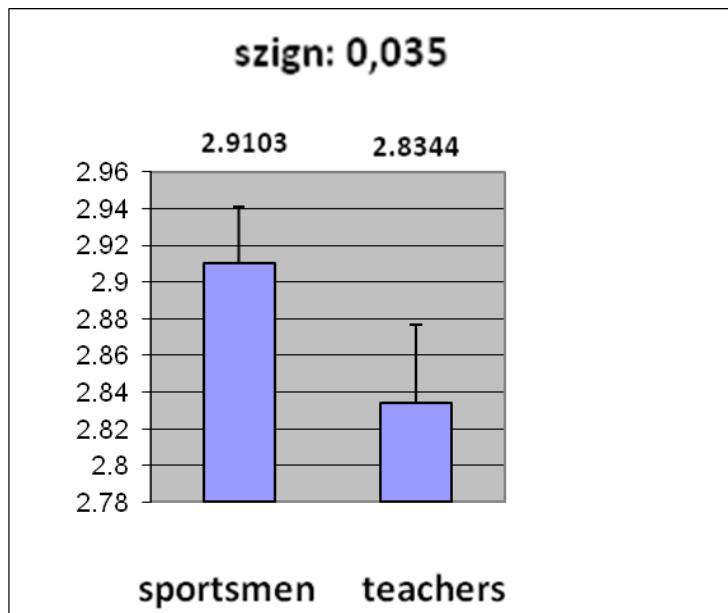


Figure 3. The avarage of the survey

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# **Empowerment, locus of control and professional interests: an action research with Kore University students**

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## **Abstract**

*The aim of our action research was to analyse the different factors playing a role in the professional choices and chosen career profiles of students at Kore University. To achieve our goal, we analysed motivational factors, psychological interpersonal adjustment, self empowerment, locus of control, coping strategies, professional interests and values.*

*We surveyed a sample of fifty students attending Physical activities and sport sciences and Architecture courses degrees, gender balanced. The research intervention aimed at helping students in their professional choices and building all the skills that the job market requires. We carried out two focus groups for each degree course: 1) Self empowerment; 2) Locus of control. In each focus group a counsellor supported students in analysing their motivational and choice awareness process concerning their professional carriers.*

*After the intervention, it is possible to have a change in the variables already collected. Results may provide suggestions to design objectives and curricula of Physical activities and sport sciences degree courses.*

## **1 Introduction**

Our research action is based on the social cognitive theory on the observational learning developed by Albert Bandura, the founder of social cognitive theory (Bandura, 1977). Bandura's researches broadened the knowledge on the learning process, focusing on the different ways social experiences play a role in people's personality and their regulation of conduct.

Our research project analysed all the variables linked to the students selection process. The sample we surveyed was made up for students attending two different degree courses at Kore University of Enna.

Our project aimed at studying the main variables connected to Physical activities and sport sciences degree course and Architecture degree course students professional choices during their education. The collected data have to be considered part of person-environment system where individuals are retroactively aimed at a possible and aware future, especially because counselling is considered to be a complex topic.

We provided three workshop activities where we discussed about topics inherent to the studied variables: empowerment, locus of control and professional interests.

Every workshop activity used the same methodology: participants were given a instrument to survey variables and, afterwards, the focus group activity took part for two hours for each workshop.

Students choice concerning their university or professional carrier is the product of different factors – individual, social and situational ones- which play a role in the final result (Grimaldi, 2005; Grimaldi, Del Cimmuto, 2006).

The empowerment process is very complex and is defined as “process centred on a local community, intentional and continuative, that implies mutual respect, critical consideration, affection and group participation. By means of it people who did not have these resources in an appropriate way could perceive their Self better and have a better control of their lives (Rappaport, 1981).

Concerning locus of control (LoC), Rotter differentiated from internal locus of control and external LoC (Rotter, 1966); “LoC” can be often used in an interchangeable way with self-efficacy. It is considered to be a personality feature that reflexes how a person perceive all the events that are under his control (internal locus) or external to it (external locus) (Rotter 1966).

Professional values, involvement and satisfaction are essential components of the complex topic called “the importance of job” (Super, 1981; Trentini, 1995). They are in a intermediate level between needs and interests, linked to cultural and environmental factors and closely connected to individual motivations. They are constantly mediated by internal and external factors, that is why we can define them as dynamic values (Super, 1970; Boerchi and Castelli, 2000).

Whenever we talk about interests we mean a positive attitude of individuals towards some activities. People got their interests during a personal and subjective experience where they are aimed at achieving a certain goal. Interests are the motivational elements that will make individuals feel able to face situations and activities. During education, students interests can be orientated, modified for the professional opportunities offered by the territory and the contest. Important working aspects like satisfaction and realization are up to individuals; they come from the congruity between professional interests and individual features (Di Nuovo S., 2003).

## **2 Method**

### **2.1 Instruments**

Our project used the following research instruments:

- professional values Scale (Avallone, Farnese, Grimaldi & Pepe, in Grimaldi, 2007);
- perceived skills for the entry in the job market Scale (Farnese, Avallone, Pepe & Porcelli, in Grimaldi, 2007);
- perceived self-efficacy in job search Scale (Farnese, Avallone, Pepe & Porcelli, in Grimaldi, 2007);
- job market self-perception Scale (Farnese, Avallone, Pepe & Porcelli, in Grimaldi, 2007);
- focus group.

The focus group was used to achieve the following goals:

- to get to know oneself and other group members better in order to create a positive clime and a common basis for other activities;
- to sound out members' knowledge of the studied subjects;
- to point out the factors that played a role in their professional choices.

We provided three workshop activities to discuss about empowerment, locus control and professional interests. In the end of each workshop we supplied the focus group activity.

### **2.2 Subjects**

Our research project surveyed a sample of fifty people, thirty students attending Physical activities and sport sciences degree course and twenty students attending Architecture degree course at Kore University of Enna.

### **2.3 Processing data**

We used T-Lab (F. Lancia) to analyse focus groups data. T-Lab software is an all-in-one set of linguistic and statistical tools for text analysis for text analysis. We used co-occurrence analysis, as word associations and concept mapping, especially the Multidimensional scaling with Sammon's mapping method.

### 3 Results and Discussion

The research presentation is on the analysis of the results carried out by the focus groups.

#### Qualitative analysis of “Empowerment” focus group data

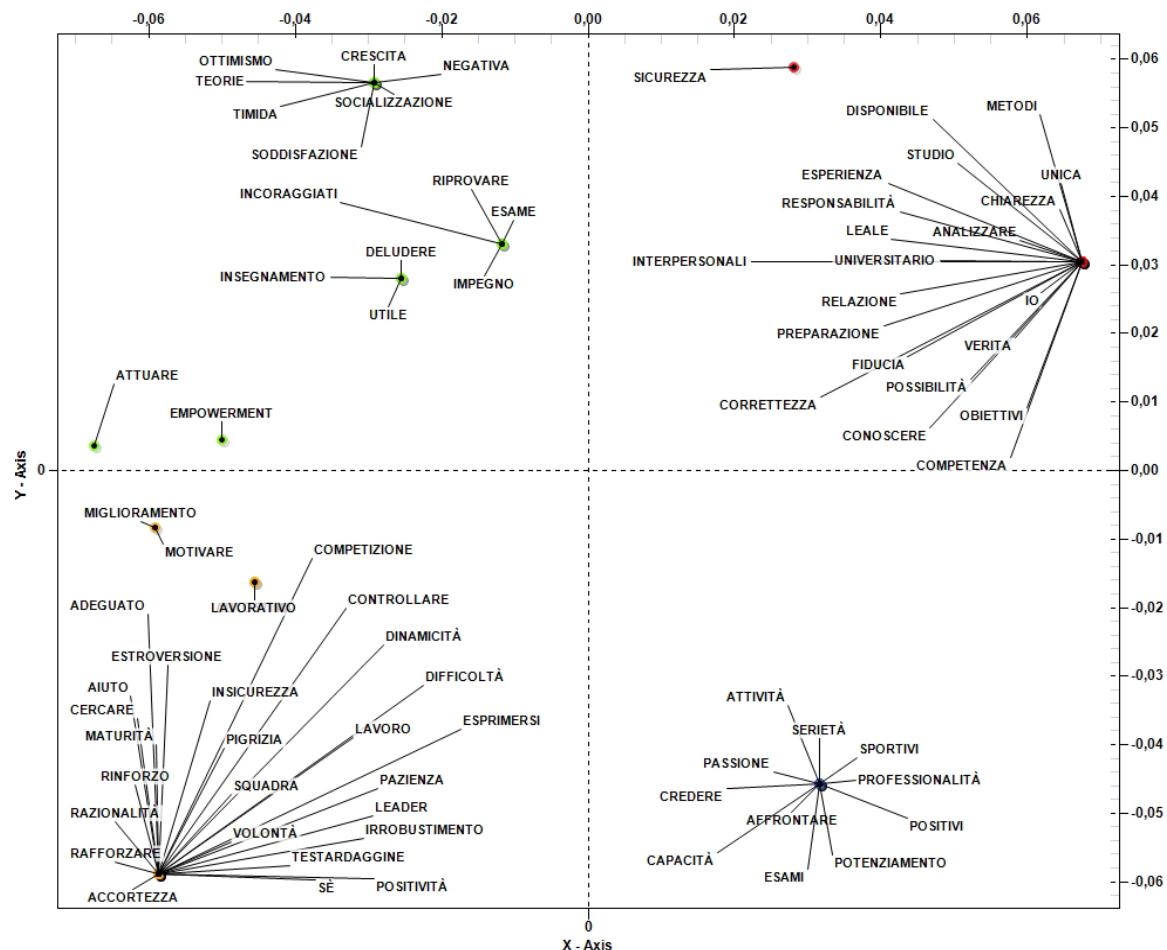


Figure 1. Multidimensional scaling of Empowerment focus group  
MDS metodo Sammon; stress=0,0059



Figure 2. - Associations with the concepts group called “control” in both of the degree courses

#### *Word association and multidimensional scaling*

The overall conceptual picture outlined by the students is represented in the graphic map realized through the multidimensional scaling (MDS & Sammon's mapping). Students' representation of the present is clearly different from their representation of the future (Figure.1). On the right side of the Figure.1, we mostly have positive concepts related to their university studies (present) and their professional carriers (future), on the left side we have the ideas linked to the students personal growth and their possible Selves (Markus & Nurius, 1986).

By means of the analysis of Empowerment focus group data we realized that Physical activities and sport sciences degree course students see their own Self-representation closely linked to the study concept (within “study” we can also include concepts as goals, knowledge, competence, etc... and values as loyalty and transparency).

The current empowerment analysis showed that Physical activities and sport sciences degree course students consider their biggest difficulties to be the chance to fail an exam or not be able to achieve what they could not do already.

The future empowerment is seen in the representation of their future Self. Development, passion, extroversion and stubbornness are linked to the concept of seriousness of sport

What they consider as difficulties is what they want to improve or to avoid.

Concerning the current empowerment, Architecture degree course students' Self-representations are characterized by patience, availability and their skills, that seem to be all distinguish features of the architect profession. Concerning the future empowerment, they consider improvement to be connected to commitment, responsibilities, determination, realism without abandoning their dreams/desires and their ambitions.

By means of the results of the analysis of the second workshop focus group we realized the locus of control was associated to the concept of control related to the possible different situations and to the fortune (Figure 2).

Physical activities and sport sciences degree course and Architecture degree course students think that their perception of control over chances is external to their capabilities. All the participants believe the university environment to be controllable only through strategies not related to their

study or preparation. The chance, in their opinion, deals with their relationship with professors and schoolmates and their emotions, rather than their cognitive processing.

The results we got from analysis of the third workshop activity concerning students' interests and professional values showed us that love, friendship and family are shared by both degree courses students. Physical activities and sport sciences degree course students associate to the term "honesty" the predominant values of commitment and technical competences, while for Architecture degree course students family is the predominant value, followed by love, friendship, respect and sincerity. Students of Physical activities and sport sciences degree course link their self-image to the profession, using general values and referring to a general ethic of work. Professionalism, honesty, technical competence etc., may in fact be applicable as values to any profession. Students of architecture, however, introduce in general values, personal ethics of the professional relationship with the customer and with the works created by the professional.

Overall, a clear fact is the general perception of students on their degree course. The degree course in Architecture, which has direct access to a professional register with well-defined job opportunities, appears to establish a clear definition of the profession in the future students. In contrast, students of Physical activities and sport sciences degree course do not have a clear vision of the work they will do, but they indicate professions characterized by little or no consistency with regard to the course undertaken.

The results, obtained by self-rating scales, complete and confirm the overview of personal and business representation, present and future, constructed by students through focus groups. By comparisons of degree courses, can be seen differences in work values: an analysis of focus groups made possible to detect a tendency to conservatism of the students of Architecture and a willingness to change in students of Physical activities and sport sciences degree course, which is further confirmed by Professional Values Scale. Other significant differences are found in the job market self-perception Scale, students in Science of motor and sports activities perceive the labor market as more dynamic, clearer, more equitable, but also more complex.

## 4 Conclusions

The results obtained by our research highlighted dissimilar perceptions among students attending two different degree courses. Differences can be found in students goals and aims, especially in their current studies and future profession.

Students think the knowledge gotten from their studies is distant to their future job. This is an extremely important data that requires our attention and intervention.

Another meaningful data is that University is for them *the only knowledge institution*, while working stands for the practical part that can not be learnt at university, but only in their future working life.

A clear data is students perception of their degree courses: students attending a course that will give them the possibility to work immediately after university with a well-defined profession, such as Architecture degree course ones, know exactly what they want to do.

Otherwise, Physical activities and sport sciences degree course students do not have clear ideas about their future profession, as it is shown by their answers to the above mentioned question.

However, the lack of a traditional representation of the future profession and the idea that however they will try many roads to work, allows students who have chosen sports and physical activities, to be more open to news and more assertive towards their future work. They are ready also to the complexity and rapid changes of the job-market.

Probably, this would push Physical Activities course degree students to a state of readiness and greater flexibility in coping with the unexpected. They feel able to redesign of their competencies for rapid adaptation to the demands of an ever-changing job world. The perceived self-efficacy in building their own career plan and interpersonal relationships, should be connected, however, -

including through professional guidance intervention - in a coherent and realistic knowledge of the career opportunities in sport and physical activities.

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## **Physical activities in early adolescence: implications for self-description and interpersonal perception.**

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### **Abstract**

*Few studies have so far examined the relation between Self (physical and social), the variables linked to identity construction and physical activity.*

*The psychological well-being resulting from exercise or sport is now generally accepted both in scientific literature and common belief. The improvement of mood, energy and body image, greater stability and confidence in the physical Self perception, greater perceived interpersonal and physical competence in sport or exercise, are some of the physical, cognitive, emotional and social correlates in physical activity.*

*During adolescence, the transitional period from childhood to adulthood, when individuals try to adapt to all the physical, cognitive and social changes, exercise and sport - especially 'structural' ones - can have a very important role in the developmental acquisition of this particular age. All these changes can make the adolescent experience very strong emotional events which can lead to a significant reduction of self-esteem. An area of self-esteem that can be mainly affected during adolescence is the physical self-esteem, which includes both body attractiveness and physical competence perception. The results of a study by Bowker (2006), showed the mediating role of physical self-esteem in the relationship between sports participation and global self-esteem.*

*The study wants to investigate the effects of specific training, based on the physical activity practice, on Self concept, physical and social self-esteem, self-efficacy and interpersonal psychological adjustment.*

*Pre-adolescents from 11 to 14 years of age were involved in physical activities and educational itineraries. The instruments used were the Interpersonal Adjustment Questionnaire (QAI) for middle school students; the Physical Self-esteem Scale in the Multidimensional Self-Concept Scale – MSCS; the Self Image Scale for the investigation of Self-Concept – VIS; the General self-esteem and Self-efficacy scales; the Italian version of the Physical Self Description Questionnaire (PSDQ) in a single administration in post test.*

*Results show that physical fitness may provide more positive social feedback and recognition from peer groups, and this will subsequently lead to improvement in an individual's self-image and self esteem.*

### **1 Introduction**

Many studies have shown that physical activity provides a harmonious development of personality and psychological dimensions of the physical self description (Cairano, 2008; Fox , 1997; Annesi, 2007; Bowker, 2006; Bandura, 1997; Sonstroem, Harlow e Josephs, 1994). Physical self is the initial core of the self (Epstein, 1973; Jacobson, 1974; Wallon, 1967) and plays a key role in childhood and adolescence. During adolescence, bodily changes, combined with individual and environmental factors, lead to a revision of the physical self, which has a deep impact on global self, identity and emotion. Fox (1997) considers the bodily self as a "public" self, means the body is the medium that allows us to show to others. In the Fox's model, physical self-concept has a critical mediating role in psychological adjustment processes.

The self-description of the body is the ideal bridge between self and others; a connection through which build relationships with others and, according to James (1890), elaborate the “characteristics of the self recognized by the other”, contributing to the social self.

Through the social group we develop personal perceptions, judgments and patterns of behavior (Sherif, 1967). In addition, the acquisition of behavior patterns, through social learning and through imitation, leads the individual to the formation of expectations on the capabilities of personal achievement, on sense of self-efficacy (Bandura, 1977; 1995; 1997). The present work aims to link the studies of physical self to the practice of teaching physical activities, to observe changes in the descriptive and evaluative aspects of self-perception and interpersonal relationships in a sample of preadolescents. This research is a part of a longitudinal study that analyzed the reprocessing of the self concept – especially of the social and physical selves – in early adolescence, multi-level cognitive and metacognitive aspects of learning motor skills. During pre-adolescence, the effects of pubertal development include a focus on the subject's own body and to a deeper reflection on self-schemas of the physical self (Markus, 1977). Within the research, was made an educational intervention based on group work and on the acquisition of motor skills and cognitive, motor and social problem-solving. Participation in these activities has improved the perception of self in interpersonal relationships, enhanced social skills, increased physical and general self-esteem and, finally, has improved a positive Self-image.

## 2 Method

### 2.1 Project Structure

The research is divided into three phases.

The first phase (pre-test) was led to the pre-evaluation of the variables investigated (physical self and global self image, physical and global self-esteem, self efficacy, interpersonal psychological adjustment) in a sample of preadolescents aged 11 to 13 years old.

In the second phase, realized in the scholastic year after, the participants involved in physical activities and structured games aimed at potentiating motor, cognitive and social problem solving.

In the third phase (post-test), at the end of the scholastic year, the final rating of the test scorings collected.

### 2.2 Subjects

Have joined the project over 200 preadolescents attending two middle schools in the town of Enna (Sicily, Italy). Test administered in the same sample, in two different times and scholastic year, before (Time 1) and after (Time 2) the intervention.

This work will analyse the data concerning a sample of students attending the first and the second classes of the middle school<sup>2</sup>. Participants were divided into two groups, 22 students that have concluded the first year of the intervention (Experimental Group - EG) and 46 students that were not involved in project (Control Group - CG).

The age of the participants, during the Phase I (Time 1), was between 11 and 13 years ( $M = 11.33$ ,  $SD = 0.52$ ,  $Mdn = 11.00$ ).

More over, in this school year, about 60 subjects, divided in three PE classes, are completing the phase II of the second edition of the project. A sample of 80 subjects will be the control group. We attend that the assessment of these groups will confirm this data.

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<sup>2</sup> In the Italian educational system, the first and the second classes are equivalent to the 6<sup>th</sup> and 7<sup>th</sup> grades of the middle school in United States, whereas to the 7<sup>th</sup> and 8<sup>th</sup> grades of the secondary school in United Kingdom.

## 2.3 Instruments

In the first and third phases of the project, the tools used were:

- the Interpersonal Adjustment Questionnaire (QAI) for middle school students (Di Nuovo, 1998); the four subscales of QAI – Ambient and Family pressure (A&F), External Locus of control in relationship engagement (ELC), Tendency to Depression (D) and Tendency to Psychosomatization (P) – represent the main hurdles in social adjustment;
- the Physical Self-esteem Scale in the Multidimensional Self-Concept Scale – MSCS (Bracken, 1993);
- the Self Image Scale for the investigation of Self-Concept – VIS (Magnano & Di Nuovo, 2010);
- the General self-esteem and Self-efficacy scales (Bandura, 1977; Schwarzer, 1993);
- the Italian version of the Physical Self Description Questionnaire (PSDQ) (Marsh, 1996; Meleddu et al., 2002) in a single administration in post test.

## 3 Results and Discussion

Results are presented in two sections: Phase I (pre-test) and phase III (post-test). First, we present preliminary results concerning total group and differences between gender. Second, pre-post test findings are presented both in experimental and control groups.

In the Phase I (pre-test), participants presented average levels of physical and general self-esteem, average levels of self-efficacy, a high degree of interpersonal adjustment and a positive evaluation of self-image. However, in girls there were lower levels of physical self-esteem than boys. The results show, for what concerns the bodily self, the emergence of a significant gender difference on the concept and image that people perceive their own body, in line with previous research (Harter, 1997, cit. in Bowker, 2006).

### *Comparisons pre-post test with Paired sample T-Test*

In the final assessment, the experimental group (EG) has lower average intervention in all the four subscales of the Interpersonal Psychological Adjustment Questionnaire (QAI). Even if, A&F, ELC and D are significantly lower in Time 2.

In comparisons between gender, after the intervention, A&F is significantly lower ( $p=0,04$ ), but in the girls the A&F scores are significantly higher than boys ( $p<.001$ ). So, for the girls to obtain the social consent and to sustain the effects is more oppressive than boys. There are significant differences in Tendency to depression (D), that decreases in boys ( $p=0,05$ ). More, the Externalism (ELC) decreases significantly in boys and girls ( $p<0,001$ ).

Results show that as far as Self Image is concerned, in girls involved in the project, the overall vision of Self-Concept is better than the beginning ( $p =0,05$ ). In Physical Self Description (PSDQ), boys shows a better sense about the weight than girls ( $p=0,03$ ), in Obesity, a PSDQ factors.

As far as Physical Self, EG-boys perceived their own phisical abilities ( $p=.05$ ), motor coordination ( $p=.03$ ), strength ( $p=.01$ ) and endurance ( $p=.01$ ) higher than EG-girls.

In EG, final averages of A&F subscale is significantly lower ( $p=0,04$ ) than averages of time 1.

Between pre-test and post-test, the self-evaluation of negatives features of Self-image increased in CG subjects ( $p=0,03$ ), that reported higher averages than EG. Consequently, Global Self Vision in Time 2 is significantly lower than Time 1 ( $p=0,03$ ).

### *Comparisons between experimental and control groups with the Test U of Mann-Whitney*

In comparisons between groups, averages of the CG in the QAI subscales, Tendency to depression (D) ( $p=0,03$ ) and Externalism (ELC) ( $p=0,05$ ), are significantly higher than experimental group.

Global Self-Image in participants group is significantly higher than control group ( $p=0,04$ ).

Table 1. Correlation with Spearman's Rho in Control group, among Self concept, Self esteem and other variables in environmental and individual psychological adjustment in Time 1 and in Time 2

Time 1	Time 2									
	A&F	ELC	D	P	Self esteem	MSCS	Self efficac y	VIS (NA)	VIS (PA)	G-VIS
<b>Ambient and family pressure</b>	0,78***	0,32	0,29	0,04	-0,51	-0,32	-0,24	0,35	-0,28	-0,41
<b>External Locus of control</b>	0,19	0,01	0,28	-0,08	-0,21	-0,03	-0,05	0,30	0,03	-0,26
<b>tendency to depression</b>	0,44	0,44	0,54	0,31	-0,58	-0,20	-0,44	0,42	-0,11	-0,41
<b>tendency to psychosomatization</b>	-0,03	0,09	-0,03	0,48	-0,08	-0,11	-0,05	0,17	0,12	-0,11
<b>Self esteem</b>	-0,50	-0,40	-0,26	-0,45	0,68**	0,61	0,30	-0,12	0,35	0,29
<b>Physical Self esteem - MSCS</b>	-0,20	-0,18	-0,30	-0,34	0,55	0,60	0,41	-0,14	0,28	0,25
<b>Self efficacy</b>	0,16	0,16	-0,16	-0,05	0,30	0,26	0,32	-0,18	0,17	0,18
<b>VIS - Self-image– negatives aspects (NA)</b>	0,33	0,15	0,45	0,31	-0,60*	-0,18	-0,51	0,68**	-0,13	-0,58
<b>VIS - Self-image– positives aspects (PA)</b>	-0,03	-0,09	-0,01	0,10	0,23	0,14	0,19	0,15	0,21	-0,01
<b>G-VIS – Global Self-image</b>	-0,37	-0,33	-0,37	-0,25	0,67	0,25	0,55	-0,43	0,28	0,49

\*p<.05 \*\*p<.01 \*\*\*p<.001

Table 2. Correlations with Spearman's Rho among PSDQ and other variables in environmental and individual psychological adjustment (Experimental group in Time 2)

Environmental and individual psychological adjustment	Physical Self Description Questionnaire Factors										
	Health	Coordination	Physical activity	Body fat	Sport skills	Global Physical	Appearence	Strength	Flexibility	Endurance	Esteem
<i>Self-image – VIS</i>											
<b>G-VIS – Self Image</b>	0,10	0,09	0,04	0,38	0,22	0,43	0,39	0,20	0,10	-0,15	0,56* **
<i>Intra-personal psychological adjustment</i>											
<b>Self-esteem</b>	0,15	0,18	0,22	0,36	0,24	0,48	0,47	0,35	0,23	-0,01	0,63* **
<b>Physical Self-esteem - MSCS</b>	0,13	0,58*	0,36	0,58 *	0,52 **	0,72* **	0,66* **	0,63** *	0,52	0,33	0,68* **
<b>Self-efficacy</b>	0,05	0,42	0,30	0,29	0,30	0,32	0,30	0,28	0,32	0,18	0,54
<i>Inter-personal psychological adjustment</i>											
<b>Ambient and family pressure</b>	-0,10	-0,06	-0,11	- 0,36	- 0,23	-0,41	-0,27	-0,33	-0,00	0,10	-0,43
<b>External Locus</b>	-0,14	0,21	0,24	0,01 -	0,03	-0,19	0,05	0,07	0,22	0,30	-0,27
<b>Tendency to depression</b>	-0,09	-0,03	-0,05	- 0,21	- 0,30	-0,48	-0,29	-0,07	0,04	0,05	-0,48
<b>Tendency to psicosomatization</b>	-0,36	0,09	0,05	0,08	0,16	-0,06	-0,01	-0,05	0,05	0,15	-0,29

\*p<.05 \*\*p<.01 \*\*\*p<.001

In comparisons by gender, we observed that this finding is attributable to females. Indeed, the evaluation of Self-Image in EG-girls was higher than CG-girls ( $p=.05$ ).

#### *Correlations with Spearman's Rho in control group (Table 1)*

Correlations between initial and final assessment in CG confirmed comparisons findings. From Phase I and Phase III, we observed positive correlations between A&F ( $p<0.001$ ) and general self-esteem ( $p<0.01$ ). In CG preadolescents, there is a positive correlation between negative Self-evaluation about their own Image from Time 1 to Time 2 ( $p<0.01$ ) and a negative correlation between Negative aspects of Self-Image and General Self-esteem ( $p<0.05$ ).

#### *Correlations with Spearman's Rho (Table 2)*

Physical Self-esteem of Bracken's MSCS is significantly related with several subscales of PSDQ: Coordination, Obesity, Global Physical, Appearance, Strength and Esteem (see Table 2). As far as Esteem, the PSDQ subscale, there is a positive correlation among General and Physical Self-esteem (MSCS) and Positive Perception of Self Image (VIS) ( $p<.001$ ).

In girls, Physical Self-esteem is related with General Self-esteem ( $p<.001$ ) and Positive Perception of Self Image ( $p<.05$ ); furthermore, general Self-esteem related with Appearance and Global Physical.

## **4 Conclusions**

Participating in activities linked to sport and problem solving didactic, during adolescence, can play a protective role in decreased self esteem and help the development of cognitive and metacognitive processes.

In accordance with previous researches (Marcoux et al., 1999; Sallis et al., 1999), a program structured on specific physical activities could determine significant positive changes in interpersonal adaptation, global self-image and specific dimensions of physical self, which are indispensable aspects in psychological and physical well being in early adolescence.

The first year of research has produced a first step in two directions: the first is to establish a planning group for the didactics of Physical Activities and to integrate learning between universities and schools. The second of the results obtained in the followed work program, led to significant results in some critical areas of development in adolescence: interpersonal adjustment, overall vision of self and in some sub-dimensions of the physical self.

With regard to psychological regulation in interpersonal relationships, there was a reduction in the factors hindering a balanced and positive adaptation to school environment and family, and particularly in the pressure perceived in social settings, control on externalism and a tendency to depression. At the end of the project, the participants perceived themselves as more assertive, better able to establish positive relations with others, more aware that they can withstand the environmental pressures and more able to interact with the environment in an active way. At the conclusion of the meetings, even the reflections, expressed by the children themselves, showed greater awareness for relational processes and satisfaction with the route taken.

The overall view of self is enhanced, especially in girls, who initially had lower body self-esteem than boys. Compared to the beginning of the project, the girls have a better sense of their body weight, while boys perceived themselves as more coordinated, with more sports skills, stronger and more resilient.

It must, however, dwell on the most critical elements identified in the first year of research. The findings, though positives, reflect the general approach of the educational planning. In other words, positive - or *no* negative - changes have been made in general in the size of inter- and intra-individual self. However can not find specific evidence in the individual factors of the physical self. Meleddu & Scalas (2003) pointed out that, since pre-adolescence, it would seem that interest in the body is different between genders; previous studies have found that for girls seems to be more important the physical appearance, while for boys the physical capacity (Lerner, Orlos and Knapp, 1976, cited in Meleddu & Scalas, 2003). We add to this recently (Thornton and Ryckman, 1991, cited in Meleddu & Scalas, 2003) also the emphasis on physical performance for both boys and girls. In particular, at the conclusion of the project, with regard to the description of the physical self, was found in girls a better understanding of weight while in the boys a better perception of strength, endurance, skills and coordination.

It wonders, therefore, whether the differences in our sample take such a configuration, are determined by patterns of gender, female or male, or derived from a higher concentration in the planning of exercises and activities that privileged strength, endurance, and flexibility rather than dexterity. Aspects, the latter, where the girls would probably be more effective and achieve better results. Consistent with gender differences observed in the studies cited, it could assume that in the absence of a programming of the body characteristics for gender or of other units of learning related to the subdimensions of Physical Self, participants were directed towards those aspects which they considered more important for self-adjustement.

Another limitation is the current sample size that does not yet allow a generalization of the results.

Despite the limitations exposed, which is believed will be overcome thanks to the expansion of the sample and to a more specific program of assistance for the second year of the project, it can finally say that the intervention has helped, in this group of participants, to face up to some of the psychological processes derived from somatic changes of adolescence, especially those relating to the physical self in social relationships and adaptation intraindividual. In general, the instruments and the modalities of physical activity and sports can be a valuable asset and effectively, in adolescence, to allow for a positive revision of its physical self and to improve the climate of relationships in the peer group and with adults in the school environment.

A further consideration concerns, finally, the pedagogical aspects of the project, which focused on cooperative learning, based on problem solving, in motor activity which has also enabled links with other disciplines (such as mathematics, geography, Italian literature, music education). This kind of intervention, which is a new practice in school physical education in Italy, can be a simple and flexible model of teaching - although open to improvement - to achieve the "personality formation through knowledge and awareness of their own corporeal identity" required by the Directions of the Italian Ministry of Education Curriculum for the Elementary and Middle school of 2007.

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## **The influence of canistherapy on motoric skills of junior school age children with mental retardation.**

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### **Abstract**

*Research results from the fact, that dogs positively affect human health on the mental, physical and social part. The therapy is suitable as an additional psychotherapeutic method for the work with patients who have communication problems, motoric problems and mental retardation.*

*Research represented motional and relaxation exercises, which was realised as a part of the regular lessons for 3 months. The research was designed as case studies.*

*Participants with similar diagnosis was observed once a week for three months. Part of the lessons was: positioning, relaxation, training of motoric skills by kinetic cubes, combing, smoothing, feeding.*

*In the end was evaluated the changes of the rate of the reactions, punctuality in action with kinetic cubes.*

*Progress was notable on social level as progression closer contact with dog and better spontaneity. Mental concentration stayed very low.*

*Canistherapy as a psychotherapeutic method may be supporting in the process of developing motoric, mental and social skills for children with mental retardation.*

**Key words:** *canistherapy, mental retardation, motoric skills, relaxation, positioning*

### **1 Introduction**

Canistherapy is composed from words „canis – dog and therapy – healing“. Dogs positively affect human health on the mental, physical and social part. The therapy is suitable as an additional psychotherapeutic method for the work with patients who have communication problems; it supports the abilities for feeling, thinking and moving.

### **2 Method**

Case studies was realised at ZŠS Ibsenova in Brno. Two participants were observed and analysed – girl and boy in junior school age between 10 – 11. Participants had similar diagnosis of mental retardation and psychomotoric retardation F80.

Evaluated were: The changes of the rate of the reactions, punctuality in action with kinetic cubes.

Research represented motional and relaxation exercises, which was realised as a part of the regular lessons for 3 months, between September 2009 – December 2009. The research was designed as case studies.

Two participants were observed individually once a week for three months. Part of the lessons was:

- Positioning
- Relaxation
- Training of motoric skills by kinetic cubes
- Combing
- Smoothing
- Feeding

Positioning is a method based on direct physical contact of the client and the dog (dogs). Basic conditions are the client's confidence in the dog, calm and undisturbed and relaxing atmosphere, what can be complemented with relaxation music etc. In the research participants was: the physiotherapist (methodic guiding, determination of positions), the dog handler (deals with the dog), the teacher.

At first the participants saluted the dog, then they practised with kinetic cubes for five minutes (put them down on the dog body, rise them and put them back to the basic big cube). Then the physiotherapist choose a position suitable for the client (or the client could choose it himself), they were lying in positions on a soft mat (on back, on side or on stomach). Subsequently the dog handler brings the dogs to him so that they get down closely beside the client - on places determined by the physiotherapist. Other places are additionally positioned by rehabilitation aids (pillows, rollers, blankets) and free places are covered so that heat cannot escape. The participant lies in a pleasant undisturbed atmosphere for individual time duration (30 minutes).

The factors working here are particularly the warming through, the breath stimulation of the dog, the stimulation by the dog hair, the calm atmosphere, the relationship to the dog. In this part participants smooth the dog. The impacts discovered are mainly calming, promoted blood circulation, relaxation, pleasant experiences, warming-through. Then they feed the dog by their hands. And finally they train fine motor ability with kinetic cubes once again after positioning.

### **3 Results and Discussion**

In the end was evaluated the changes of the rate of the reactions, punctuality in action with kinetic cubes on motoric skills. Progress was notable on social level as professional closer contact with dog and better spontaneity. Mental concentration stayed very low.

Canistherapy as a psychotherapeutic method may be supporting in the process of developing motoric, mental and social skills for children with mental retardation. Canistherapy may be supporting in the process of healing children with mental retardation.

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## **Research into Pedagogical Impacts on the Movement Development of Crèche Children**

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### **Abstract**

*In 2008 a new BA major was introduced in Hungarian higher education. The permission for the establishment of the major of Infant and Early Childhood Educator was accepted in the branch of Pedagogue Education. The possibility of attaining a qualification of higher education in this field can be regarded as a prominent achievement even in international context. The Benedek Elek Faculty of Pedagogy of the University of West Hungary obtained the right to launch the above mentioned major in 2009. Consecutively, education began in correspondent and full time courses. Instructing the methodology subjects connected to majors classified as part of the educational branch of Educator on a high level makes the conduction of researches necessary, which examine the educational impacts on crèche children.*

*During the sport-pedagogical study introduced in the poster-lecture we were searching for an answer to the following questions: How far do the movement possibilities offered by crèche pedagogues support the optimal movement development of infants? Does their background knowledge provide a sufficient basis for planning and conducting PE trainings professionally? We also examined what expectations the parents formulate concerning physical education in the crèche as well as how far they contribute to the efficiency of pedagogical work in this field of education. Our methods included analysing documents, compiling written questionnaires and examination. We recorded the data of 54 crèche educators during our study. The parents' sample consisted of 29 women and 26 men.*

*While examining 28 informal PE trainings we came to the conclusion that structure and content of crèche physical education have individual features. Our experiences confirmed our hypothesis that there are untapped possibilities of movement development of small children within the framework of institutional physical education. This can be primarily explained with the fact that health care skills of crèche educators are on a higher level than their pedagogical qualification and that they did not receive a proper education concerning the methodology of physical education. We found that parents regard regular playful physical education significant in the crèche. However, their knowledge is incomplete regarding the movement forms guaranteeing optimal development for small children and they are insecure about the content of physical education in crèche.*

## **1 Introduction**

The traditions of crèche education are going back as far as 1852. Training the professionals for these institutions has been taking place on intermediate level for a long time. This level of training, by our days, however, has not secured the prevailing of pedagogical and psychological research concerning early learning. In infant age and at early childhood - according to this research - not only nursing, but also education has a crucial role regarding the development of the nervous system, as well as cognitive and social improvement. Establishing post secondary vocational training, later on the launching of the BA major of Infant and Early Childhood Educator emerged as a professional claim. Higher professional qualification is to secure more thorough pedagogical preparedness of professionals dealing with infants and small children. This step can be regarded crucial from the viewpoint of the prestige of the profession as well, since up till now crèche employees wanting to study were forced to attain a degree in various different institutions; in the education of kindergarten teachers, primary teachers, socio-pedagogues, etc. The rocketing of the number of crèche children also puts a need to the renewal of professional education, to guarantee more thorough pedagogical preparedness, as the higher headcount puts a higher responsibility on attendants and educators in crèche. Sharing the task with the parents, they will be in charge of the education and movement development of more and more infants.

The Benedek Elek Faculty of Pedagogy of the University of West Hungary obtained the right to launch the BA major of Infant and Early Childhood Educator in 2009. Consecutively, education began in correspondent and full time courses. Instructing the methodology subjects connected to majors classified as part of the educational branch of Educator on a high level makes the conduction of researches necessary, which examine the educational impacts on crèche children. During the sport-pedagogical study introduced in the poster-lecture we were searching for an answer to the following questions: How far do the movement possibilities offered by crèche pedagogues support the optimal movement development of infants? Does their background knowledge provide a sufficient basis for planning and conducting PE trainings professionally? We also examined what expectations the parents formulate concerning physical education in the crèche as well as in what extent they identify with the view that regular, planned exercises are already important in the early years.

Before we start introducing the research, it is important to define what we mean by optimal movement development at this age. According to our experience, in our urbanized world, the movement-deficient lifestyle of adults already affects small children. A remarkable part of the parents do not pay attention to satisfying the natural movement-requirements of their children. The cause of this might be lack of time, or not proper sport-socialization (Bognár et al, 2006). Regarding sporting habits, parental ambition is determinative in the life of the rising child (Gombocz, 2008). The task of institutional physical education is the compensation of the harmful effects caused by inactive lifestyle - using the natural movement-requirements of the children - as well as forming the habitual system of regular physical education bound to time limits (Bucsy, 2009). A significant part of crèche children is in their early childhood. At the age of 1-3 practicing basic movement forms extensively is the content of physical education, as the child already knows and uses several various kinds of movements, but the special-dynamic features of these fall behind mature movement patterns (Farmosi, 1999). We regard the fulfilment of the above mentioned fundamental for undisturbed movement development. At this early stage children acquire basic movement forms or their simple combinations via personation and in a playful way (Istvánfi, 2006). The development of

some movement forms, the appearance of their diversified forms particularly requires the help of adults, their movement pattern. For this reason, crèche educators' pedagogical qualification, methodological knowledge and expertise is an indispensable element of motoric development.

## 2 Material and method

### 2.1 The hypotheses of the research

We set our hypotheses according to the aim of the research.

$H_1$ : We presumed that the health care qualification of crèche attendants is higher than their pedagogical qualification.

$H_2$ : We presumed that structure and content of crèche physical education have individual features, there are untapped possibilities of movement development of small children within the framework of institutional physical education.

$H_3$ : We presumed that parents regard regular playful physical education significant in the crèche.

### 2.2 The sample of the research

In the research we recorded the data of 54 crèche educators, who work in four Sopron crèches carrying out practical training. Students taking part in the post-secondary vocational training of Infant and Early Childhood attendant and BA major Infant and Early Childhood Educator students accomplish their practice in these institutions. We can see the distribution according to age in Figure 1.. The average age of the sample is 40,8 years, the modus is 50. We consider the data of crèche educators in more detail by the presentation of the results of the research.

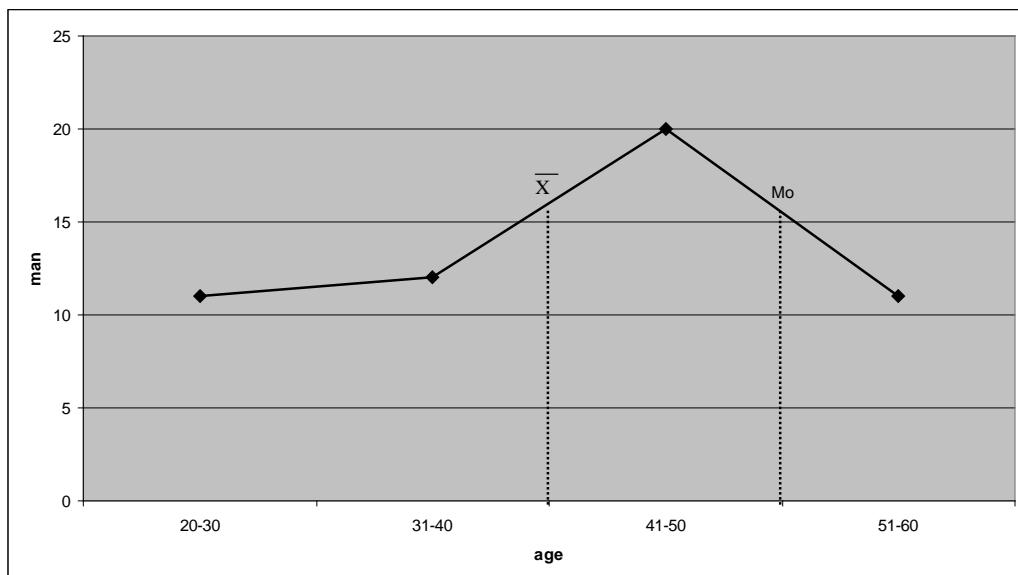


Figure 1. The distribution of crèche educators according to age.

The parental sample consisted of the parents of the children from the Practice Crèche No. 1., 29 women and 26 men.

From the data regarding the parents' qualification, income and sporting habits we drew the conclusion that in both the case of the fathers and the mothers we can speak about a positive sample. We attached great importance to recording sporting habits among the features, as the judgement of crèche physical education seriously depends on the parents' relationship to exercise.

Table 1. The data of the parental sample.

	Mother	Father
Average age(years)	34,8	36,3
Qualification (%)		
University, College	51	35
Secondary school	21	42
Vocational school	28	23
Primary school	0	0
Standard of living (%)		
We are well-off	7	12
Average	90	76
Not well-off	3	12
Pursuing sport regularly (%)	35	23

### 2.3 The methods of the research

We used several different methods to verify our hypotheses. We applied document analysis to examine „The National Fundamental Programme of Crèche Education-attendance” (2008), the educational programmes of the individual crèches and the week timetables of crèche groups. We drew up minutes about 28 crèche classes, applying a ‘monitoring technique without coding’. Our observations primarily focussed on the content of the informally organised physical education trainings. We used the method of ‘eliciting in writing’ about parents’ expectations in connection with the content and regularity of physical education in crèche.

From the elaborating methods we conducted an elemental examination of the data, regarding statistical schemes factor analysis applying SPSS.

## 3 The results of the research

### 3.1 The personal conditions of physical education in the crèche

By the fulfilment of personal conditions we considered the qualifications of crèche educators. The column diagrams of Figure 2. exemplify well, that professional education is not unified in this field. The pedagogical, methodological knowledge and preparedness connected to each qualification is hard to trace. From the 54 attendants taking part in the examination 1 is qualified as belonging to category C, which means she took part in an Infant and Early Childhood Attendant Course which does not require GSSE. The ones classified as members of category D possess a skill of Infant and Early Childhood Attendant requiring GSSE, the ones in category D acquired a qualification as professional attendants. The attendants who accomplished their studies in the above

mentioned two school types received first and foremost health care education and had little possibility to acquire professional methodology knowledge. On the other hand, they frequently take part in professional trainings organized by the regional methodological centre. Information brochures covering several educational areas and methodological letters help daily pedagogical activity. 23 from the attendants taking part in the research have accomplished the two-year post secondary vocational training for Infant and Early Childhood Educator-Attendant – which also means classification into category E. 15 of them had in their curriculum the block of subjects called “The Bases and Methodology of Physical Education” for three terms, with theoretical and practical knowledge. This group of subjects prepares the students for planning, organizing and conducting physical education in the crèche.

6 of the 54 crèche attendants possess a college degree. They have a qualification as kindergarten teacher or socio-pedagogue. Their curriculum includes sport-professional subjects that can oscillatorily be connected to crèche physical education.

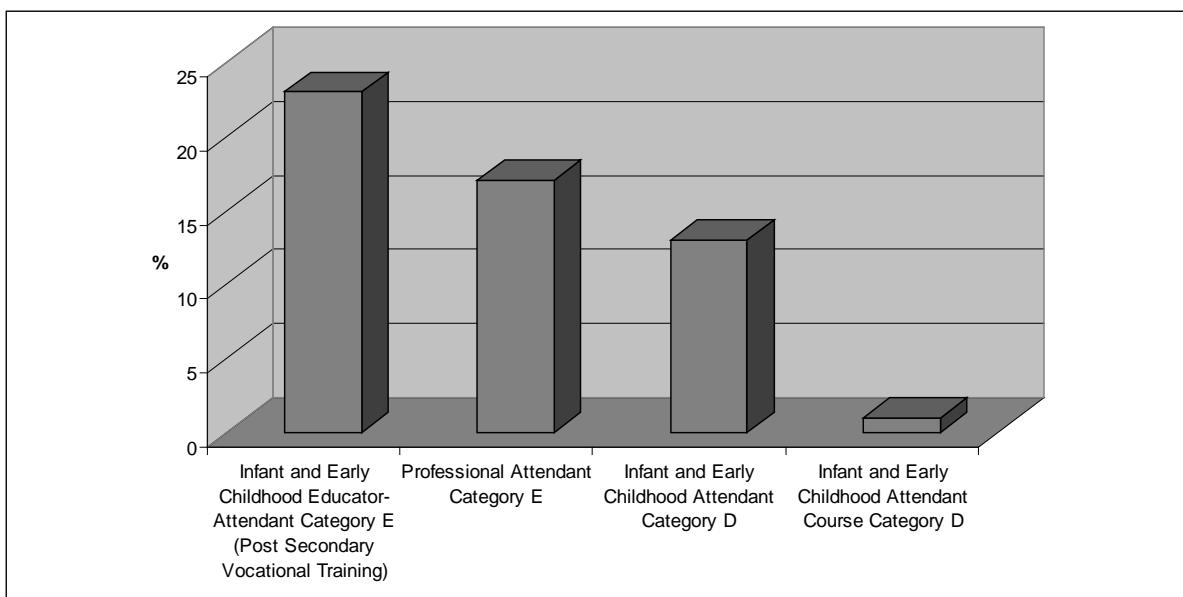


Figure 2. The qualification of crèche attendants

### 3.2 The content of crèche physical education

The National Fundamental Programme of Crèche Education-attendance contains the principles of organising crèche life. The first place of the here formulated educational tasks is taken by facilitating healthy physical development and forming healthy lifestyle. In favour of the healthy physical development of infants and small children possibility for movement development, physical exercise has to be assured by daily regularity. Documents record the institutional framework of kindergarten physical education, laying down the number of weekly physical education trainings respectively physical education classes, and their framework of content. There is no unified instruction on national level with reference to the institutional framework and content of crèche physical education.

Before analysing the minutes recording the content of crèche physical education, we recorded the age of crèche children, which we present in Figure 3.

Introducing the age characteristics of the crèche children is crucial considering the content of physical education lessons. The data recorded in September show that the average age of the 307 recorded children was 27,5 months. The youngest child was 6, the oldest 43 months old.

Our observations about the structure and content of crèche physical education took place in October and November, when the children were mainly inside. At that time the majority of the children was already two years old. According to our experience, the structure of the informal 20-25 minute lessons is different from what is common in physical education lessons in kindergarten and in school. In kindergarten and in school warm-up exercise are followed by learning the main exercises and physical education games helping to learn the main exercises, finally, the organism is cooled down. According to our observations, the preparatory part of crèche physical education consists of 2-4 beat gymnastic exercises, occasionally complemented by walking-running exercises. The fundamental movement forms are practiced in the main part. We saw no examples of physical education games. As for the proportions, the preparatory part takes up half of the informal lessons in time. When analysing crèche physical education we grouped the movement material into gymnastic exercises (Table 2.) and basic movement forms (Table 3.)

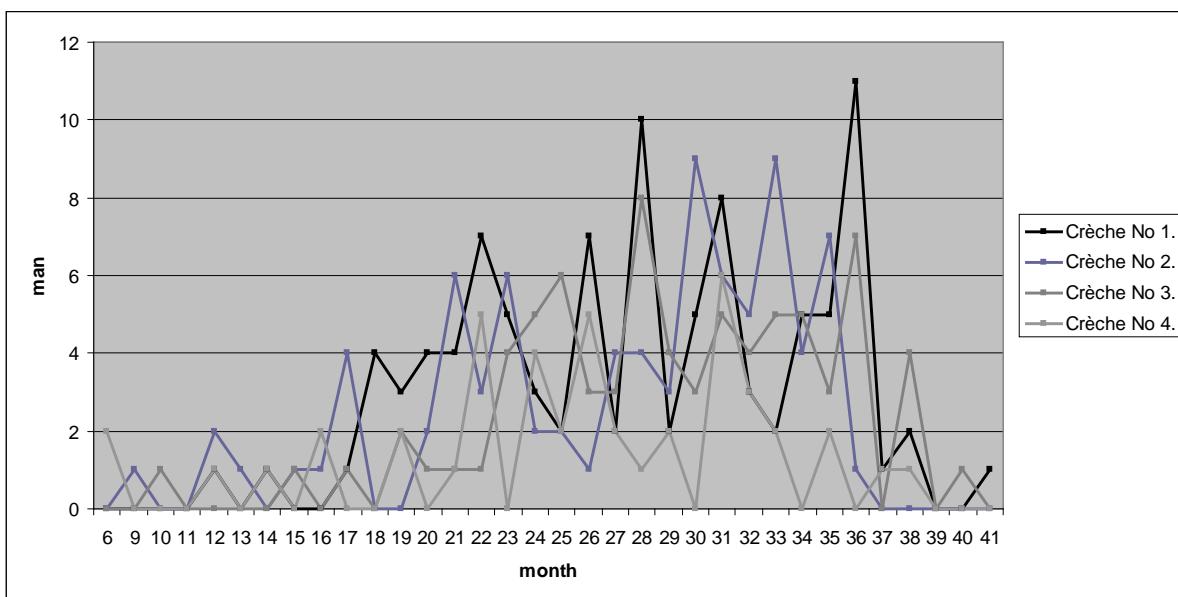


Figure 3. The age distribution of crèche children.

Table 2.: The fundamental gymnastic forms observed in the crèche physical education.

<i>Muscle groups</i>	<i>Stretching exercises</i>	<i>Strengthening exercises</i>
Neck exercises	neck bending, neck rotation exercises	
Arm exercises	finger- and wrist exercises arm swing exercise arm rotation	arm lift -lowering arm floating
Abdominal exercises	backward trunk bending	leg movements in sitting, lying
Back exercises	forward trunk bending	forward trunk bending 90

		degree, lying on abdomen backward trunk bending, leg lift backwards
Side exercises	turning trunk sideways sideways trunk bending	
Leg exercises	toe- and ankle exercises leg swing exercises heel lift exercises	toe- and ankle exercises knee bending - stretch jumping exercises

The table assembling fundamental gymnastic forms demonstrates well, how rich crèche physical education is in fundamental gymnastic forms. In the 28 informal lessons we could on the whole observe exercises stretching or strengthening almost all muscle groups. The characteristic method of conducting practise was the imitating form, using nursery rhymes well known by the children. In the composition of the set of exercises the methodological aspects that have to be taken into consideration for the sake of general and versatile development of children's organism were poorly represented.

The wide- range practice of fundamental movement forms in the crèche secures the movement basis, on which early childhood and at the same time kindergarten physical education can build. At the age of 4-7 years this is the base of improvement of movement forms and of the appearance of the first movement combinations (Meinel, 1977:293-410). The versatile practice of basic skills is also important because in the early childhood movement development takes first place as a coordinative, later on as a differentiating process (Hirtz-Ludwig,1976:506-510; Israel,1976: 501-506).

Table 3.The fundamental movement forms observed in the crèche physical education lessons.

Fundamental movement forms	Variations of fundamental movement forms
crawling	crawling on abdomen (with bean bag, on a bench), crawling on all fours, crabwalk crawling in 4- point kneeling position, bunny hop, crawling sitting stretch
walking	walking keeping pace, tiptoeing, walking on heels, with knee lift, walking on outer-, inner sole edge, walking changing pace, walking with tasks (squatting for a sign), stepping over a string, balancing walking
running	running around
jumping	vertical jumping, jumping home, jumping over
throwing	punching ( balloon), throwing home (horizontal target), bean bag toss, ball toss, rolling ball in pairs,
lifting-carrying	
dragging-pushing	dragging in sitting with a partner
rolling	rolling around longitudinal axle
hanging, climbing	

Taking the data of Table 3. into consideration, the principle of versatile movement practice did not entirely come to fulfilment in the lessons monitored. From fundamental movement forms we could observe the richest variations in the field of walking. However, we missed the walking exercises in the various spacial directions (sideways, backwards) and exercises with diverse gymnastic apparatus. The different types of crawling are the first dislocation movements of small children. These are the most important means of forming the biomechanically right posture and developing motoric skills at this age. Although they came after walking as the second movement form in the physical education lessons, their use qualitatively and quantitatively still fell behind the needs of the age group. Running is a preferred movement form of children, they enjoy performing it. In spite of this, it was carried out few times in the informal lessons; however developing a running with good technique is an important task of physical education. Practicing running in the crèche under manifold circumstances - running in different formations, in pairs, evading objects, etc., - helps more and more secure, better and better carried out running. The study is not aimed at a detailed analysis of all the movement forms, as with the help of the table the occurrence of the individual exercises can clearly be followed. Nevertheless, it is important to note that we have not seen examples of hanging and climbing. The inevitable movement material serving the development of trunk musculature might possibly have been ousted from the physical education exercises- as - with one exception - there are no wall bars in the crèche group rooms. Hopefully, outdoors gymnastic apparatus and jungle gyms stop this gap in spring and autumn. We also experienced that informal lessons do not contain physical education games; crèche educators did not make use of this possibility for practicing movement forms. Crèche children enjoy running games the most, at the end of early childhood individual races can also successfully made to be practiced among them. The advantage of this physical educational game is that it makes the practice of various movement forms possible; furthermore, children have to adapt few rules.

### **3.3 Parents' opinion about physical education in the crèche**

Before presenting the results of the questionnaire fact-finding, it is important to mention that we processed the data of a positive sample considering pursuing sports, as 35 per cent of the mothers and 23 per cent of the fathers marked on the questionnaire that they pursued sport at least 2-3 times a week. This proportion exceeds the national average by far. As a result of the attitude towards sport, 96 per cent of the mothers and 97 per cent of the fathers considers regular playful physical education important in the crèche. We also asked questions about the content of physical education in the crèche. We enumerated the fundamental movement forms; in addition, we asked, the practice of which they considered significant in the early years. According to the data of Table 4., mothers privilege balancing, jumping, crawling and walking. Most of the fathers favour running, jumping and balancing.

Table 4.: The content of physical education according to the opinion of the parents.

Fundamental movement forms	Mother (%)	Father (%)
Crawling	45	35
Walking	55	50
Running	52	62
Balancing	83	58

Rolling	28	27
Throwing	52	46
Jumping	66	58
Experiments for hanging	35	42

At this age the extensive practice of fundamental movement forms guarantees the optimal movement development of small children. The answers of the parents indicate that only few of them are aware of this. Only two parents marked the full scale of all the movement forms in the relevant question of the questionnaire. The results of the factor analysis refer that the movement forms does not have a close system in the parents' thoughts.

#### 4 Conclusions

The research aiming at the study of pedagogical effects influencing the movement development of crèche children affirmed our hypotheses.

Our hypothesis, namely that the health care qualification of crèche attendants is higher than their pedagogical qualification, was verified. Only 15 of the 54 attendants had been prepared in post-secondary vocational training to plan, organize and conduct crèche physical education. While examining 28 informal PE trainings we came to the conclusion that the structure and content of crèche physical education have individual features. It was for example conspicuous that gymnastic exercises are more stressed than practicing the basic skills, furthermore PE games did not occur in the informal lessons observed. Our experiences confirmed our hypothesis that there are untapped possibilities of movement development of small children within the framework of institutional physical education. In our view more possibility has to be given to practice fundamental movement forms through applying toys and games triggering quick and accurate actions.

According to written eliciting, parents regard regular playful physical education significant in the crèche. However, their knowledge is incomplete regarding the movement forms guaranteeing optimal development for small children and they are insecure about the content of crèche physical education.

In view of our research experience so far we think it is expedient to conduct further studies with reference to crèche education and to employ the results at the BA major of Infant and Early Childhood Educator at the Benedek Elek Faculty of Pedagogy of the University of West Hungary.

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## **Sport Physiology**

## **Research trends in adapted physical activity.**

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### **Abstract**

*Adapted Physical Activity (APA) is a cross disciplinary body of knowledge, with an aim towards the identification and solution of psychomotor problems throughout the life span (Hutzler & Sherrill, 2007). In turn, Sherrill (2004) stated that APA incorporates service delivering, pedagogy, training, coaching etc., and is provided by qualified professionals to enhance, through physical activity, empowerment and quality of life of individuals of all ages, with a variety of disabilities and societal restrictions. Using the above definitions and following the research study of Reid and Stanish (2003), APA was perceived for the purposes of the present study as a discipline for its own sake, with an existing knowledge base, methodology and terminology. In turn, the hallmark of APA as a discipline was related to the advancement of theoretical knowledge through research (Reid & Stanish, 2003). Therefore, the aim of the present study was to examine the latest research trends in APA. Following previous research studies (e.g. Reid & Broadhead, 1995; Porretta & Sherrill, 2005; Sherrill, 1997; Sherrill & O'Connor, 1999), the 2007-2010 publications in the Adapted Physical Activity Quarterly (APAQ), a committed international research journal in the field, were reviewed. It was assumed that the APAQ was representative of the research conducted in the respective field (Sherrill, 1997). Examination of the 2007-2010 publications revealed information concerning the researchers involved and countries of origin, scientific focus, disabilities examined, sampling designs, statistical analyses used, validity and reliability reports, theories used, etc. The results are discussed in accordance to previous publications, in an attempt to describe the current research trends in APA.*

### **1 Introduction**

According to the Web, trend is considered as the general course or prevailing tendency or the general direction. In turn, research may be considered as the systematic inquiry or investigation into a subject in order to discover or revise facts, theories, applications, etc (Google: <http://dictionary.reference.com>). According to Sherrill (1997), research may be perceived also as ‘means by which a body of knowledge is developed’ (citation) (p. 2). Research trends therefore were defined, for the purposes of the present study, as the tendency of systematic inquiry in the field of adapted physical activity (APA) providing the general direction for scientists planning their future research endeavors.

Adapted Physical Activity (APA) is perceived as a cross disciplinary body of knowledge, directed towards identification and solution of psychomotor problems throughout the life span. Further, it is a service delivery profession and an academic field of study that supports an attitude of acceptance of individual differences, advocates access to active lifestyles and sports and promotes innovation and cooperative service delivery programs and empowerment systems (Hutzler & Sherrill, 2007; Reid & Stanish, 2003; IFAPA, 2004). According to Sherrill (2004), APA refers to the integration of

knowledge from many disciplines in the creation of a distinct, unique body of knowledge focusing on adaptation, individual differences and physical activity. Information from different academic disciplines, such as kinesiology, exercise and sport science, recreation (leisure studies), social studies, special education, general education, counseling, medicine, law, physical and occupational therapy are shaping therefore the knowledge base of APA (Sherrill, 2004).

The European Association on Research into the APA field (EARAPA) defined APA in terms of movement experiences and applications directed towards the needs, interests and abilities of individuals with impairments, disabilities and handicaps (Doll-Tupper, 1996, p. 598). Definitions of impairment, disability and handicap may be found in a variety of academic textbooks, such as those of Winnick (2005), Sherrill (2004), Steadward, Wheeler & Watkinson, (2003), etc. Disability for example, as a target area in the APA field, was defined by Steadward et al (2003) as 'any restriction or lack (resulting from impairment) of ability to perform an activity in the manner or within the range considered normal for a human being' (p. 54). According to the International Classification of Functioning and Health (ICF), disabilities as a general term were revised as the human experience of activity limitations in their daily living. These limitations must be severe enough to interfere with activities of daily living, like dressing, general education, transportation, employment, etc., and are specific to particular areas of human functioning. Further, definition of impairments was also provided, while the term handicap is no longer used and substituted from the term 'restrictions'. Based on the above description, daily activities may be adapted and the experienced activity limitations can be minimized or even eliminated, providing this way a less permanent and a more dynamic perspective in the disability term (Sherrill, 2004).

The importance of promoting research in the scientific field of APA stems mainly from the world wide rising population of individuals with disabilities. Sherrill (2004) for example stated that approximately 45 million of individuals experience some type of disability in the USA (16% of the total population). According to the Federal Public LAW (105-17) in USA, the 13 legally recognized disabilities are: autism, deaf-blindness, hearing impairment, mental retardation, multiple disabilities, orthopedic impairments, other health impairments, serious emotional disturbance, specific learning disability, speech or language impairment, traumatic brain injury, and visual impairment including blindness. Of this 45 million with disabilities in USA, 10% are children and adolescents, 30% are young and middle aged adults while over 50% are individuals above the age of 65. Further, approximately 10-12% of individuals experience disabilities from birth to the age of 22 years old, and may benefit from special education services, including APA.

A variety of researchers have evaluated in the past the body of research in the APA field (Reid & Prupas, 1998; Reid & Stanish, 2003; Sherrill, 1999; Sherrill & O'Connor, 1999; Hutzler & Sherrill, 2007, Porretta & Sherrill, 2005). Reid and Stanish (2003) for example examined the APA literature (APAQ and Clinical Kinesiology) in an attempt to conclude whether APA represents a cross disciplinary knowledge base, through the advancement of it's theoretical knowledge from research. Further, Reid and Stanish (2003) used the knowledge base flowing from academic research as the basic criterion to evaluate the professional and academic discipline of APA. The researchers stated that APA has a cross disciplinary knowledge base, borrowing terminology, theory and methods from a variety of allied fields, such as kinesiology, psychology, sociology, etc. Sherrill (1997) however, few years earlier had disputed the above conclusion and opened up the way for researchers to support APA to meet all the necessary criteria and get recognition as an autonomous academic discipline. Specifically, Sherrill (1997) stated that 'the first step in that direction is the publication of theoretically rich research

that helps to clarify our domain and seeking answers to vital questions related to a healthy life style for all individuals involved' (p. 3). Finally, few years later, Hutzler and Sherrill (2007) claimed that APA may be perceived as a discipline that prepares professionals to work in the field of physical activity for individuals with disabilities. However, whether APA represents a unique discipline or cross discipline is still under debate among academic scholars in the field (Hutzler & Sherrill, 2007; Sherrill & DePauw, 1997).

Following the above studies (Reid & Prupas, 1998; Reid & Stanish, 2003; Sherrill, 1999; Sherrill & O'Connor, 1999; Porretta & Sherrill, 2005), it was decided to examine the APA literature in an attempt to describe the future trend in the APA research field. Overall, the 'major advances in APA over the past years have resulted from a vigorous application of the scientific method, and this approach holds the greatest promise as we move into the new millennium' (Shepherd, 1999, p. 342).

## 2 Method

The major concern in the present study was to identify the sources where the major body of research in the APA field may be found. Porretta and Sherrill (2005) stated that Adapted Physical Activity Quarterly (APAQ) and Palaestra are two well-known scientific journals publicizing exclusively research in the APA field. The above researchers stated that APA scholars publish in a variety of different journals while the primary journal in the field is APAQ. The same direction was followed by Sherrill (1999) who evaluated the first decade of publications in the APAQ, while Reid and Stanish (2003) reviewed studies from APAQ and Clinical Kinesiology as representative in the APA field. Finally, Hutzler and Sherrill (2007) stated that since 1994, the International Federation of APA has selected APAQ as the main international journal increasing the knowledge base of the field through research. Overall, following the direction provided above from distinguished scholars in the past, we assumed that the APAQ is representative of the research in our field, and as such was selected to evaluate the research trends in APA. The study of Porretta and Sherrill (2005), examining the APAQ publications during the last two decades, provided the rational for continuing upon their work and examine the APAQ literature thereafter.

Personal accessibility over the APAQ publications was available since 2007. Unfortunately, 1 volume during 2009 and 2 volumes during 2010 could not be retrieved. Further, the last (4<sup>th</sup>) 2010 volume was not published yet by the time the present study was conducted. Therefore, 12 APAQ volumes were evaluated, with a total of 56 studies since 2007. The above studies may be found in Appendix 1.

Accordingly, the 56 studies were evaluated in an attempt to define the research trends in APA. Following the example of previous researchers, the studies were evaluated according to the scientific area examined (Porretta & Sherrill, 2005), disability (Reid & Broadhead, 1995; Porretta & Sherrill, 2005), quantitative vs qualitative method used (Sherrill & O'Connor, 1999; Bouffard, Strean & Davis, 1999), country authorship (Porretta & Sherrill, 2005), sampling design (Sherrill & O'Connor, 1999), validity and reliability reports (Yun & Ulrich, 2002), software for statistical analysis and theories used (Sherrill, 1997, 1999; Reid & Broadhead, 1995).

Concerning the area, the attempt was to retain those identified by Porretta and Sherrill (2005), and the respective brief definitions may be found in Appendix 2. The disabilities identified may be found in Appendix 3. For the quantitative vs qualitative distinction between studies the definitions of Langridge (2004) were used (Appendix

4), while country authorship was determined by ‘the university/ agency affiliation and mailing address at time of publication’ (Porretta & Sherrill, 2005, p. 126). In the present study, authors were counted additionally in case they had published more than once in APAQ since 2007. Further, the research sampling design, the software used for statistical analysis and validity and reliability reports were counted to strengthen the evaluation of research studies in an attempt to detect the research trends in APA (Sherrill & O’Connor, 1999, Sutlive & Ulrich, 1998, Yun & Ulrich, 2002).

Finally, the present study evaluated the theories used in the APA literature, since 2007. According to Slife and Williams (1995) theories may be perceived as formalized ideas applied to explain different phenomena. Sherrill (1999) stated that theories constitute a conceptual framework in which inter related knowledge is synthesized in an attempt to describe, or even predict the phenomena we examine. Further, Sherrill (1999) stated that in ‘selecting topics for future research, we should be cognizant of their underlying theories and how they fit together to form the whole that makes up our knowledge base’ (p. 212). Following the above suggestions, it appeared that the evaluation of theories publicized in the APAQ were of significant merit for describing the respective research trends. For the purposes of the present study, we counted the frequency and content of theories specifically presented into the 56 APAQ publications, which in turn were either incorporated as separate sub sections or specifically addressed within the introduction.

### 3 Results

The 56 studies were evaluated according to the respective area examined, disability, quantitative vs qualitative method used, country authorship, sampling design, validity and reliability reports, software for statistical analysis and theories used. Reliability checking was conducted with a doctorate student in the APA field. The percentage of agreement obtained between researchers was above 80% (Thomas & Nelson, 2001) and the results are presented accordingly.

Concerning the scientific areas, the majority of publications since 2007 examined psychosocial issues (16 studies, 28.57%), measurement/ assessment/ classification (9 studies, 16.07%), motor behavior (8 studies, 14.29%), exercise science/ physical activity (8 studies, 14.29%) and biomechanics (5 studies, 8.92%). No history studies were identified and the overall findings are presented in table 1.

Table 1. The areas identified in APA.

<b>Scientific Focus</b>	<b>Frequency</b>
Psychosocial issues	16 (28.57%)
Motor behavior	8 (14.29%)
Exercise science/ physical activity	8 (14.29%)
Inclusion/ programming	4 (07.14%)
Measurement/ assessment/ classification	9 (16.07%)
Research issues	1 (01.79%)
Professional preparation/ issues	1 (01.79%)
Biomechanics	5 (08.92%)
Pedagogy	1 (01.79%)
Other	3 (05.35%)
History	
Total	56 (100%)

With respect to the disabilities examined, the majority evaluated samples of individuals with physical (11 studies, 21.15%) and intellectual disabilities (10 studies, 19.23%). The generic studies were next, with samples of e.g. parents, students without disabilities (7 studies, 13.46%) etc, while no studies were published examining individuals with hearing impairment, learning disabilities, and at-risk infant-toddlers. The above findings are presented in table 2.

For the quantitative vs qualitative distinction, 34 studies were evaluated as quantitative, 13 studies were qualitative and 3 studies used mixed quantitative and qualitative methods. Further, 3 review studies were identified which were not counted as either quantitative or qualitative.

Table 2. Disabilities identified in the APA literature.

<b>Disability</b>	
<b>Frequency</b>	
Generic (13.46%)	7
Intellectual disability (Mental Retardation)	10 (19.23%)
Multiple sample (03.85%)	2
Physical disability DCD/ awkward/ MI (07.69%)	11 (21.15%)
Down syndrome (01.92%)	4
Neurological impairment (07.69%)	1
Hearing impairment	4
Medical conditions (01.92%)	3
Emotional/ behavioral disorders (05.77%)	1
Visual impairment (03.85%)	2
Learning disabilities	2
Autism (03.85%)	3
Multiple disabilities (05.77%)	2
Gerontology (03.85%)	1
At-risk infant toddlers	52 (100%)

Researchers from 19 separate countries appeared in the APAQ since 2007. The researchers from the USA appeared in 33 studies, with colleagues from Canada (12 studies), Australia (6 studies) and Belgium (5 studies) being next. The respective data from country authorship may be found in table 3.

The specific sampling design used was introduced in 36 studies. The majority of the above studies incorporated recruited (11 studies), purposive (9 studies), and convenience (8 studies) sampling selection methods. In turn, volunteer sampling (3 studies) and random selection/ assignment (2 studies) were coming next. Single case study,

representative sampling selection and invited to participate methods of sampling, were used in one study each.

Accordingly, validity and reliability reports appeared in 40 studies. A variety of methods were used to report the validity and reliability evidence, and as such, it was not feasible to summarize the respective findings, which are presented in table 4.

Interestingly, trustworthiness was the method appeared most often, in 8 separate studies, and was related to validity methods in studies using qualitative methods of research.

Statistical analyses used mainly an SPSS version (13 studies), with SPSS-14 more often reported (5 studies). Interestingly, the SPSS-15 was the latest version reported in one study only, although latest SPSS versions are nowadays available for researchers and statisticians to use (e.g. SPSS-19). The LISREL and PRELIS were reported in three studies for conducting Confirmatory Factor Analysis (CFA). Further, the LISREL 8.54 was reported in one study for reporting CFA results as well. Other statistical software used was the Strata 9.0 (1 study), the SAS (1 study) and the Statistica 6.0 (1 study).

With respect to the theories used, a total of 35 studies (66.04%) indicated the exact theory guiding the respective research study. The social cognitive theory of self-efficacy (Bandura, 1997) and the self-determination theory (Wehmeyer, 1998; Wehmeyer & Gamar, 2003; Deci & Ryan, 1985, 1991) were the most commonly used. The above results are summarized in table 5.

Table 3. Country authorship.

<b>Country authorship</b>	<b>Frequency</b>
Australia	6 studies
Belgium	5 studies
Brazil	1 study
Canada	12 studies
Finland	1 study
France	1 study
Germany	1 study
Greece	1 study
Hong Kong	2 studies
Israel	2 studies
Latvia	1 study
Netherlands	3 studies
Norway	1 study
Poland	2 studies
Puerto Rico	1 study
Portugal	1 study
Spain	2 studies
Taiwan	1 study
USA	33 studies

Country authorship is listed alphabetically and was determined by the affiliation and mailing address at time of publication

Table 4. Validity and reliability reports.

<b>Method</b>	<b>Frequency</b>
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Quantitative research method	
Reliability	
Internal consistency	3 studies
Intraclass coefficients	3 studies
Internal consistency – Inter rater reliability	2 studies
Internal consistency – test retest	2 studies
Reliability – accuracy	5 studies
Inter observer agreement	6 studies
Validity	
Construct validity	2 studies
Content validity	1 study
Translation validity	1 study
Concurrent validity	1 study
Reliability and validity	
Test retest – Intraclass – Concurrent validity	1 study
Test retest reliability – Convergent validity	1 study
Qualitative research method	
Trustworthiness	8 studies
Credibility	2 studies
Triangulation	2 studies

Table 5. Theories used.

Researchers	Theory	Citation
Oh & Kozub (2010)	Self-efficacy theory	Bandura (1997)
Todd et al (2010)	Self-determination theory	Wehmeyer (1998)
Sousa et al (2009)	Conception of the lived body (1996)	Merleau-Ponty
Mazzoni et al (2009)	Hierarchical model of self-esteem and self efficacy	Fox (2000) Bandura (1977)
Kasser (2009) 1986)	Self-efficacy theory	Bandura (1977,
D'Hondt et al (2009)	Activity-deficit hypothesis	Wall (2004) Bouffard et al (1996)
Standal & Jespersen (2008)	Situated learning theory	Wenger (1998)
Moola et al (2008)	Social cognitive theory	Bandura (1977)
Klavina & Block (2008)	Contact theory	Allport (1954, 1979)
Martin (2008)	Social cognitive theory	Bandura (1977)
Driver (2008)	Self-worth model	Harter (1987)
Pan (2008)	Self-determination	Wehmeyer & Gamer (2003); Deci & Ryan (1985, 1991)
Collumna et al (2008) (1977)	Ecological model of human development	Bronfenbrenner
Hutzler & Sherrill (2007) (2003)	Social constructionism	Denzin & Lincoln
An & Goodwin (2007)	Disablement model	Peters (1996)
Arbour et al (2007)	Social identity theory	Turner (1984)
Driver (2007)	Multidimensional social influence	Chogahara (1999)

Maiano et al (2007) (1976) Hutzler (2007)	Multidimensional self-concept Systematic ecological model in APA	Shavelson et al Hutzler (2007)
Perreault & Vallerand (2007) 1991)	Self determination theory	Deci & Ryan (1985,

## 4 Discussion

The present study examined the research trends in APA. As such, and following the example of previous scientific reports (Porretta & Sherrill, 2005; Sherrill 1997) the APAQ publications since 2007 were selected to serve the present research purpose. A total of 56 studies were evaluated and the results are presented accordingly.

The most commonly examined subject area included psychosocial issues (28.57%), followed by measurement/ assessment/ classification (16.07%), motor behavior (14.29%), exercise science (14.29%) and biomechanics (8.29%). Individuals with physical disabilities (21.15%) were the most commonly examined, followed by individuals with mental retardation (19.23%), developmental coordination disorder-DCD (7.69%) and neurological impairment (7.69%). The generic group, incorporating individuals without disabilities, was examined in 13.64% of the studies.

The quantitative research methods used were evident in 34 studies, while 13 studies reported qualitative methods and 3 studies used mixed (quantitative and qualitative) methods. The USA was most commonly seen as country authorship, followed by Canada, Australia, Belgium and the Netherlands. The common sampling methods used were either recruited (N = 11), volunteer (N = 3), purposive (N = 9) and convenience (N = 8). The SPSS was used in 13 studies for data analysis, while quantitative validity and reliability reports were evident in 28 studies. Twelve more studies used qualitative reports of validity and reliability evidence, presented as either trustworthiness, credibility and triangulation.

Comparison of the present figures with those reported by Porretta and Sherrill (2005) revealed the following, with respect to the scientific area examined: Inclusion (7.14%) and professional preparation (1.79%) research were less than the 13.38% and 4.46% respective figures of Porretta and Sherrill (2005). In turn, the 8.92% in biomechanics was higher compared to the respective 2.97% during the last two decades. No history studies were reported since 2007 which is similar to the previous figure of 0.37%. Overall, it appears that the editors interest for publicizing research from the biomechanics field has increased lately, while there is a slight drop for inclusion and professional preparation. The psychosocial, motor behavior, exercise science and measurement gather the highest research attention and this trend remains invariant across time.

Concerning the population examined, no studies with at-risk infant toddlers, individuals with hearing impairment and learning disabilities were published during the last four years. Individuals with autism (3.85%) and gerontology (3.85%) were more often examined than the 0.37% and 0.74% figures reported by Porretta and Sherrill (2005). The DCD group of children retained a similar scientific interest (7.69% since 2007 vs 9.29% during the last two decades). Further, physical disabilities (21.15%), MR/ID (19.23%) and generic studies (13.46%) gathered the highest research attention lately. Porretta and Sherrill (2005) reported a 13.75% for physical disabilities, 30.11% for generic research and 15.24% for individuals with mental retardation (MR/ ID).

Overall, physical disabilities and mental retardation still accumulate a wide research attention, while there is a tendency for a decrease number of research studies in the generic field.

Authorship from the USA was still the dominant figure (42.86%), although smaller than the 52.34% reported by Porretta and Sherrill (2005). The present and past figures from Canada (15.58% vs 14.48%), Australia (6.49% vs 4.45%), and Netherlands (3.90% vs 3.79%) remained similar, while there was a slight increase in the studies from Belgium (6.49% vs 3.56%). Surprisingly, no researchers from England appeared in the APAQ throughout the last four years, compared to the 6.46% reported for the previous two decades. Further, no publications were reported from New Zealand, Ireland, Sweden, Singapore, Republic of Korea, China and Jordan (Porretta & Sherrill, 2005), while new authorship was reported from Brazil, Latvia, Poland and Puerto Rico. Overall, it appears that the APAQ editors are open to international publications from a variety of countries. However, authorship from North America (USA and Canada) still approach almost 60% of the total publications. Therefore, although a variety of researchers from different countries are welcome to submit their studies in the APAQ, they have, proportionally, a limited space for their research work to be published. Finally, researchers in the APA field may also attend other journals to publicize their studies, besides APAQ, which may be an explanation for the absence of research studies reported from England lately.

Although not presented as a separate research hypothesis, there was a further attempt to evaluate the representativeness of male and female researchers in the APAQ, following the example of Sherrill and O'Connor (1999). The only criterion used in that case was the researcher's first name and as such, the results may not be valid enough to consider. Consultation with a doctorate student revealed several cases where it was not possible to determine the researcher's gender and these cases were excluded from statistical recording. Overall, the percentage of male and female researchers (52.91% vs 47.09%) since 2007 was similar with the 55% vs 45% reported by Sherrill and O'Connor (1999). Male and female researchers therefore appear to have similar accessibility in the APAQ. However, the present findings are limited from the method used to analyze our data and should be considered with extreme caution.

As mentioned above, the dominant sampling design was recruited, purposive, convenience and volunteer, all counting for 58.49% of the sampling methods used since 2007. Similarly, Sherrill and O'Connor (1999) reported random, purposive, volunteer, systematic and convenience as the more frequently sampling methods used. In the present study however, random selection/ assignment was reported for two studies only. This fact, along with the added tendency for a more qualitative research method used (reported below) and a lower tendency to report sophisticated statistical software (reported below), may be indicative for a shift of APA research towards examining specific samples, an attempt to get more in depth understanding, without a general tendency to generalize the findings and an overall qualitative tendency for future researchers in the field.

The quantitative vs qualitative research method used since 2007 revealed 34 and 13 studies respectively, while 3 studies reported mixed (quantitative and qualitative) methods. Review studies were not counted as either quantitative or qualitative for the purpose of the present analysis. Therefore, a total of 16 studies used qualitative methods of research, which represented a respective figure of 32%. The 32% is higher compared to the 5.26% reported by Sherrill and O'Connor (1999) and indicative for a shift towards qualitative methods of research in the APA field.

The SPSS was the statistical software more often reported for statistical analysis. Further, a variety of reliability and validity evidence were reported for a total of 40 studies, following the suggestions of Yun and Ulrich (2002). Yun and Ulrich (2002) however presented mainly methods for sample specific validity and reliability evidence in quantitative research (construct validity, concurrent validity, internal consistency, inter observer agreement). The present study revealed that their suggestions were followed in 28 quantitative studies since 2007. Further, 12 qualitative studies followed the suggestions of Yun and Ulrich (2002) but reported different methods for providing validity and reliability evidence, such as trustworthiness (8 studies), credibility (2 studies) and triangulation (2 studies). Overall, the general guidelines of Yun and Ulrich (2002) and other researchers in the field (e.g. Sherrill & O'Connor, 1999) still prevail since APA researchers need to provide validity and reliability evidence for their findings. The validity and reliability reports however, may vary, according to the quantitative or qualitative method used to examine their research hypothesis.

A total of 35 publications (66.04%) reported the theory used to guide the respective research studies. This figure is in agreement with scholars in the field who suggested that APA is strongly driven by theory (Sherrill, 1997; Bouffard & Watkinson, 1998; Sherrill, 1999; Sherrill & O'Connor, 1999; Reid & Stanish, 2003; Hutzler & Sherrill, 2007). According to Slife and Williams (1995), theories may be perceived as formalized ideas, such as understandings, observations, assumptions, etc., applied in an effort to understand a variety of phenomena. The theories more often emerging in the APAQ, since 2007, were the self-efficacy theory (Bandura, 1977) and the self-determination theory (Deci & Ryan, 1985, 1991; Wehmeyer, 1998; Wehmeyer & Sands, 1996; Wehmeyer & Gamar, 2003). In brief, Bandura (1997) stated that self-efficacy is the individual's belief of his/ her personal capacity to be successful. High levels of self-efficacy result in higher motivation and desire to excel. Individuals with assurance of their personal abilities tend to focus on challenging goals and persist when facing difficulties. Individuals, however, with lower self-efficacy, avoid challenging goals and withdraw easily when facing difficulties (Bandura, 1997). In turn, self-determination (Deci & Ryan, 1985, 1991) is a life long developmental process. According to Wehmeyer and Sands (1996), self-determination is leading individuals 'to act as the primary causal agent in one's life, and to make choices and decisions regarding one's quality of life, free from undue external influence or interference' (p. 24). Autonomy, self-regulated behavior, psychological empowerment and self-realization are the four main characteristics which must be met for an individual to be self-determined. Finally, the APAQ publications since 2007 revealed a unique research study introducing an innovative theory in the APA field (Hutzler, 2007). Specifically, Hutzler (2007) presented a systematic ecological model for adapting physical activities. This model was developed as a theoretical frame to guide researchers and practitioners in the APA field and was not borrowed from allied disciplines (such as psychology and sociology).

## 5 Conclusions

The purpose of the present study was to detect the research trends in adapted physical activity (APA). The APAQ publications, since 2007 were examined for that purpose and the results revealed a decrease in generic research and an emphasis in specific samples recruited with a variety of sampling methods, other than those commonly used in experimental research. A wide increase in qualitative methods was reported suggesting that there is a research trend towards a more specific, qualitative approach in the field.

Further, validity and reliability reports were still prominent, while no emphasis was provided on sophisticated statistical software. Finally, the suggestions of scholars in the field were kept and the APAQ literature may be perceived as strongly driven by theory.

The present findings are in agreement with Bouffard, Strean & Davis (1998) who stated that ‘a related trend is to strive from a heavy focus on statistical analysis toward more emphasis on meaning derived from language, discourse and symbols’ (p. 264). This trend may be a healthy way to afford more focus upon the individual, at least when we want an individual level of analysis (Bouffard et al., 1998). Overall, a tendency for researchers appears in the field to withdraw from aggregating data when working with individuals, freeing this way themselves from a perceived obligation to legitimize and validate all information they collect with probability values (Bouffard, 1993).

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## **Appendix 1**

### **The 12 APAQ volumes, since 2007, with the 56 studies used to evaluate the research trends in APA**

2007 (1)

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- 2) Hodge, S., Kozub, F., Robinson, L., & Hersman, B. (2007). Reporting gender, race, ethnicity, and sociometric status: Guidelines for research and professional practice. *Adapted Physical Activity Quarterly*, 1, 21-37.
- 3) An, J., & Goodwin, D. (2007). Physical education for students with spina bifida: Mother's perspectives. *Adapted Physical Activity Quarterly*, 1, 38-58.
- 4) Van Waelvelde, H., Peersman, W., Lenoir, M., & Smits Engelsman, B. (2007). Convergent validity between two motor tests: Movement ABC and PDMS-2. *Adapted Physical Activity Quarterly*, 1, 59-69.
- 5) Davis, R., Kotecki, J., Harvey, M., & Oliver, A. (2007). Responsibilities and training needs of paraeducators in physical education. *Adapted Physical Activity Quarterly*, 1, 70-83.

2007 (2)

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- 2) Lahtinen, U., Rintala, P., & Malin, A. (2007). Physical performance of individuals with intellectual disability: A 30-year follow-up. *Adapted Physical Activity Quarterly*, 2, 125-143.
- 3) Arbour, K., Latimer, A., Martin Ginis, K., & Jung, M. (2007). Moving beyond the stigma: The impression formation benefits of exercise for individuals with a physical disability. *Adapted Physical Activity Quarterly*, 2, 144-159.
- 4) Driver, S. (2007). Psychometric properties and analysis of the physical activity social influence scale for adults with traumatic brain injuries. *Adapted Physical Activity Quarterly*, 2, 160-177.
- 5) Maiano, C., Ninot, G., Morin, A., & Bilard, J. (2007). Effects of sport participation on the basketball skills and physical self of adolescents with conduct disorders. *Adapted Physical Activity Quarterly*, 2, 178-196.

2007 (3)

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- 2) Beets, M., Foley, J., Tindall, D., & Lieberman, L. (2007). Accuracy of voice-announcement pedometers for youth with visual impairment. *Adapted Physical Activity Quarterly*, 3, 218-227.
- 3) Beets, M., Combs, C., Pitetti, K., Morgan, M., Bryan, R., & Foley, J. (2007). Accuracy of pedometer steps and time for youth with disabilities. *Adapted Physical Activity Quarterly*, 3, 228-244.
- 4) Motl, R., Zhu, W., Park, Y., McAuley, E., Scott, J., & Snook, E. (2007). Reliability of scores from physical activity monitors in adults with multiple sclerosis. *Adapted Physical Activity Quarterly*, 3, 245-253.
- 5) Reina, R., Moreno, F., & Sanz, D. (2007). Visual behavior and motor responses of novice and experienced wheelchair tennis players relative to the service return. *Adapted Physical Activity Quarterly*, 3, 254-271.

2007 (4)

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- 2) Perreault, S., & Vallerand, R. (2007). A test of self-determination theory with wheelchair basketball players with and without disability. *Adapted Physical Activity Quarterly*, 4, 305-316.
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- 5) Passmore, S., Burke, J., & Lyons, J. (2007). Older adults demonstrate reduced performance in a Fitts' task involving cervical spine movement. *Adapted Physical Activity Quarterly*, 4, 352-363.

2008 (1)

- 1) Przysucha, E., Taylor, M. J., & Weber, D. (2008). The nature and control of postural adaptations of boys with and without developmental coordination disorder. *Adapted Physical Activity Quarterly*, 1, 1-16.
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- 3) Pedersen, S. J., & Surburg, P. R. (2008). Lower extremity movement preparation and children with attention deficit hyperactivity disorder. *Adapted Physical Activity Quarterly*, 1, 36-48.
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2008 (2)

- 1) Frey, G., Stanish, H., & Temple, V. (2008). Physical activity of youth with intellectual disability: Review and research agenda. *Adapted Physical Activity Quarterly*, 2, 95-117.
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anorexia nervosa and healthy controls. *Adapted Physical Activity Quarterly*, 2, 159-173.

2008 (3)

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2008 (4)

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2009 (1)

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- 2) D'Hondt, E., Deforche, B., De Bourdeaudhuij, I., & Lenoir, M. (2009). Relationship between motor skill and body mass index in 5- to 10- year old children. *Adapted Physical Activity Quarterly*, 1, 21-37.
- 3) Loh, P., Piek, J., & Barrett, N. (2009). The use of the developmental coordination disorder questionnaire in Australian children. *Adapted Physical Activity Quarterly*, 1, 38-53.
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5) Harada, C., & Siperstein, G. (2009). The sport experience of athletes with intellectual disabilities: A national survey of Special Olympics athletes and their families. *Adapted Physical Activity Quarterly*, 1, 68-85.

2009 (3)

- 1) Seymour, H., Reid, G., & Bloom, G. (2009). Friendship in inclusive physical education. *Adapted Physical Activity Quarterly*, 3, 201-219.
- 2) Kim, S., & Yun, J. (2009). Determining daily physical activity levels of youth with developmental disabilities: Days of monitoring required. *Adapted Physical Activity Quarterly*, 3, 220-235.
- 3) Sousa, A., Corredeira, R., & Pereira, A. (2009). The body in persons with an amputation. *Adapted Physical Activity Quarterly*, 3, 236-258.
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- 5) Kasser, S. (2009). Exercising with multiple sclerosis: Insights into meaning and motivation. *Adapted Physical Activity Quarterly*, 3, 274-289.

2009 (4)

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2010 (3)

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- 2) Oh, H., & Kozub, F. (2010). The psychometric properties of the Difficult Behavior Self-efficacy scale. *Adapted Physical Activity Quarterly*, 3, 191-207.
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- 5) Van Biesen, D., Verellen, J., Meyer, C., Mactavish, J., Van de Vliet, P., & Vanlandewijck, Y. (2010). The ability of elite table tennis players with intellectual disabilities to adapt their service/ return. *Adapted Physical Activity Quarterly*, 3, 242-257.

## Appendix 2

**The areas identified and their respective definitions to evaluate the research trends in APA (Porretta & Sherrill, 2005).**

Pedagogy: teacher behavior

Inclusion/ programming: activity setting where persons with and without disabilities participate together

Measurement/ assessment/ classification: psychometric properties of instruments or focus on disability classification issues

Biomechanics: Kinetics or kinematics of motion

Exercise science/ physical activity: Effects of exercise or activity on human body

Motor behavior: Development, performance, learning and control of movement

Psychosocial: Psychological or sociological perspectives

Research issues: General or specific research methodologies or practices

Professional preparation issues: Preparation of teachers/ coaches or issues driven by legislation, litigation, innovation, etc.

History: Changes over time

Other: Articles not categorized into one of the above areas

### **Appendix 3**

#### **Disabilities identified in the APA literature (Porretta & Sherrill, 2005; Reid & Broadhead, 1995)**

Generic, mental retardation-ID, Down syndrome, physical disabilities, multiple sample, DCD/ awkward/ MI, learning disabilities, at-risk infant toddlers, developmental delay (preschool), neurological impairments (cerebral palsy, TBI, stroke, multiple sclerosis, etc), medical conditions (e.g congenital heart disease), visual impairment, hearing impairment, emotional/ behavioral disorders, gerontology, autism, multiple disabilities.

Examples:

Physical disabilities: e.g muscular dystrophy, spinal injury, amputations, etc

Emotional/ behavioral disorders: e.g. depression, anorexia nervosa, hyperactivity (ADHD), conduct disorder

Multiple disabilities: two or more conditions concurrently

Multiple sample: individuals from different disability categories

Neurological impairments: incorporated TBI, Stroke, multiple sclerosis etc.

Cerebral palsy was incorporated as well and therefore, was not included under physical disabilities

### **Appendix 4**

#### **Definitions of quantitative and qualitative research**

**Langdridge (2004)**

Quantitative research concerns the quantity of measurements of some phenomenon. Quantifying phenomena. If we measure things accurately, we can make claims about the object of study. Hypothetico-deductive approach to knowledge acquisition. Generalization focus. Large samples.

Qualitative research is concerned with the qualities of some phenomenon. Is concerned with text and meaning. Inductive approach to knowledge acquisition. There are no truths about the world. More in depth focus. Limited samples.

## **A special kinetic programme for advancement of coordination skills in paravaulting training.**

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### **Abstract**

*Paravaulting, or acrobatics on horseback, is one of many rehabilitation methods based on therapeutic pedagogical-psychological riding, and at the same time one of discipline sport riding for disabled people.*

*Coordination skills are basic components of motor training in paravaulting. The aim of the study was to examine if regular paravaulting exercises influence coordination skills of disabled competitors. We performed an experimental examination for selected group in term of kinetic tests. The intervention program improved basic skills, supporting this way the research hypothesis. The results are further discussed in detail.*

**Keywords:** *hippo therapy; paravaulting; horse; gymnast; kinetic tests*

### **1 Introduction**

Sports and rehabilitation for disabled individuals incorporate newly established and innovative methods such as the hippo rehabilitation, hippo therapy or paravaulting. Paravaulting for example allows the opportunity of expression, self-fulfillment and the development of creative skills. The paravaulting is performed by individuals with different disabilities, who learn with each other respect and tolerance. Vaulters are trained and compete together. In addition to the cooperation between them, exercising on the horseback leads to greater responsibilities, autonomy and physical coordination (Ježková, Nejedzchlebová, 2002).

Paravaulting, or acrobatics on the horse back, is one of the rehabilitation methods based on therapeutic pedagogical-psychological riding, at the same time it is also a discipline of sport riding for disabled people. Three-dimensional movement of the horse can have a beneficial effect on clients with impaired mobility, holding body, coordination and balance. It is a complex therapeutic method which is intended for a wide range of clients with physical, mental or educational problems. These sports disciplines have a high claim to correct technical performance and harmonize movement with horses. Paravaulting has also specific aims in addition to other forms of therapeutics horse riding. It means mainly developing and improving motor skills of disabled individuals (Kulichová et al., 1995). This sport is recommended particularly for people with special types of handicaps: Cerebral Palsy, Down syndrome, Autistic behavior or Diabetes mellitus. Handicapped clients (paravaulters/gymnast) performed acrobatic exercises on the horse with medical attendants.

#### **1.1 Training model of paravaulting**

Paravaulting is physically demanding discipline which places heavy demands on coordination and joint mobility. A gymnast must practice on a relatively small and constantly moving area, which is the saddle of a horse. The basic physical ability is the

dynamic force and an additional static force. Static force is needed during the endurance exercises. Endurance exercise must be performed for 4 seconds, representing the horses four beat gait. These four steps are the regular rhythm of the horse, which aids the exercise (Ježková, Nejezchlebová, 2002).

Paravaulting is rhythmic exercise where the rhythm of horses helps to induce concentration of the gymnast. Gymnasts should learn to be aware of their body, the location of body parts, control muscle tone and be able to keep an upright sitting position. Training unit was formed to match the general requirements for construction and training tailored to the specificity of work horses and work with disabled vaulters. For paravaulters is important that the schedule of training remains consistent. Gymnasts, after a few practice sessions remember what comes next and what their obligations are, which greatly contributes to a faster and smoother workout.

## 1.2 Aim

Determining what happens with the selected coordination skills of disabled athletes through the intervention program.

This is a pilot study to a doctoral dissertation.

### Types of training in paravaulting:

• Introduction	approx. 5 minutes
• Warm-up	approx. 20 minutes
• <i>Intervention program</i>	approx. 30 minutes
• Preparing the horse	approx. 10 minutes
• Work on the simulator	approx. 30 minutes
• Work on riding/paravaulting	approx. 30 minutes
• Conclusions	approx. 10 minutes



## 2 Methods

Gymnastics paravaulting exercises, with regard to growth performance, were implemented. Gymnastic elements were included in main part of training, especially for the development of orientation, balance and the overall dexterity.

A total of 4 standards tests were used for the purposes of the pilot study. The participants were 6 vaulters from one riding club in the Czech Republic. Training was held in the horse riding club, regularly 3 times per week. First (pre) testing was held in precompetitions time in March. Second (post) testing was held in postcompetitions time in November. The intervention program lasted 6 months, from March to November.

### 2.1 Subjects

#### Proband 1 – Female, 20 years old, Cerebral Palsy

Central diparesia spastic. Since she was 5 years old went to a section of hippotherapy. Paravaulting practice since she was 12 years old and rode her first competition after one year of training. She is one of the first gymnast paravaulting.

Currently competing about 8 years and belongs to the category of severe disability. From the beginning, when she had problems with walking and dexterity, regular training has achieved several titles Czech champion.

#### **Proband 2 – Male, 19 years old, Cerebral Palsy**

Hypotonic form of cerebral palsy, mental defect moderate degree. He is competing in paravaulting since 2002 in the category of mental handicap. Initially, in exercise greatly feared, it was necessary to help him. Over time, the fear was removed and seen great progress. It is difficult to communicate with him, he uses mostly sign language. The basic problem that we must eliminate is the haste and lack of concentration.

#### **Proband 3 – Female, 13 years old, Cerebral Palsy**

Cerebral Palsy, hypotonic form. With paravaulting began in January 2009, previously not attending any form of hippotherapy. She belongs to the category of severe disability. She has during the ride a little scared, which over time slowly degrades.

#### **Proband 4 – Male, 43 years old, Down syndrome**

Down syndrome and hips osteoarthritis. He practices paravaulting since 1999. Previously visited a hippotherapy. Currently practicing paravaulting for 10 years, but the first competition was 5 years ago. He was classified as a heavy handicap. Despite of his reduced intellect is quite separate, mainly due care and access from his father. The negative impact of the training is his mood.

#### **Proband 5 – Female 15 years old, Epilepsy**

3 years attended hippotherapy, due to the improvement started from September 2008 to train paravaulting. The competition was first in the 2009 season in the category of light handicap. She is very slow, must be stepped up her response so that during exercise would be better able to respond to any motion changes of horses.

#### **Proband 6 – Female 15 years old, Personality Disorders**

Paravaulting in our club devote 2 years in the category light handicap. She has at her age, very childish behaviour, she is confused and disoriented. Sometimes she hides and falls asleep.

#### **2.2 Few examples of exercises during the intervention program:**



Figure 1. Static exercises to strengthen arm muscles. One of the pair in the default position of kneeling, the other grabs him by the ankles and lifted into the push-up.

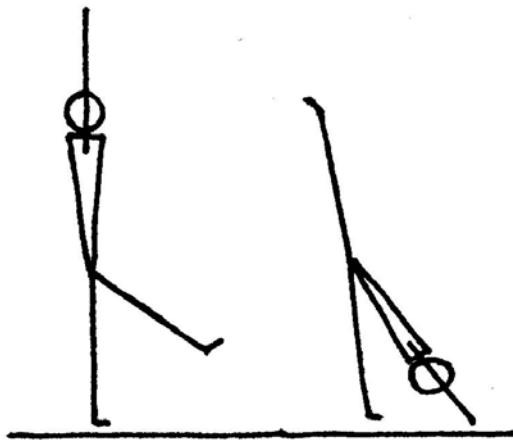


Figure 2: Dynamic exercise on leg strength. Gymnast in action is deep forward and swing his right foot while the rear. The torso and upper limbs are moving down and right leg up, the axis of motion in the hip joint. The final phase of exercise is a dove in a standing position.



Figure 3: Dynamic exercises to strengthen leg muscles. Over swing legs over gymnasts ahead (Wiemers, 1997).

### 2.3 Kinetic tests

**Flexibility:** Bending forward in a sitting position. Test the flexibility of the spine and hamstrings. In contrast, standing forward bend test excludes the influence of gravity (Neuman, 2003).

**Dynamic body rotation and bending forward:** Dynamic mobility of the trunk muscles and hamstrings. Gymnast stands with his back about 30-40 cm from the smooth wall and leans forward with straight legs and touch the fingertips of both hands between feet. Then quickly rises and turns the body to touch the wall behind him, turns right and turns left. Calculates the number of cycles (forward bend and turn) for 20 seconds (Neuman, 2003).

**Orientation:** Stand on one leg with closed eyes. Tested person stands with closed eyes on one preferred leg. Other leg is attached to the knee leg stance. Free foot must not touch the floor. It is measured in seconds (Měkota, 1980).

**Burpee test-testing speed and endurance:** Testing of speed-endurance ability, in the same time muscle strength and dexterity in arms and legs. Tested person had to implement accurately and quickly 10times cycle consisting of four positions: upright position - squat down - push up (in which the torso and legs form a straight line) - squat down - upright position. (Neuman, 2003).

### 3 Results

Graphs from data obtained through kinetic tests are presented.

In the Figures we may see some differences between vaulters, which may be attributed to differences across gender, age, and severity of disability.

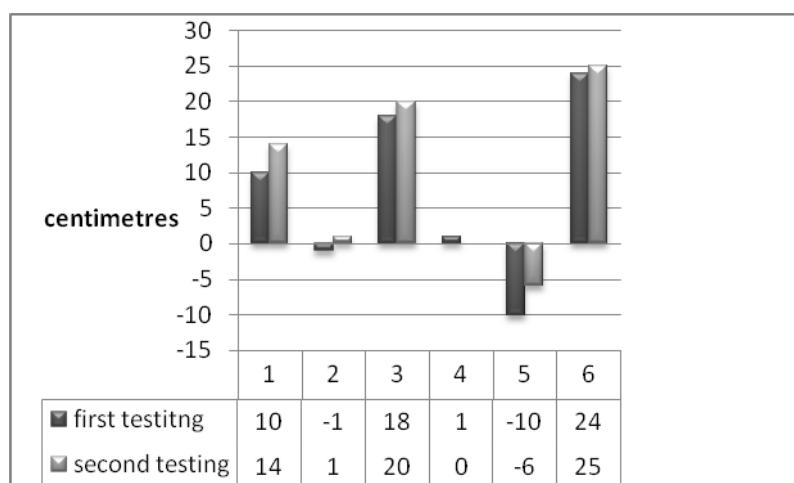


Figure 1. Bending forward in a sitting position.

Generally speaking, the regular intervention program had the greatest influence on the development of flexibility.

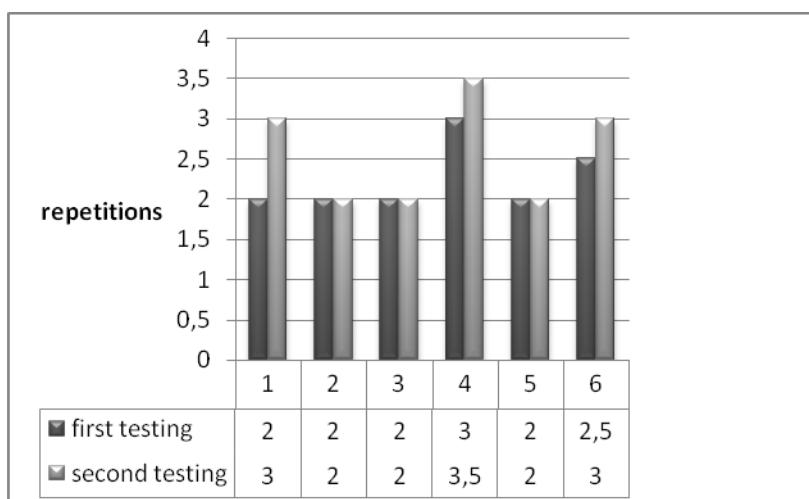


Figure 2. Dynamic body rotation and bending forward.

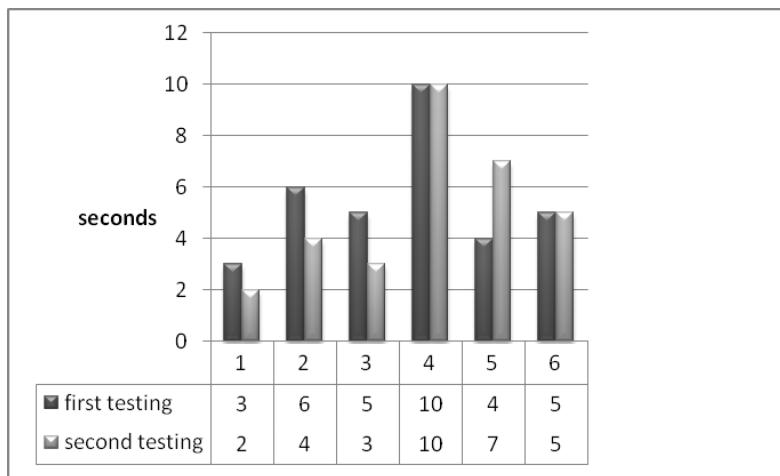


Figure 3. Standing on one leg with eyes closed

The lowest score was obtained from an individual who was afraid to close eyes during the second test.

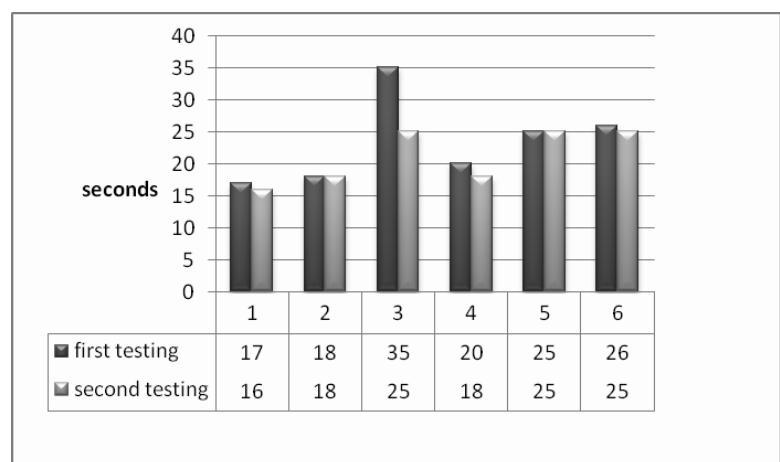


Figure 4. Burpee test - speed and endurance.

We could not rehearse and repeat tests like Burpee test and dynamic movement many times, they rapidly lost condition and after a few attempts were very uncertain and wobbled. Guidance for the further research is carefully choose the order of tests. In this pilot study, we confirmed that the more physically demanding tests we have to choose at the end of testing. On the other hand, use correct tests at the beginning in which we need to use balance or orientation.  
**WELL, HERE IS TO DIFFICULT FOR ME TO PROVIDE ANY REVIEW FEEDBACK (MUST BE WRITTEN AGAIN)**

### 3.1 Analysis of the results of probands

**Probands 1 - Cerebral palsy:** the testing of all the most improved. Despite her strong will in practice still has a problem with coordination, particularly given the fact that her disability hinder the further development. Still working hard and it is most visible in the flexibility test, since there was an improvement by 4 cm during the six months intervention.

**Proband 2 - Cerebral Palsy:** During testing there was no substantial improvement of physical structures. Proband has a problem with joint mobility, but improved in dexterity and orientation. The performance largely depends on his mood. If he is in a bad mood, takes development exercises very long and if he feels sure, his performance increases dramatically up.

**Proband 3 - Cerebral Palsy:** With paravaulting just starting, it makes less of a problem to learn a new form of movement. With gymnastics and acrobatics is not yet acquainted. With regard to hypertonic form of cerebral palsy was published best test of flexibility.

**Proband 4 - Down's syndrome:** Has not improved significantly, it is necessary to take into account that he has coxarthropathy. It took him longer to exercise and he had problems remembering what to train, be it repeated several times. Standing on one leg managed to try a few times because he was afraid to close his eyes. The negative impact on his growth performance is the lack of training, which is large due to his moodiness. Yet for his age and extent of disability is very handy and thanks paravaulting keeps in shape.

**Proband 5 - Epilepsy:** she is in good condition, which is reflected in the results of our experiment. However, due to her disability must exercise great caution. For example, in deep forward has made very far, then had dizziness about an hour and was not able to exercise more. This had the effect that the result of second test (stand on one leg with closed eyes) was weaker than the first test.

**Proband 6 - Personality disorders:** Problem with more complex coordination exercises, which is seen on the results of the tests. Small improvement due to inclusion of the coordination exercises into daily training. She is very slow and slowly understands new kinetic structures. Her slowness has positively affected the outcome of test - stand on one leg with closed eyes.

#### 4 Conclusions

This kind of sport riding is very difficult. Training must be well laid out with regard to individual access. It is not always strictly adhered to the prepared schedule due to weather or current health status of the gymnasts. Analysis revealed that the regular training increased across the intervention period.

This pilot study has shown that it is good to be devoted to each individual gymnast, according to disability. In developing an intervention program is important to encourage the athletes to learn more difficult exercises. In further research, we must also choose an appropriate order of kinetic tests to achieve other partial results that can be used for routine practice.

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# **Thermographic changes in overloaded back muscles of people with sedentary job.**

Jan Novotný, Faculty of sport studies, Masaryk University, Czech Republic

## **Abstract**

*The muscles are stressed at work. We have observed the ability of infrared thermography to see muscles with more and less activity (temperature). The first meeting with thermal imaging was display calf (m. gastrocnemius – caput mediale et laterale).*

*The aim of our research is to determine the activity of the trunk and head stabilizer for people with sedentary jobs.*

*In preliminary research, we took 23 shots back of people of different sex and age. In 11 cases we have seen an increase in muscle temperature, which are loaded in the seated position (m. trapezius, m. levator scapulae, m. rhomboideus major et minor, m. seratus posterior, m. erector spinae, m. splenius capititis). The images were taken with the Fluke TIR camera.*

*After tuning the methodology we want to study 20-30 persons aged 25-40 years with a sedentary job. Each person will be examined in the morning and afternoon during one day. For each area, which will represent a particular muscle group, will calculated average and relative temperature. Images will capture the new higher-level system, SC620 FLIR camera.*

*The research results will help diagnose congested muscles, the next output will PhD work and materials in teaching.*

## **1 Introduction**

During the work, the muscles are stressed and issue radiation. Kind of camera can catch and show this radiation like warm. We have observed the ability of infrared thermography to see muscles with more and less activity (temperature). The first meeting with thermal imaging was display calf (m. gastrocnemius – caput mediale et laterale) and then others parts of human body.

Recently works have appeared recommending infrared technique as an auxiliary diagnostic method in ports physiology. Zaidi et al. (2007) brought the original findings on the effects of different swimming strokes at the distribution of skin temperature on competitive swimmers. Furthermore, the Chudecka et al. (2008) dealt with changes of thermal emission on the arms of handball players before, immediately and 10 minutes after training. This way I could continue listing other sporting disciplines using thermography. Thermography is used in the sport long before the layman can imagine. First began to be used in veterinary medicine for horses, perhaps because the horse can not talk about their problems and perhaps also because the horses are very much appreciated. In any case, thermography in horse racing and dressage is still used (Turner et al 2002 Ciutacu et al. 2006).

Infrared Thermal Imaging in Sports Medicine (ITI) has been shown to be useful as a diagnostic tool in the differential diagnosis of neuromusculoskeletal injuries and their prognosis for return to participation and/or competition. Since ITI is noninvasive,

risk-free, and relatively portable. ITI not only helps confirm a diagnosis, but can be used as a gauge to clinically assess progress and treatment response, as well as a prognostic indicator (Meditherm 2010).

### 1.1 Aim

Determine muscle activity of the trunk and head stabilizer for people with sedentary jobs. In the literature there is not enough documented evidence to objectively identify the thermographic loaded muscles – stabilizers for rigid body in a sitting position.

### 2 Method

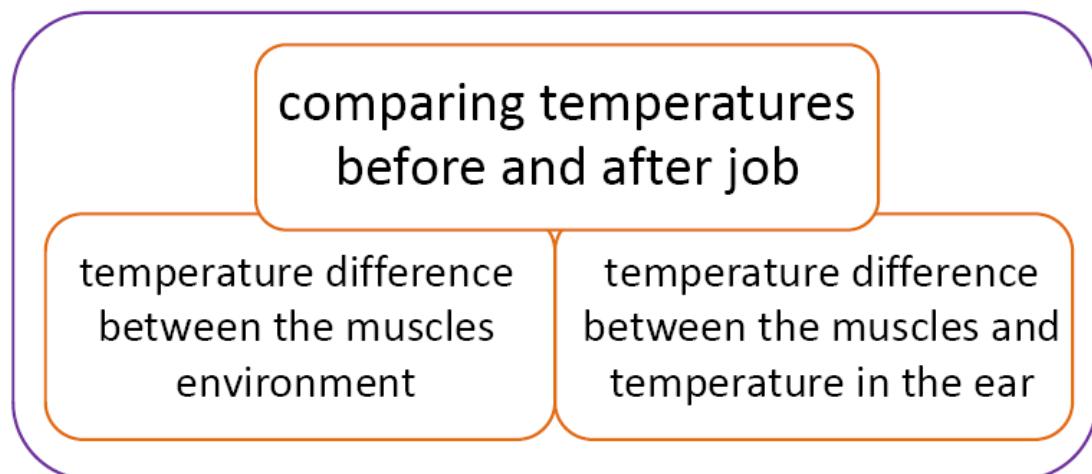
A total of 23 back-side shots of people of different sex and age were taken. In 11 cases an increase in muscle temperature was observed, in the seated position (m. trapezius, m. levator scapulae, m. rhomboideus major et minor, m. seratus posterior, m. erector spinae, m. splenius capitis, m. supraspinatus).

After tuning the methodology, the plan was to examine 20-30 persons aged 25-40 years with a sedentary job. Each person would be examined in the morning and afternoon of the same day.

Differences in muscle temperatures:

1. before job and after job without exercise
2. before job and after job with exercise
3. before job without exercise and after job with exercise

Comparisons will be based on permanent temperature of ear and with environment (relative temperature).



### 3 Results

**Thermographic pictures of back:**

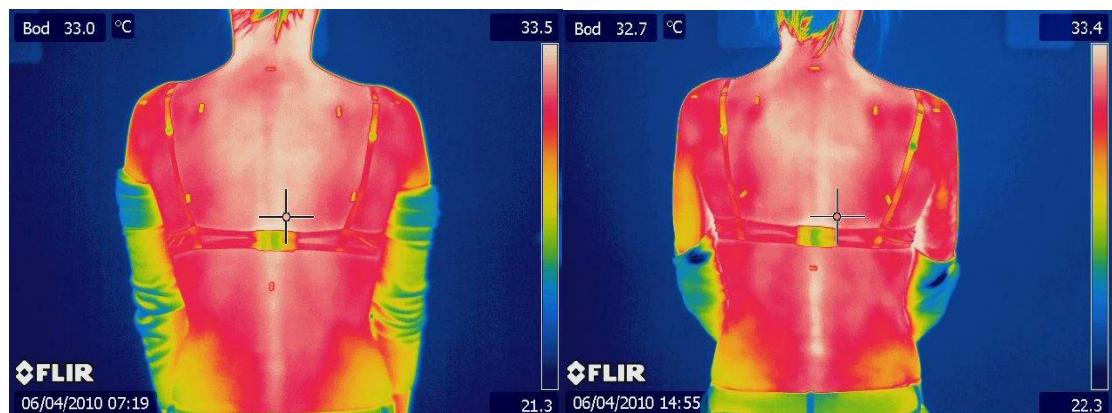


Plate 1. Before job (without exercise).

Plate 2. After job (without exercise).

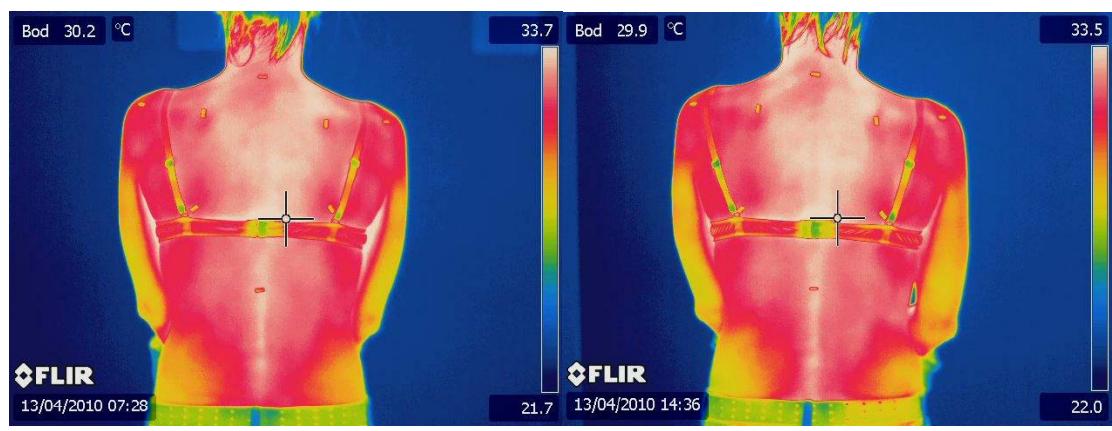


Plate 3. Before job (with exercise).

Plate 4. After job (with exercise).

For each area, which will represent a particular muscle group, will calculate average and relative temperature.

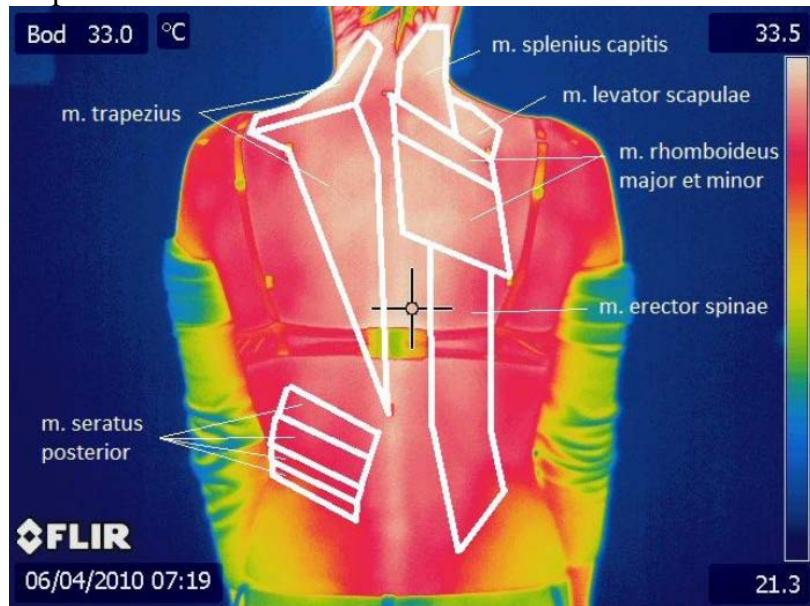


Plate 5. Areas of back muscles – will count average temperature

of each areas. Every area has left and right side.

Images will capture the new higher-level system, SC620 FLIR camera. This type of camera has highest sensitivity and most advanced feature set available on portable cameras.



Plate 6. SC620 FLIR - front view.



Plate 7. SC620 FLIR – back view.

These research results will help diagnose congested muscles and offer advices for exercise at work.

#### 4 Conclusion

We assume that everyday short excercise can help to ease overloaded back and neck muscles.

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## **Monitoring physical activity of children living in children's houses at school.**

Hana Bednářová\* and Jana Vašíčková\*\*

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\*\*Centre for Kinanthropology Research,

Faculty of Physical Culture, Palacký University in Olomouc, Czech Republic.

### **Abstract**

*The research dealt with the physical activity of children living in children's houses within school (CHHS). Children with socio-pathological behaviour who were enacted institutional or protecting education by court are placed into these institutions. The aim of the present research was to compare weekly physical activity expressed by the number of steps and skips by the children living in families and children living in children's houses with school. An index of PA level (average daily number of steps) was used for the purposes of the study.*

*We chose the pedometer 'Yamax Digi-Walker SW-200' for monitoring physical activity, since it has acceptable validity and reliability (Le Maurier, Sidman & Corbin, 2003). The gadget is not demanding for carrying and operating. Steps and skips are recorded on electronic display. The IBM SPSS 18.0 (Chicago, IL, USA) software was used for data analysis. For comparison of average number of steps, a Mann-Whitney U-test for two independent sets and an estimation of the effect size (Cohen's d) (American Psychological Association, 2002) were used. The significance of differences for Mann-Whitney test was set at  $p<0,05$  and  $p<0,01$ .*

*The differences in number of steps were most apparent on school days. The effect of difference was large (Cohen's d). Middle-size effect was detected in the difference of average number of steps over the whole week. There was nearly no difference over the weekend in average number of steps of the control group of children vs children living in children's houses at school. Despite the fact that children live in children's houses, the average daily amount of walked steps overreached the recommendation for PA, which is 10,000 steps a day. We were also interested whether average number of steps differentiates according to age. We compared two groups of children. One group of children was of primary school age (12-14 years old) (general population:  $n=240$  and CHHS:  $n=45$ ) and another group of children was 15-16 year old attending first grade of secondary school (15-16 years old) (general population:  $n=141$  and CHHS:  $n=58$ ). An interesting finding is a higher average number of steps by the 12-14 years old children during weekend days.*

*PA of children from CHHS is lower compared to the control group of children. What matters is the location of school which has a direct effect of their involvement in walking and physical activity in general. School attendance is substituted by leisure-time PA.*

**Key words:** physical activities, pedometer, leisure time, children's houses with school

## **1 Introduction**

The research dealt with physical activities of children in the environment of children's houses within school (CHHS). Children with socio-pathological behaviour who were enacted institutional or protecting education by court are placed into these institutions.

The interest in physical activities among children and the youth is decreasing dramatically. Children with socio-pathological behaviour are usually enacted institutional or protecting education. This type of education is carried out in some of the following school institutions, such as: diagnostic institution, children's houses, children's houses with school and educational institutions. Children's houses with school are for children and the youth until they finish their compulsory school attendance. Children in children's houses with school abide a weekly and daily system within the institution, which is markedly influenced by the educators, by children's interests and by material and space conditions of the institution. That is why we assume that students in CHHS have got quite low range of physical activities in comparison to children living with their families.

### **1.1 Aim**

The aim of our research was to compare weekly physical activity expressed by the number of steps and skips by the children living in families (control) and children living in children's houses with school. The index of PA level (average daily number of steps) was used to serve the purposes of the present study.

## **2 Methods**

We chose pedometer Yamax Digi-Walker SW-200 for monitoring physical activity which has sufficient validity and reliability evidence from previous research (Le Maurier, Sidman & Corbin, 2003).



Plate 1. Pedometr Yamax Digiwalker SW-200.

The gadget is not demanding for carrying and operating. Steps and skips are recorded on electronic display. The IBM SPSS 18.0 (Chicago, IL, USA) software was used for data analysis. For comparison of average number of steps, we used Mann-Whitney U-test for two independent sets and estimation of the effect size was obtained (Cohen's *d*) (American Psychological Association, 2002). The significance for the Mann-Whitney test was set at  $p<0,05$  and  $p<0,01$  levels.

At the beginning, the research set was made of 127 children aged 12 to 16 from seven children's houses within schools in Moravia region (Veselíčko, Šumperk, Horní Těrlicko, Počátky, Jihlava, Bystřice pod Hostýnem, Moravský Krumlov). After the data was entered to the database and was processed we used the records of 103 children. The elimination was carried out on the basis of incomplete or pointless data. For analyses and comparison, data, received during 2000-2006 through a weekly monitoring by pedometers in children of common population ( $n=381$ ) aged 12-16, was used.

Table 1. Basic characteristics of the research group.

	CHHS		Common population+	
	Boys $n=73$	Girls $n=30$	Boys $n=197$	Girls $n=184$
	M±SD	M±SD	M±SD	M±SD
<b>Age (years)</b>	14,30±1,08	14,80±0,96	14,1±1,3	14,6±1,3
<b>Height (cm)</b>	168,0±10,2	163,3±7,6	164,7±12,6	164,0±7,4
<b>Hmotnost (kg)</b>	57,3±12,3	58,5±8,0	53,8±11,7	51,9±8,3

Key: CHHS – children's houses with school; M – mean; SD – standard deviation; n – number of children; <sup>+</sup> Vašíčková, in press

### 3 Results and discussion

The differences in number of steps were most apparent on school days. The effect of difference was large (Cohen's *d*). Middle-size effect was detected in the difference of average number of steps over the whole week. There was no significant difference over the weekend in average number of steps of common population children and children from children's houses. Despite the fact that children live in children's houses, the average daily amount of walked steps overreached the recommendation for PA, which is 10,000 steps a day.

We were also interested whether average number of steps differentiates according to age. We compared two groups of children. One group of children was of primary school age (12-14 years old) (common population:  $n=240$  and CHHS:  $n=45$ ) and another group of children was 15-16 year old attending first grade of secondary

school (15-16 years old) (common population: n=141 and CHHS: n=58). An interesting finding is a higher average number of steps by the 12-14 years old children during weekend days.

Table 2. The average daily number of steps during the week, on work days and at weekends of children of common population and children living in children's houses with school and differences between them.

<b>Average daily number of steps (steps x day -1)</b>	<b>CHHS (n = 103)</b>	<b>Comon population (n = 381)</b>	<b>z</b>	<b>p</b>	<b>d</b>
	<b>M ± SD</b>	<b>M ± SD</b>			
<b>Work days</b>	10852 ± 3694	15047 ± 3917	8,48	0,00	0,77
<b>Weekends days</b>	10879 ± 4389	10728 ± 4605	0,41	0,68	0,04
<b>Week</b>	11330 ± 3460	13813 ± 3476	5,60	0,00	0,51

Key: CHHS – children's houses with school; n – number of children; z-body (Mann-Whitney test); p – level of statistic significance; d – effect size; M – mean; SD – standard deviation

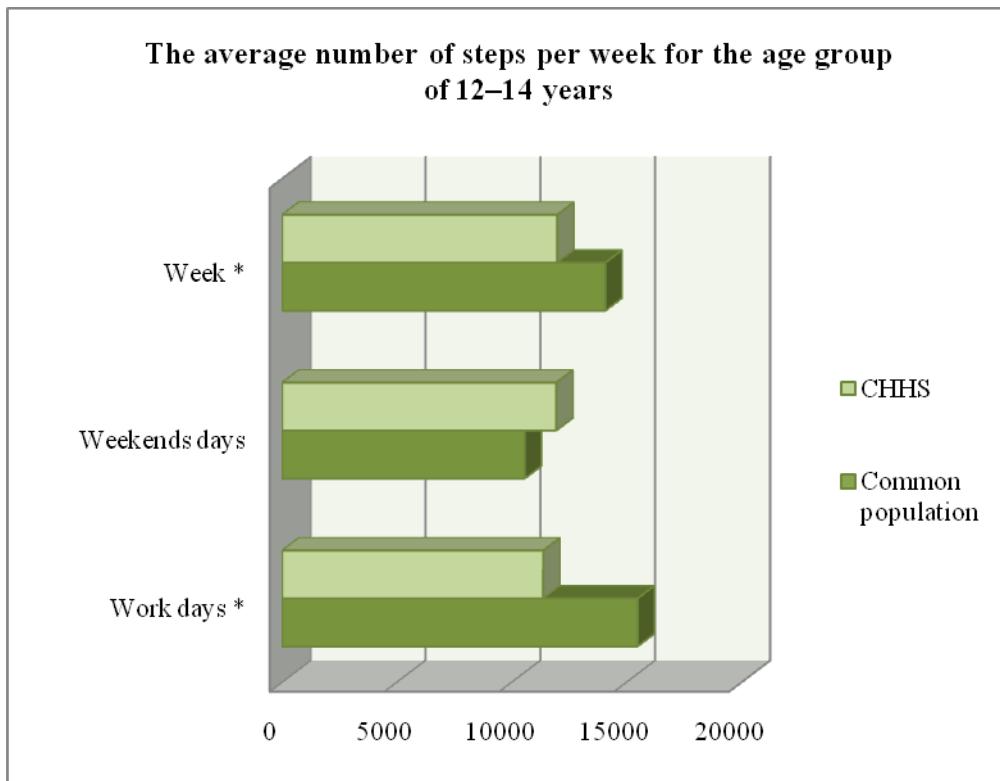
Table 3. Differences in the average number of steps during school days, weekends and the whole week according to age groups of common population children and in children's houses with school.

<b>Average daily number of steps (steps x day -1)</b>	<b>Age groupe</b>	<b>Common population</b>	<b>CHHS</b>	<b>z</b>	<b>p</b>	<b>D</b>
		<b>M ± SD</b>	<b>M ± SD</b>			
<b>Work days</b>	12 – 14 let	15479 ± 3815	11373 ± 3962	5,30	0,00	0,63
	15 – 16 let	14313 ± 3992	10447 ± 3453	5,85	0,00	0,83
<b>Weekends days</b>	12 – 14 let	10566 ± 4806	11934 ± 4399	1,96	0,05	0,23
	15 – 16 let	11004 ± 4244	10060 ± 4240	1,52	0,13	0,22
<b>Week</b>	12 – 14 let	14075 ± 3427	11979 ± 3619	3,03	0,00	0,36
	15 – 16 let	13368 ± 3525	10826 ± 3274	4,09	0,00	0,58

Key: CHHS – children's houses with school; z-body (Mann-Whitney test); p – level of statistic significance; d – effect size; M – mean; SD – standard deviation

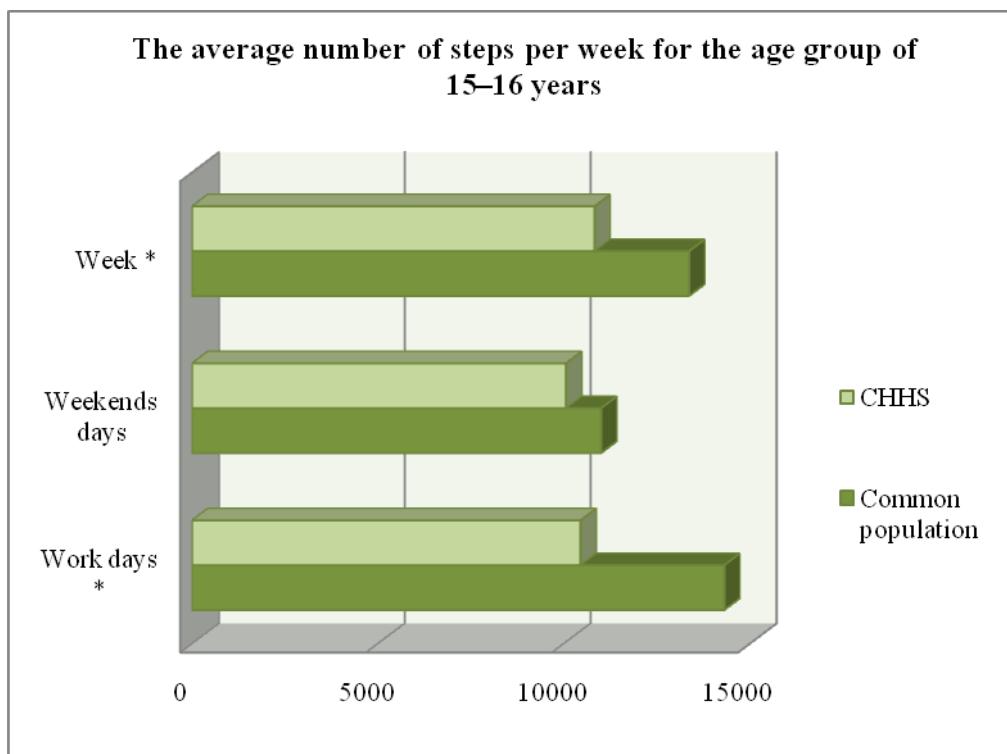
#### 4 Conclusions

PA of children from CHHS is lower by the children of common population. What matters is the location of school that is directly in the premises where children do not have to walk. School attendance is substituted by leisure-time PA. We assume that 12 to 14 years old children reach higher average number of steps at the weekend thanks to organized program in that institution, which is different from life in common families. The number is also positively influenced by the pedagogues who organize their free time and decide about its content. The age matters too because these children are keen on physical activity more at this age. The interests of older children turn away from physical activities.



Explanatory: \* – statistic significance on the surface  $p < 0.001$

Figure 1. The average number of steps per week for the age group of 12–14 years children of common population and children's homes with school.



Explanatory: \* – statistic significance on the surface  $p < 0.001$

Figure 2. The average number of steps per week for the age group of 15–16 years children of common population and children's homes with school.

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Zákon č. 383/2005 Sb., o výkonu ústavní výchovy nebo ochranné výchovy ve školských zařízeních a o preventivně výchovné péči ve školských zařízeních a o změně dalších zákonů

[http://www.msmt.cz/socialni-programy/statistika-poctu-deti-umistenych-v-zarisenich-ochranne-a](http://www.msmt.cz/socialni-programy/statistika-poctu-deti-umistenych-v-zarizenich-ochranne-a)

<http://slovnik-cizich-slov.abz.cz/web.php/slovo/socialne-patologicke-chovani>

<http://www.vzd.cz/node/9>

# **Physical Activity of preschool children**

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## **Abstract**

*The aim of this thesis was to map and evaluate physical activity (PA) and environmental stimulus of pre-school kindergarten students. An experimental group was created with 200 children (96 girls, 104 boys) from 17 kindergarten in different region of Czech Republic. Mean of age was 5,71 years. We evaluated PA employing the daily amount of steps (STEPS: number  $\times$  day $^{-1}$ ) by the pedometer Yamax Digi-Walker SW-200 and active energy expenditure (AEE: kcal  $\times$  kg $^{-1}$   $\times$  day $^{-1}$ ) by the accelerometer Caltrac. A 7-day survey took place in September and October in similar climatic conditions. Data were obtained with the support of the research grant No. MSM 6198959221, 'Physical Activity and Inactivity of inhabitants of the Czech Republic in the context of behavioral changes', which was gained by the Centre Kinanthropology Research at the Faculty of Physical Culture of Palacky University, Olomouc. With regard to the children's low age, parents' written approval and approval of Ethical Committee of Faculty of Physical Culture in Palacký University in Olomouc were sought for realization of the research.*

*The level of PA index – AEE (kcal·kg $^{-1}$ ·day $^{-1}$ ) and STEPS (steps·day $^{-1}$ ) – was nearly equal during the monitored week and it did not show any significant differences. The exception is the time period of the stay in nursery school and the time period the children stayed out of nursery school during the working days, where significant differences ( $p < 0,001$ ) were found out between the values.*

*It is necessary to create conditions for separate and also safe transport of children by elaborate urbanisation and by creating networks of footpaths and cycle lanes, which depends a lot on the state policy. It is important to focus on systematic educating of citizens – future and current parents – in the area of knowledge about healthy life style and its benefits for positive development of a child and to create conditions for mutual PA of parents and children.*

**Key words:** pre-school children, active energy expenditure, amount steps, accelerometer, pedometer

## **1 Introduction**

Physical activity (thereinafter PA), being integral part of human life, is currently being examined from various view points. In terms of importance for health of present-day and future generations it is very important to devote our time to the youngest age groups. The reason for that is that acquired knowledge about this age

group can bring new, more positive approaches to the relationship to physical activities of children and the young. The future benefits could be expected in increasing the level of fitness, in responsible approach to one's own health and in preferring health life style of the future adult generation. That is why we focused on PA of pre-school age children. That is the age group which pedagogical effect of the family and school usually first intervene in. The main target was to map and evaluate PA of pre-school age girls and boys, who attend kindergarten.

## 2 Method

The results were measured within the scope of MŠMT ČR investigative project on the topic "*Physical Activity and Inactivity of the Czech Republic Population in the Context of Behavioural Changes*" RP identification code: 6198959221, whose organizer is Faculty of Physical Culture Palacky University in Olomouc.

For mapping PA of pre-school age children 200 children total composed the research group (96 girls, 104 boys) whose average age was 5.71 years. The demands of the observation lay mainly in long-term preparation of the research – written and oral communication with the school head masters and children's parents. The participation on the research was voluntary, without any financial interest of the people concerned and all data was acquired as anonymous. With regard to the children's low age, parents' written approval and approval of Ethical Committee of Faculty of Physical Culture in Palacký University in Olomouc were sought for realization of the research.

A 7-day survey took place in September and October in similar climatic conditions. All nursery schools kept at disposition common space conditions (play room, playground), material conditions meeting the Czech Republic standard and personal conditions corresponded to the demands on the pedagogical worker's qualification at the given kind of school in the Czech Republic. Curriculum in all nursery schools resulted from valid Framework Educational Programmes for pre-school education.

For monitoring PA a combination of techniques was used:

1. Pedometer Yamax Digi-Walker SW-200 (Yamax Corporation, Tokyo, Japan), which records every vertical oscillation stronger than sensitivity threshold of the instrument (0.35 g). The values (number per day) indicate a number of footsteps in a time unit.
2. Accelerometer Caltrac (Muscle Dynamics Fitness Network, Torrance, California), which measures vertical movements and calculates overall and active energy expenditure out of them. This happens in the context of set data: calendar age of the measured person, weight, body height, gender. The values (kcal per minute) represent a value of so called active energy expenditure, expenditure without standard metabolism.

The instruments were taken off only during children's sleep and during possible water contact (personal hygiene, swimming, bathing). The parents carried out the data record out of the instruments Caltrac and Yamax (including the time of record) to the individual recording forms. The data records were always carried out in the morning, before putting it on, and in the evening, as the instruments were taken off before sleep. Those data records were carried out daily during the whole period of the monitoring, including weekends. The teachers recorded the values out of both instruments to the individual recording forms after children's arrival to school and when they were leaving the school. The teachers did not record activities, which were not usual in common

schedule (visit of a cultural action, all-school academy, school trips, swimming, and so on). In the afternoon the first monitored day (before a walk) elastic belts with instruments for PA monitoring were fastened to the children. The instruments were reset and data necessary for measuring were entered into them in advance. Stiffening was placed over the buttons of the accelerometer and attached firmly. The recording forms, including pencils, were put in the “pockets” for the instruments.

The last day the parents delivered the instruments with filled recording forms to the teachers at kindergarten. Only data of the children was registered who finished the whole 7-day monitoring, including two weekend days, completed entire program of the nursery school during working days

Special software (Chytil, 2004) was used for transferring the data from the individual records. Pearson's correlating coefficient ( $r_p$ ) was used to find out the closeness of the relationship between monitored PA indexes reciprocally – active energy expenditure and number of footsteps. Negativeness of correlating coefficient was evaluated in accordance with the recommendations of the mentioned author with regard to logical significance. Statistic significance of the difference between the PA indexes, which were reached in particular parts of the monitored day (SKaee, LEIaee, SKsteps, LEIsteps) or monitored week (AEE7, AEE5, AEE2, STEPS7, STEPS5, STEPS2), depending on gender were found out by means of a single-factor analysis of variance for dependant measures. Fisher's LSD test was used as a post-hoc test.

<b>INDICATOR PA</b>	<b>GROUP</b> <b>(n = 200)</b>	<b>GIRLS</b> <b>(n = 96)</b>	<b>BOYS</b> <b>(n = 104)</b>
<b>AEE7</b>	11.89	11.43	12.31
<b>AEE5</b>	11.94	11.50	12.34

### 3 Results

Table 1. Indicators of Physical Activity – active energy expenditure ( $\text{kcal} \cdot \text{kg}^{-1} \cdot \text{day}^{-1}$ ) and number of steps ( $\text{steps} \cdot \text{day}^{-1}$ )

<b>AEE2</b>	11.76	11.25	12.23
<b>SKaee</b>	3.67	3.67	3.68
<b>LEIaee</b>	7.74	7.66	7.82
<b>STEPS7</b>	9322	8785	9866
<b>STEPS5</b>	9384	8876	9866
<b>STEPS2</b>	9337	8718	9925
<b>SKsteps</b>	3051	2930	3173
<b>LEIsteps</b>	6458	6197	6721

**Legend:** AEE7 – active energy expenditure during the week ( $\text{kcal}\cdot\text{kg}^{-1}\cdot\text{day}^{-1}$ ) ; AEE5 – active energy expenditure in workweek ( $\text{kcal}\cdot\text{kg}^{-1}\cdot\text{day}^{-1}$ ); AEE2 – active energy expenditure at weekend ( $\text{kcal}\cdot\text{kg}^{-1}\cdot\text{day}^{-1}$ ) ; SKaee - active energy expenditure in kindergarten ( $\text{kcal}\cdot\text{kg}^{-1}\cdot\text{day}^{-1}$ ); LEIaee -active energy expenditure in leisure time after kindergarten ( $\text{kcal}\cdot\text{kg}^{-1}\cdot\text{day}^{-1}$ ); STEPS7 – number of steps during the week ( $\text{steps}\cdot\text{day}^{-1}$ ) ; STEPS5 – number of steps in workweek( $\text{steps}\cdot\text{day}^{-1}$ ); STEPS2 – number of steps at weekend ( $\text{steps}\cdot\text{day}^{-1}$ ) ; SKsteps – number of steps in kindergarten ( $\text{steps}\cdot\text{day}^{-1}$ ) ; LEIsteps – number of steps in leisure time after kindergarten ( $\text{steps}\cdot\text{day}^{-1}$ ) ; GROUP – monitored group (pre school children)

#### 4 Discussion

Based on the results it could be said that the need of PA for children of pre-school age children is high. The level of PA index – AEE ( $\text{kcal}\cdot\text{kg}^{-1}\cdot\text{day}^{-1}$ ) and STEPS ( $\text{steps}\cdot\text{day}^{-1}$ ) – was nearly equal during the monitored week and it did not show any significant differences. The exception is the time period of the stay in nursery school and the time period the children stayed out of nursery school during the working days, where significant differences ( $p < 0,001$ ) were found. Average values for the monitored group maybe found in Table 1.

Last, and also according to current level of researches, I consider necessary:

- to map space and material conditions at nursery and primary schools, examine their quality according to educational process of physical education and frequency of their use by teachers and public,
- to evaluate curriculum at nursery schools and further at primary schools from the view of physical education and time donation for PA, because

- the results could lead to strengthening time donation of physical education teaching mainly at lower levels of schools,
- to analyse and restructure studying programs of universities, which educate future teachers of nursery schools and primary schools in the Czech Republic, which will lead to deepening of professional level of teachers teaching physical education the youngest age categories.

I assume that a certain pressure on authorities at nursery and primary schools for determination of sufficient time for systematically conceived children's physical education in curriculum could bring desired effect in keeping the interest in PA for older age categories. The research enclosures from those areas should be headed to teachers practice at nursery schools. It is necessary to create conditions for separate and also safe transport of children by elaborate urbanisation and by creating networks of footpaths and cycle lanes, which depends a lot on the state policy.

## **5 Conclusions**

It is important to focus on systematic education of citizens – future and current parents – in the area of knowledge about healthy life style and its benefits for positive development of a child and to create conditions for mutual participation in PA for both parents and children.

More attention to economical consequences of civilization diseases, caused by insufficient PA must be paid. These diseases are present but their effect has not been expressed numerically yet. That is the reason why we should pay increased attention to these areas, make a prognosis and at least enumerate approximately economical impact of those civilization diseases on future generation (according to current health state of children and the young) and to streamline the system of prevention.

## **6 References**

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## **Secular trend in changes of the subcutaneous fat in the Transdanubian Region among 3-18 year old children – unfavourable changes.**

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### **Abstract**

*The Körmend Growth Study – launched in 1958 and repeated at regular 10-year intervals – has proven the changes in the children's growth and maturity, the phenomenon of the secular trend.*

*Recording the values of biceps, triceps, subscapular, suprailiac, abdominal and calf skinfolds has been part of the anthropometric schedule from 1968 on. All extents have been measured with caliper according to Martin's technique, taking the recommendations of the IBP HA into consideration. Different periods of the children's growth are characterized by distinct skinfold values, as well. Differences in early childhood skinfold measures increasing by age –especially in the truncal region – develop to be a significant indicator of gender dimorphism by the prepubertal-pubertal age. Secular increasing trend of truncal skinfold values denote an unfavourable tendency. Changes in skinfold measure are, in certain extent, due to the alteration of nutritional conditions and physical activity.*

**Key words:** The Körmend Growth Study, skinfolds, Hungary

### **1 Introduction**

Körmend is a small town in Western Hungary. The Körmend Growth Study – launched in 1958 and repeated at regular 10-year intervals – has proven the changes in the children's growth and maturity, the phenomenon of the secular trend. As it is well known, growth and maturation of children, influenced by genetic and environmental factors, is a dynamic process: growth pattern changes from time to time. Therefore, it is necessary to investigate the somatic developmental status of the children repeatedly (Eiben, 2002; 2003; Eiben and Tóth, 2000a; 2000b; 2000c; Tóth et al, 2009a).

Body mass index is a commonly used measure for the assessment of nutritional status. However, many publications have demonstrated the unreliability of BMI for estimating adiposity Using BMI namely, body composition – body fat, lean body mass, and so on (Ross et al, 1996; Abernethy et al, 1996; Suskovics et al., 2009, Szabó, 2010) – cannot be estimated dependably. Among body measures reflecting the nutritional status, skinfold values are the most informative ones (Tóth and Suskovics 2010). Measuring skinfold values was first used in the 1960s in Hungary, in Körmend.

## **2 Methods**

The purpose of the study was to involve all healthy, 3-18 year-old boys and girls living in the town, i.e. all pre-school and school children. The representation has usually been over 95%, except in the case of K-98 (76%), and in the case of K-008 (72%). Exercising their personality rights, several parents refused assisting the investigation in 1998 and 2008. The last cross-sectional study (2008) has been carried out on 1563 children (757 girls and 806 boys).

The anthropometric programme of the KGS is an ample one. Recording the values of biceps, triceps, subscapular, suprailiac, abdominal and calf skinfolds has been part of the anthropometric schedule from 1968 on. All measurements have been conducted with callipers, according to Martin's technique (Martin and Saller, 1957), taking the recommendations of the IBP HA into consideration (Tanner et al, 1969).

## **3 Results and discussion**

On the basis of weighted means, the secular changes of body measures characteristic for the second half of the 20th century have been determined (Tóth and Eiben, 2004). As for skinfold measures, Hungarian data revealed the following results:

- Biceps skinfolds: Weighted means are 6-7 mm in early childhood and there are no notable differences between sexes. During prepuberty and puberty, there is a certain increment in values, which, in girls, appears in younger ages than in boys. After puberty, girls' means tend to be greater, showing the characteristics of a female physique, while in boys means decrease with age.
- Triceps skinfold values are perhaps the most informative skinfold measurements. Values of weighted means are greater (about 3 mm) in all age groups than those of biceps skinfold. Increasing and later decreasing with age in both boys and girls appear similarly as in case of biceps skinfold. It is worthy to mention that means of 1980s are the highest, probably because of a temporary improvement in the living standards.
- Subscapular skinfold is another very informative skinfold measurement. Means of girls are consequently greater than those of the boys.
- Suprailiac skinfold means are also greater in girls. In this case, however, differences increase with age intensively: in prepuberty, they are about 5 mm, while after puberty about 9 mm. This underpins the development of a roundish female physique.
- The means of abdominal skinfold (a relatively rarely measured characteristic) can be twice as great in girls than that in boys.
- Calf skinfold, measured on the medial side of the calf, shows a moderate excess in girls before puberty. The means are slightly increasing with age in boys, while markedly in girls.
- Until 1998, the Körment results practically matches Hungarian tendency (Tables 1-6). According to our studies the growth patterns of children have been changed in both genders at the turn of the millennium (Tóth et al. 2009b). Therefore comparison of the skinfold measures of 1998 and 2008 is considered important.

In both gender, calf skinfold values are first increasing, than decreasing, reflecting the characteristic changes in adolescence. This tendency is noticeable when measuring all skinfold values. It is caused by the changes in energy storage during the pubertal period. Thereafter, calf skinfold values tend to decrease in boys.

Table 1. Skinfold calf, means and *SD* (mm) in Körmend boys and girls (1968-2008)

Age (years)	K-68	K-78	K-88	K-98	K-008				
<i>Boys</i>									
3	10.4	2.3	10.9	2.6	12.7	3.6	9.1	2.7	9.1
4	9.9	1.9	10.1	4.1	12.7	4.3	10.1	2.7	8.6
5	8.6	1.6	9.3	2.5	10.5	3.0	10.7	3.6	8.4
6	8.1	1.9	9.7	5.3	11.4	6.1	10.6	3.8	8.6
7	8.3	2.0	9.5	3.8	11.5	4.4	11.3	4.3	8.4
8	8.5	1.9	10.4	4.7	12.2	4.9	12.4	6.8	11.8
9	9.4	2.7	11.9	5.6	13.0	6.0	12.2	5.7	14.0
10	9.8	3.1	11.6	5.8	12.9	6.2	13.2	6.2	13.7
11	10.4	3.2	12.6	6.4	14.4	7.3	16.6	8.6	13.0
12	10.4	3.8	13.2	6.4	15.8	8.9	15.5	8.1	14.4
13	11.0	3.7	13.3	5.9	13.5	6.6	15.7	6.7	14.1
14	10.9	3.5	12.7	6.1	13.4	6.3	14.9	7.5	13.3
15	10.7	3.4	12.0	4.5	13.8	8.0	11.0	5.5	10.9
16	10.3	3.7	11.1	4.3	13.0	5.7	10.1	4.2	9.7
17	10.9	3.3	10.3	4.4	13.3	8.9	11.8	6.5	10.0
18	9.8	3.1	9.8	3.6	11.7	6.1	9.3	4.3	9.4
<i>Girls</i>									
3	10.1	2.3	12.1	2.6	11.9	2.8	13.0	2.3	9.4
4	10.1	1.6	12.0	2.3	14.2	3.4	12.3	3.6	9.8
5	8.9	1.2	11.9	3.3	13.0	4.0	12.0	4.0	10.3
6	8.9	2.0	11.4	3.6	12.6	4.5	12.0	4.7	11.2
7	8.8	2.1	12.2	5.1	13.7	4.8	13.6	5.5	12.7
8	10.1	2.5	12.1	4.7	16.5	6.4	14.1	5.3	12.8
9	10.1	3.0	14.0	5.3	15.4	4.7	15.1	5.7	14.3
10	11.0	3.2	13.3	5.1	17.5	6.3	16.1	6.6	15.5
11	11.0	3.3	14.1	4.9	17.7	6.8	17.4	5.8	14.5
12	10.9	2.9	16.0	8.2	21.0	7.5	16.5	5.6	16.6
13	10.9	3.1	15.7	5.8	19.2	8.8	18.6	6.5	17.1
14	11.4	3.6	16.7	6.0	19.9	7.6	18.5	7.0	14.7
15	14.2	3.7	17.9	7.6	22.1	9.6	17.1	4.7	15.4
16	13.9	5.0	18.6	5.5	22.0	8.1	20.1	5.7	16.9
17	14.5	4.7	19.6	5.9	20.3	7.4	17.7	5.2	17.5
18	15.1	4.4	18.4	5.9	21.7	7.9	21.6	6.9	17.6

Table 2. Skinfold biceps, means and SD (mm) in Körmend boys and girls (1968-2008)

Age (years)	K-68	K-78	K-88	K-98	K-008				
<i>Boys</i>									
3	5.8	1.5	7.4	2.4	9.7	3.1	5.6	1.7	6.2
4	5.7	1.4	6.8	2.2	9.3	3.6	5.6	2.3	6.1
5	5.4	1.2	6.8	2.3	8.5	2.6	5.9	2.8	6.1
6	5.4	1.5	5.9	2.2	8.2	2.6	5.5	3.0	5.9
7	4.9	1.2	5.2	2.7	8.0	3.4	6.0	3.7	6.2
8	5.4	1.4	5.3	2.7	8.6	3.8	7.1	5.5	7.6
9	5.7	2.2	6.3	2.9	9.3	4.6	6.2	4.3	8.9
10	4.4	1.7	6.4	3.5	9.9	4.5	7.2	5.4	8.8
11	4.8	1.7	6.8	4.1	10.9	5.0	10.0	7.2	10.0
12	4.4	1.8	7.0	4.4	11.5	5.4	8.0	5.6	10.5
13	4.8	2.0	7.0	4.0	10.0	4.9	7.4	4.3	9.0
14	4.4	1.5	6.4	3.5	9.8	4.5	8.1	6.0	8.3
15	3.0	1.0	5.5	2.5	9.4	3.8	5.7	4.1	6.5
16	4.3	1.1	5.3	2.6	9.2	4.2	4.7	2.7	5.2
17	4.2	2.7	5.1	2.8	8.6	4.2	6.2	4.7	6.4
18	3.9	0.7	5.2	2.7	8.6	3.5	4.2	2.3	6.2
<i>Girls</i>									
3	5.7	1.7	7.9	2.4	8.6	2.2	7.5	2.9	7.2
4	5.6	1.4	7.3	2.0	10.3	2.8	7.5	3.1	7.4
5	5.4	1.2	7.3	2.2	9.6	2.8	6.8	3.1	7.3
6	5.4	1.5	7.3	2.5	9.9	3.2	6.7	3.3	8.0
7	4.9	1.2	6.9	3.3	9.2	3.3	7.6	4.0	8.7
8	5.4	1.4	6.5	3.1	9.9	3.6	8.4	4.8	9.3
9	5.7	2.2	7.8	2.9	10.6	4.1	9.4	5.0	10.6
10	6.5	2.1	7.6	3.3	12.1	4.5	9.0	5.8	11.6
11	6.2	2.5	8.0	3.7	12.6	4.4	10.2	5.0	10.5
12	6.2	1.9	9.4	4.3	12.2	5.6	9.1	4.6	11.6
13	6.9	2.3	8.5	3.8	12.6	4.7	10.8	5.7	10.5
14	7.1	2.2	8.8	3.6	13.3	4.5	10.4	5.2	10.4
15	8.2	3.0	8.8	4.5	13.8	5.4	9.9	4.7	9.0
16	8.0	3.1	10.9	4.0	13.9	4.9	10.6	4.6	9.2
17	7.6	2.4	10.4	3.8	12.4	4.1	9.7	3.5	9.5
18	8.0	1.9	8.6	3.6	13.2	4.7	11.9	5.6	10.5

Table 3. Skinfold triceps, means and SD (mm) in Körmend boys and girls (1968-2008)

Age (years)	K-68	K-78	K-88	K-98	K-008				
<i>Boys</i>									
3	10.4	1.6	11.9	2.7	13.4	3.4	10.8	2.4	10.2
4	9.2	1.4	10.9	2.9	12.9	3.2	11.6	3.0	10.1
5	8.6	1.5	9.7	2.2	11.7	2.6	10.9	3.3	10.1
6	8.3	1.7	9.6	2.6	11.3	2.8	10.5	3.5	9.9
7	7.3	1.7	9.0	3.2	11.9	3.9	10.7	4.7	9.7
8	7.9	1.9	9.5	4.0	12.5	4.1	11.7	5.4	12.4
9	7.4	1.7	10.4	4.0	13.4	5.0	11.5	4.7	13.4
10	7.8	2.3	10.2	4.5	13.6	5.3	12.7	5.6	12.9
11	8.4	2.7	10.5	5.1	14.5	4.9	14.5	5.7	14.2
12	7.4	2.1	10.7	5.1	15.5	6.0	13.8	6.6	14.8
13	8.0	2.7	10.1	5.2	12.4	4.6	14.3	5.3	12.9
14	7.7	1.9	10.1	5.4	12.4	4.8	13.2	5.6	11.7
15	7.0	1.9	8.9	3.7	11.9	4.8	9.5	3.9	10.6
16	7.1	2.2	8.6	4.0	12.3	5.0	8.7	4.1	9.6
17	6.9	1.8	8.1	4.1	11.1	4.5	11.1	5.4	10.4
18	6.8	2.1	8.2	3.2	11.1	4.0	8.8	3.5	9.7
<i>Girls</i>									
3	10.1	2.3	12.1	2.6	12.3	1.9	12.6	2.6	10.2
4	10.1	1.6	11.6	3.1	14.1	3.0	13.2	3.6	11.9
5	8.5	1.1	11.2	2.6	12.9	3.8	12.1	3.7	11.4
6	8.6	1.9	11.7	4.4	13.6	3.9	12.3	4.1	12.2
7	8.5	2.1	11.8	4.3	13.4	3.9	12.4	4.1	12.7
8	9.4	2.2	10.6	3.7	14.0	3.9	13.3	4.2	13.9
9	9.3	2.6	12.0	4.1	14.6	4.5	15.0	5.4	14.8
10	10.3	3.0	12.1	4.2	16.3	5.4	15.7	6.2	14.7
11	10.7	3.0	11.4	3.9	16.3	5.3	16.6	6.0	14.0
12	10.0	2.4	12.4	5.3	15.8	5.8	15.0	5.1	14.7
13	10.5	2.9	12.9	5.6	16.9	5.9	16.4	5.9	14.8
14	10.3	3.0	14.8	5.1	17.8	5.3	16.8	6.5	15.2
15	14.6	3.7	14.7	4.9	19.1	6.3	14.8	4.8	15.6
16	13.8	4.9	17.2	5.6	19.2	5.4	15.9	4.7	15.2
17	13.7	4.2	17.2	5.9	18.2	5.1	15.1	4.4	15.2
18	14.7	3.3	15.6	5.0	18.6	5.3	17.5	5.3	16.2

Table 4. Skinfold subscapular, means and SD (mm) in boys and girls (1968-2008)

Age (years)	K-68	K-78	K-88	K-98	K-008			
<i>Boys</i>								
3	6.2	1.2	5.9	1.7	9.2	3.5	5.5	2.5
4	5.4	1.1	6.2	2.7	8.2	2.8	5.8	1.9
5	5.0	0.9	6.0	2.1	7.5	2.4	5.8	3.5
6	5.1	1.2	5.9	2.5	7.6	2.6	5.4	3.7
7	5.0	1.2	5.3	2.6	9.0	4.3	6.9	4.2
8	4.4	1.3	6.7	5.2	9.0	4.5	8.0	6.5
9	5.3	1.3	7.0	4.4	10.3	6.4	7.2	4.5
10	5.8	1.5	7.8	5.5	10.5	6.1	8.3	5.9
11	6.5	2.3	8.5	5.8	12.4	8.0	12.1	6.7
12	6.1	2.0	8.9	5.9	14.3	8.5	11.2	6.1
13	6.5	2.3	9.2	6.8	12.6	6.5	10.4	6.1
14	6.5	2.4	9.6	5.9	13.5	5.5	13.4	6.3
15	7.0	1.5	8.8	3.7	14.1	6.6	10.1	5.8
16	7.5	1.9	9.7	4.1	14.9	7.0	9.9	4.9
17	8.0	2.0	9.5	4.3	14.6	5.5	13.3	6.4
18	8.2	1.6	11.3	5.1	15.3	5.7	11.3	4.5
<i>Girls</i>								
3	6.2	1.3	7.0	2.5	8.3	2.6	6.9	2.2
4	6.4	1.4	6.5	2.5	9.7	3.5	7.4	4.3
5	6.1	1.5	7.1	2.2	10.0	4.2	6.8	4.5
6	5.9	1.3	7.3	3.1	10.2	4.0	6.8	4.2
7	5.8	1.5	7.7	4.8	10.0	5.4	8.8	4.9
8	6.8	2.3	7.9	5.1	11.1	5.7	10.4	5.8
9	6.9	2.6	9.1	5.3	11.3	5.9	11.4	6.9
10	8.1	2.5	9.4	5.2	14.1	7.5	12.1	7.8
11	9.2	4.0	9.7	6.1	15.6	7.8	13.1	7.5
12	8.5	2.1	11.9	6.1	17.0	8.0	12.9	6.3
13	9.6	2.9	12.4	6.5	17.5	7.7	15.1	7.0
14	10.9	3.2	13.7	6.2	18.9	7.2	16.6	7.9
15	13.4	3.6	13.8	5.9	22.0	8.0	14.7	5.9
16	13.7	4.2	15.1	6.3	22.5	8.2	14.8	5.5
17	13.3	3.7	16.3	6.6	20.4	6.8	14.6	6.1
18	13.4	4.0	14.9	5.3	21.8	8.3	18.5	8.1
								16.5
								11,1

Table 5. Skinfold suprailiac, means and SD (mm) in Körmend boys and girls (1968-2008)

Age (years)	K-68	K-78		K-88		K-98		K-008	
<i>Boys</i>									
3	6.3	2.6	6.6	1.7	10.1	4.5	6.5	2.0	9.0
4	5.5	2.0	6.7	2.8	9.7	3.7	6.8	2.8	7.9
5	4.8	2.1	6.7	2.5	9.6	3.7	7.2	4.6	9.5
6	4.8	1.4	7.2	3.2	9.9	4.4	8.1	4.6	10.0
7	4.7	2.5	6.9	3.8	11.3	6.5	9.6	7.4	9.1
8	5.6	2.7	8.8	7.6	11.5	6.0	10.9	8.7	14.1
9	5.0	2.1	10.3	7.7	13.5	8.5	10.5	7.1	16.6
10	5.5	2.1	11.3	9.0	13.4	8.7	12.7	10.4	16.4
11	6.4	2.8	12.8	9.5	16.2	10.4	18.0	12.8	18.8
12	6.1	2.7	12.7	9.0	17.3	11.1	16.6	11.9	21.2
13	6.7	3.0	13.2	9.9	14.3	8.7	15.5	9.6	21.2
14	6.5	2.4	13.3	8.8	15.6	8.0	20.2	13.9	19.4
15	6.9	2.5	11.8	6.6	16.8	10.0	15.2	9.2	17.4
16	7.2	2.3	12.9	7.4	17.4	9.8	13.5	7.0	19.8
17	8.2	3.1	12.1	7.3	17.4	8.4	17.6	9.5	20.4
18	6.9	2.1	14.7	7.8	19.1	7.5	15.7	7.9	18.8
<i>Girls</i>									
3	7.3	2.7	7.9	2.6	9.8	3.3	8.8	2.9	10.0
4	7.5	2.2	8.1	3.1	11.9	5.0	9.8	5.6	11.5
5	7.0	2.7	9.0	3.2	11.8	6.0	9.1	6.0	11.4
6	6.7	2.1	9.3	4.0	12.7	5.6	9.7	5.5	13.7
7	6.4	3.1	10.3	6.2	12.9	6.0	11.5	5.8	13.8
8	7.2	2.5	10.0	6.2	14.3	6.9	13.3	6.2	15.8
9	7.7	2.9	12.7	6.6	14.8	8.2	15.9	8.1	18.9
10	9.5	3.2	13.1	6.7	17.6	8.6	16.7	9.9	19.5
11	9.1	3.3	13.8	7.6	18.7	8.9	18.1	8.5	20.4
12	8.8	2.5	16.5	10.0	19.7	9.4	17.7	8.4	24.3
13	10.5	3.6	16.4	8.3	19.7	8.9	20.0	9.3	23.6
14	10.9	3.2	17.4	8.0	21.7	8.4	21.2	9.7	25.5
15	16.1	4.0	17.8	7.5	24.0	9.1	19.8	7.8	23.8
16	17.7	4.8	19.2	8.1	24.8	8.8	20.1	7.2	26.8
17	15.1	4.4	21.5	8.9	22.0	6.4	20.1	7.1	26.4
18	20.6	4.9	18.6	7.0	23.1	7.6	22.9	9.4	26.1

Table 6. Skinfold abdomen, means and *SD* (mm) in Körmend boys and girls (1968-2008)

Age (years)	K-68	K-78	K-88	K-98	K-008		
<i>Boys</i>							
3	8.5	3.3	5.8	2.3	8.6	3.2	6.1
4	8.3	2.2	6.0	2.9	8.5	3.9	5.9
5	5.7	1.5	5.4	2.3	7.5	3.2	7.1
6	6.1	1.8	6.2	3.7	8.1	4.3	6.3
7	5.3	1.8	5.9	3.9	10.3	6.5	7.4
8	6.7	3.4	7.3	6.6	10.5	6.1	9.4
9	6.1	2.5	9.0	7.2	11.9	8.3	10.1
10	6.7	2.8	10.1	8.6	13.0	9.9	12.3
11	8.4	4.3	10.4	8.7	16.0	11.5	18.4
12	7.9	2.8	11.2	9.4	18.2	12.5	15.6
13	9.2	3.9	11.5	8.8	15.3	9.9	15.6
14	10.1	3.8	11.8	8.3	15.9	8.6	18.7
15	9.2	3.1	11.9	6.5	17.7	10.6	13.7
16	10.2	3.1	12.7	7.2	18.6	11.2	12.0
17	10.9	4.3	12.0	7.9	17.9	10.2	16.2
18	11.0	3.1	13.8	8.5	20.3	10.0	13.4
<i>Girls</i>							
3	7.3	1.6	8.3	3.6	7.8	2.7	9.2
4	7.5	3.4	7.2	2.6	9.7	3.9	9.1
5	6.4	2.3	7.1	3.4	9.9	5.6	7.7
6	8.1	3.4	8.0	4.1	10.7	6.0	8.7
7	6.7	2.1	8.5	5.8	11.9	7.1	10.4
8	8.3	3.2	8.5	5.5	13.2	7.2	12.2
9	8.8	3.0	11.0	7.4	14.1	9.0	15.6
10	10.6	3.6	11.2	6.1	18.5	9.8	15.4
11	10.2	3.4	13.0	7.8	19.9	10.9	17.8
12	13.3	4.6	15.9	9.5	21.4	12.6	17.5
13	15.4	4.5	16.6	8.2	23.5	10.4	19.2
14	18.9	6.0	19.1	8.1	26.6	10.7	19.4
15	22.1	4.2	19.9	7.8	29.5	11.2	18.9
16	22.8	5.0	21.6	8.8	31.7	9.6	19.4
17	17.8	4.6	23.0	9.0	29.0	8.3	17.6
18	24.3	4.7	19.7	7.3	28.5	9.5	21.9

In girls, however, after stagnating for a while, calf skinfold values tend to increase again. In both genders the 2008 values (K-008) are exceeded by those of 1998. Biceps skinfold values of boys are, in all age groups, greater in 2008 than in 1998. In girls, however, after the adolescence changes lower bicipital skinfold values were measured in 2008 than in 1998.

The values of triceps skinfolds in boys were first slightly lower in 2008 than in 1998. After the pubertal changes, however, triceps skinfold values of boys proved to be higher in 2008 than ten years earlier. Recent tricipital skinfold values of girls are, in all age groups, lower than those recorded in K-98.

Subscapular skinfold values of boys in 2008 are first identical to those in 1998; while in later ages – after a decreasing period – measures tend to exceed the 1998 ones. In girls, however, K-008 values are, in each cohort, lower than those in 1998. On the other hand, suprailiac and abdominal skinfolds (both are markers of the truncal region) tend to increase considerably in all age groups, in both genders. These unfavourable changes are presumptive predictors of adulthood abdominal type obesity.

#### 4 Conclusions

Different periods of the children's growth are characterized by distinct skinfold values. Differences in early childhood skinfold measures are increasing by age – especially in the truncal region – may be perceived as indicators of gender dimorphism by the prepubertal-pubertal age. Increasing truncal skinfold values denote an unfavourable tendency. Secular changes in skinfold measure are, in certain extent, due to the alteration of nutritional conditions and physical activity.

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## **Mental health decrease among active women in Szombathely and relationship to physical activity.**

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### **Abstract**

*Mental health is part of the general health. Its state is influenced by personal (biological and psychological), social, and cultural factors. Data, which show the high occurrence of different mental health problems worldwide, draw the attention to the importance of mental health's study. According to the WHO's report from 2001, the collective short-term prevalence of mental disorders is between 15-20% within the scope of adult population. The life prevalence rate is between 30-50%. The mental health shows a close correlation with other health problems. The connection between somatic diseases and depression was detected inversely, too. There is also a strong relationship between mental health and the subjective health condition.*

*In our research mental health was interpreted within the frame of the functional health model. According to the model, mental health problems can also cause functionality decrease which could imply such health problems which do not exhaust the diagnostic criteria. Similarly to the OLEF2000 and OLEF2003 researches, the GHQ-12 questionnaire was used in the present study in Szombathely, as an indicator of mental health. The questionnaire is a self-estimator scale which is used for estimating the mental health problems in the population. Furthermore, the complex questionnaire had a part referring to the judgment of mental state and the degree of physical activity.*

*The basis of our study is a mental health condition survey from 2008, which was carried out among people aged between 23-65 in Szombathely and its surrounding. 123 women's data got into the purified sample. Our aim was to collect data concerning the prevalence of mental health decrease and to compare the mental health condition of active working age women living in Szombathely and its surroundings, and the relationship with data from a national sample. We anticipated that the positive effect of physical activity may be detected among rates of mental health decrease and subjective health condition.*

**Keywords:** mental health, psychic health decrease, GHQ 12, subjective health condition, physical activity

## **1 Introduction**

The mental health is part of the general health. Its state is influenced by personal- (biological and psychological), social-, and cultural factors. One significant factor within the field of mental health protection is the regular physical activity which entails with health consciousness. The physically active lifestyle has favorable psychic and psychosocial effects, makes you feel well, helps fighting against distress and depression. Furthermore, it improves self-confidence and assists the formation of positive thinking. The protective factors or also called social immunogenic factors operate as psychosocial buffers, neutralize the harmful stress effects and help in health preservation and in the maintenance of the balance. The regular physical activity ensures a richer life in vitality and health, which makes you feel better, consequently the opinion about the own health condition improves.

Data, which show the high occurrence of different mental health problems worldwide, draw the attention to the importance of mental health's study. According to the WHO's report from 2001, the collective short-term prevalence of mental disorders is between 15-20% within the scope of adult population. The life prevalence rate is between 30-50%.

The mental health shows a close correlation with other health problems. The connection between somatic diseases and depression was detected inversely, too. There is also a strong relationship between mental health and the subjective health condition. In our research mental health was interpreted within the frame of the functional health model. According to the model, mental health problems can also cause functionality decrease which could imply such health problems which do not exhaust the diagnostic criteria.

Similarly to the OLEF2000 and OLEF2003 researches, GHQ-12 questionnaire was used in the research in Szombathely as one of the indicators of mental health. The questionnaire is a self-estimator scale which is used for estimating the mental health problems in the population. It concentrates on the global components of psychiatric morbidity (especially on mental health problems which entail symptoms of distress and emotional disorders). However, a concrete diagnosis can not be established with it. The questionnaire is widely-used, both in population research and within the frame of the basic health service. It was translated into more than 35 languages. The questionnaire is valid and reliable. The complex questionnaire had a part referring to the judgment of mental state and the degree of physical activity, as well.

### **1.1 Hypotheses**

1. The degree of mental health decrease is lower among working age women in Szombathely than the rates of the national representative study.
2. The positive effects of sporting and physical activity can be shown among the rates of mental health decrease.
3. The opinion about the health condition (subjective element) shows correspondence with the degree of mental health decrease (objective element).

## **2 Method**

The basis of our study is a mental health condition survey from 2008, which was carried out among people aged between 23-65 in Szombathely and its surrounding. The data of 123 women were in the purified sample. 10 yearly age groups were created for the analysis (Table 1). The applied research methods had two parts.

#### *Questionnaire method*

It contains the motivation background which basically determines the health behaviour, the physical activity, the eating habits, abilities for dealing with stress, addictive behaviour and social background. Part of the questionnaire was adapted, that is the GHQ-12 questionnaire (OLEF 2000 and OLEF 2003), while another part was based on the target group. The reliability of the scale was assessed in a pilot study (Cronbach  $\alpha = 0.748$ ).

#### **2.1 Method for analysing the biological and health conditions**

Studying the body composition and Cardiovascular indices.

Table 1: Distribution of the sample based on age groups

Group	Average	Distribution	N	Percentage
23-33 years	28,77	3,161	22	17,9
34-43 years	38,93	3,116	40	32,5
44-53 years	48,38	2,589	40	32,5
54-65 years	56,52	3,530	21	17,1
Sum	43,19	9,585	123	100,0

3

#### **Results and discussion**

1. The degree of mental health decrease is lower among working age women in Szombathely than the rates of the national representative study.

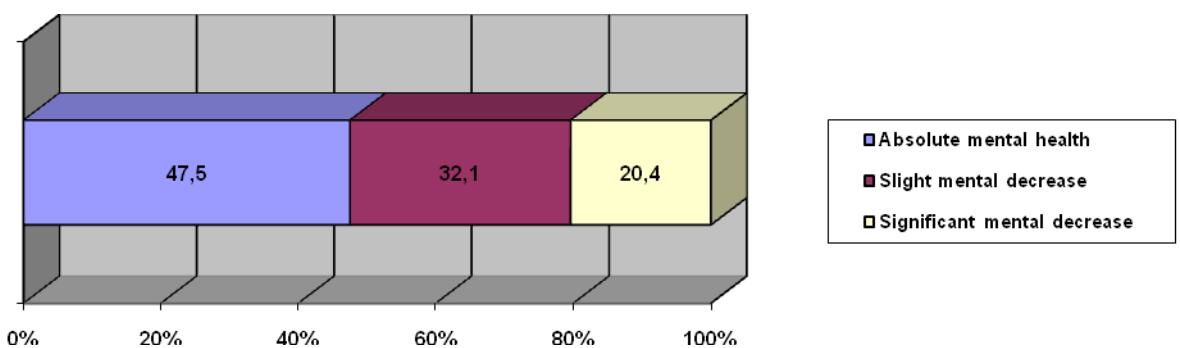


Figure 1. The degree of mental health decrease among working age women in Szombathely.

47,5% of the active, working age women in Szombathely have absolute mental health, which reached 0 point. In 2003 it was 56,8% of the Hungarian representative survey. It reached at least 5 points on the GHQ-12 questionnaire, so 11,7% of women could be described with mental functionality decrease in the national survey. Significant mental decrease was found among 20,4% of the women in Szombathely.

The changing of mental health decrease in different ages increases with age according to the Hungarian health survey. In the case of women who took part in the Szombathely survey, 22% of the respondents from the younger generation (23-33 years) show significant mental health decrease. In the other age groups this rate has decreased (18,86%, 20%, 19,23%). On the whole, regarding the age group of 34-65 years, 19,37% is the rate (see Table 2. and Figure 2.).

Table 2. Significant mental health decrease distributed according to age groups, based on the study of OLEF 2003.

<b><u>GHQ-12 value shows significant mental health decrease (higher than 5 points)</u></b>			
18-34 years	35-64 years	65+ years	sum
9,0	11,3	16,4	11,7

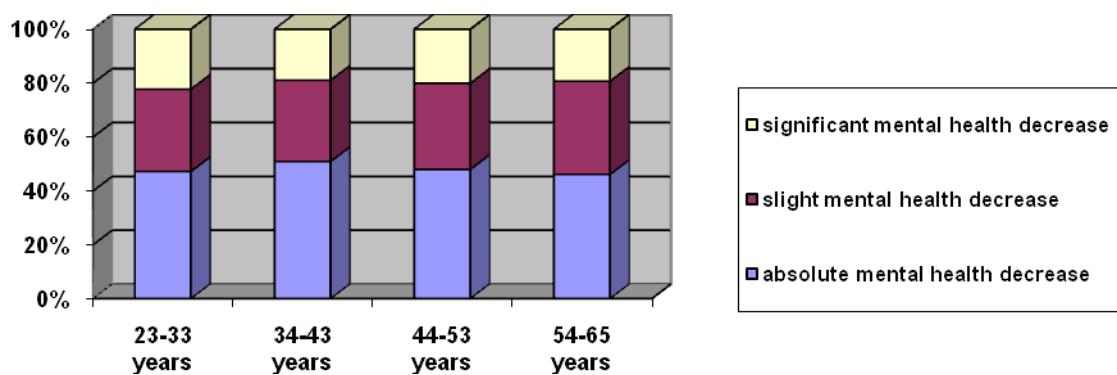


Figure 2. The degree of mental health decrease in different age groups among women from the Szombathely sample.

2. The positive effects of sporting and physical activity can be shown among the rates of mental health decrease. On Figures 3, 4, 5 the rate of mental health decrease can be seen in connection with sporting. The connection is significant (0,012) between sporting and mental health. At the same time, regarding the frequency of sporting, the differences can not be seen (Figure 6).

3. The opinion about the health condition (subjective element) shows correspondence with the degree of mental health decrease (objective element).

It was proved that those people who do some sports are able to define their own mental health condition in an elaborated way as their choice ranged from the very bad to the very good categories. However, those people who do not do any sports chose only the average category.

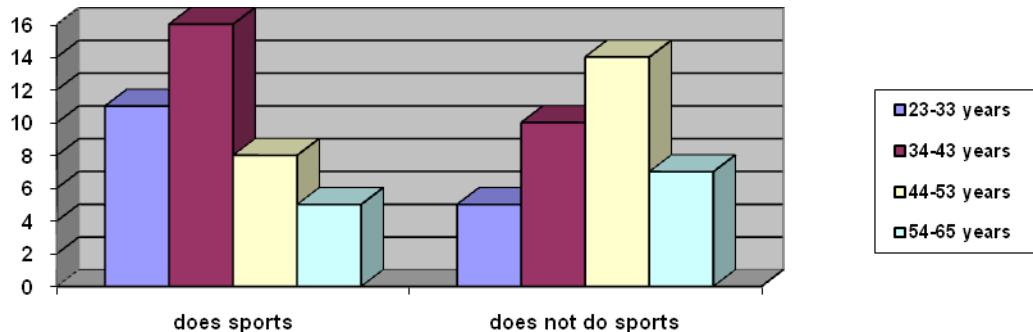


Figure 3. The appearance of absolute mental health related to the sporting activity.

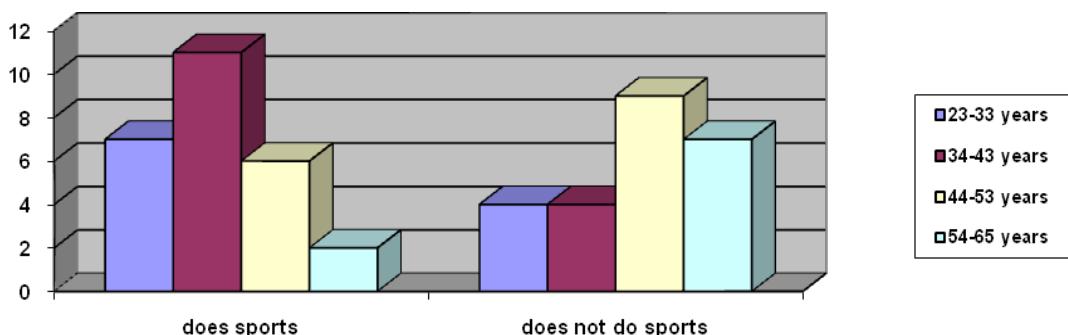


Figure 4. Slight mental health decrease related to the sporting activity

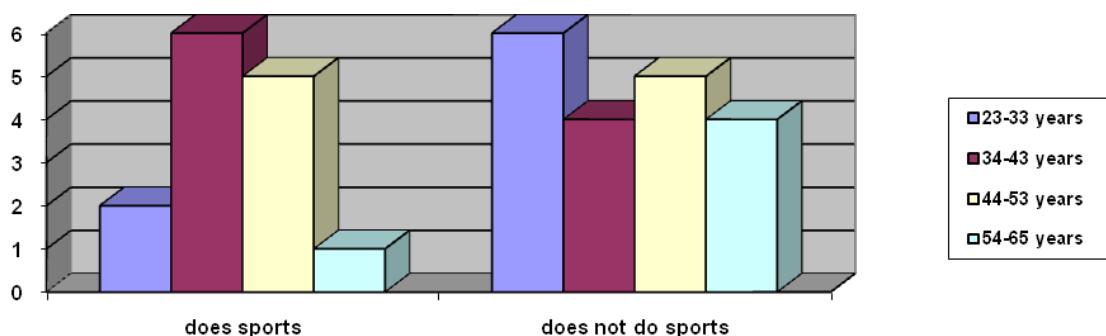


Figure 5. Significant mental health decrease related to the sporting activity

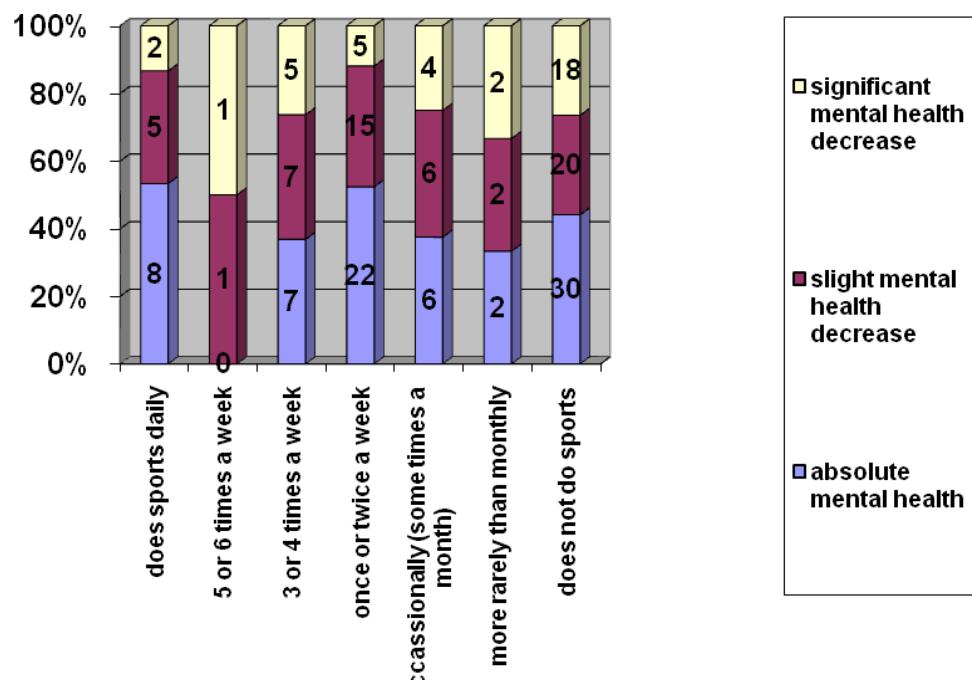


Figure 6. The degree of mental health decrease related to the frequency of the sporting activity.

The connection is obvious (0,002) between the existence of mental health and the evaluation of the subjective health condition, both in the sample of sporting and no sporting. (Figures 7, 8).

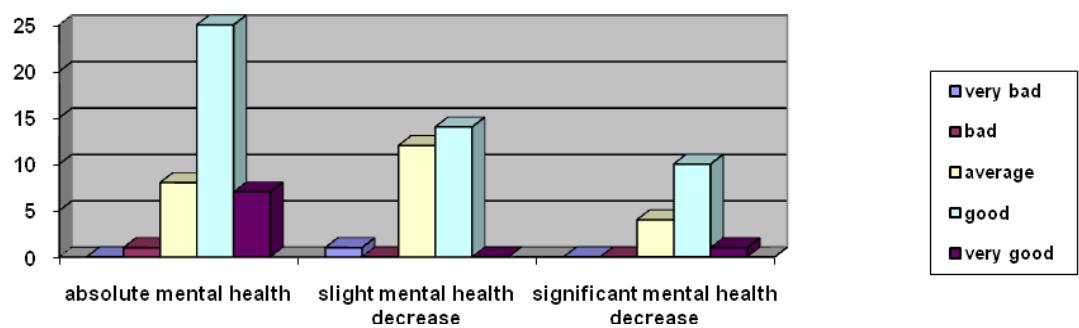


Figure 7. The judgement of health condition among respondents doing sport.

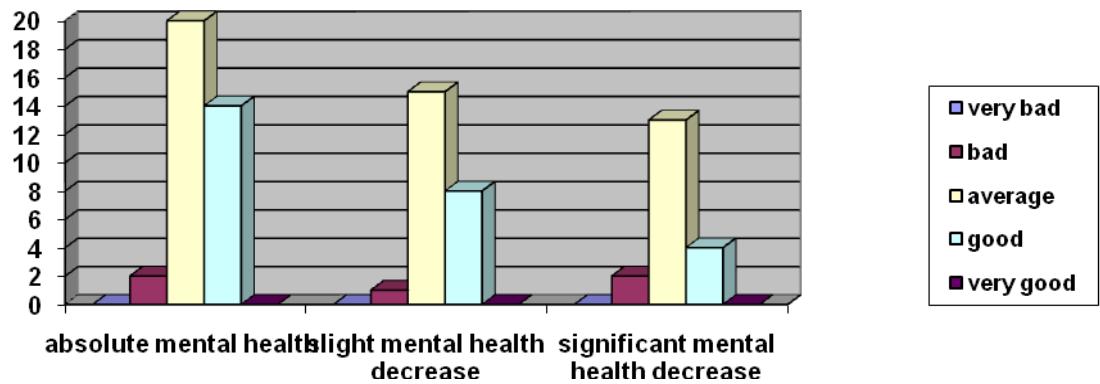


Figure 8. The judgement of health condition among respondents not doing sports.

#### 4 Conclusions

Except the first hypothesis, the second and third ones were proved. It is worth thinking about the reason why the degree of mental health decrease is so significant among active age women in Szombathely. The relation between sporting and the mental health is evident. The primer **nuovum** of the Szombathely research is that the GHQ-12 questionnaire, which measures the mental health decrease and preferred by the WHO and the European Union, has not been published in the relationship with physical activity and sporting yet.

**Performance Analysis – INTERNATIONAL WORKSHOP**

## **Physical characteristics of elite Serbian female soccer players.**

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### **Abstract**

*The main aim of this study was to describe physical performance characteristics of top Serbia female soccer players. In addition, the aim of the study was to examine positional differences in this sample of athletes. Research was performed on a sample of 22 elite female soccer players from Serbian A-national team (aged 23.95±4.52, body height 168.82±7.19 cm, body weight 61.4±6.0 kg). The following tests were used for measurement of speed and agility with and without the ball: 10-m Sprint (S10), Flying 20-m Sprint (LS20), 30-m Sprint (S30), Zigzag Test (CC), Zigzag With the Ball (CCL). For the estimation of the explosive strength of lower extremities three tests have been used: Squat jump (SJ), counter movement jump (CMJ) and counter movement jump with arm swing (CMJZ). Yo-Yo intermittent recovery test level 1 (YYIRL1) was used for measuring the physical match performance. The values of physical performance of the Serbian female soccer players are lower than those in some other studies that included high level players. In addition, their physical performance do not significantly differ depending of the position in the team.*

**Key words:** female, performance, differences, position

### **1 Introduction**

Female soccer has become one of the fastest growing sports with over 26 million participants around the world (Andersson, 2010). Germany has over one million registered female soccer players, while both Sweden and Denmark have approximately 60,000 registered players (Andersson, 2010). Traditionally the number of female soccer players is limited when compared to other sports played by females. However, the number of young girls deciding to professionally take up soccer is nevertheless increasing in Serbia. The general characteristics of female soccer players have been extensively described in the literature (Andersson, 2010). These studies showed that average range in height, weight, VO<sub>2</sub>max, vertical jump performance and 20-m sprint time vary among players in the various levels of competition and the different positions of players in the field (Krstrup et al., 2005; Mohr et al., 2008; Polman et al., 2004; Siegler et al., 2003; Stølen et al., 2005; Tumilty and Darby, 1992). More recent studies stated that total distances covered in a game by female soccer players amounts to around 10 km per game (Gabbett and Mulvey, 2008; Hewitt et al., 2007; Krstrup et al., 2005; Mohr et al., 2008). The requirements of women's soccer, in this respect, appears to be similar to those of the men's game (Krstrup et al., 2005; Mohr et al., 2003b; Mohr et al., 2008), but differs from elite male players in high intensity running. It has been shown that top international female players covered an average of 1.7 km of high intensity running during a game (Mohr et al., 2008). The total distance includes a large amount of walking and jogging (>50%). Therefore, the distance covered in high

intensity running has been suggested to be a better indicator of the physical stress during a game (Andersson, 2010). The amount of high intensity running performed by female soccer players is related to the competition level and may range between 0.7-2.0 km during a game (Krustrup et al., 2005; Mohr et al., 2008). It has also been reported that the same female player covered a longer distance of high intensity running when playing an international game than when playing a domestic league game (Andersson et al., 2010; Gabbett and Mulvey, 2008). Krustrup et al. (2005) concluded that YYIRTL1 (Yo-Yo intermittent recovery test level 1) is a good predictor of elite female soccer player's ability to perform high-intensity running throughout competitive matches and it can be used as an indicator of physical match performance. In addition, it has been shown that power has great impact in soccer and can contribute directly to winning possession of the ball and to scoring or conceding of goals (Chamari et al., 2008; Matkovic et al., 2003). Agility is very important when it comes to soccer players (Miller et al., 2006; Thomas et al., 2009). Not only do they use it to outmaneuver the opposition but it also helps in preventing injuries (Jovanovic et al., 2010).

A number of field tests are often used to evaluate physical performance. The assessment of physical performance is commonly used to identify talent, monitor training interventions and observe normal growth and development patterns (Vescovi et al., 2009). Various physical performance tests have been used in soccer in order to make the difference between levels of play (Reilly et al., 2000; Franks et al., 1999) as well as to classify positional differences for male soccer players (Reilly et al., 2000; Franks et al., 1999; Matkovic et al., 2003). Specifically, it has been found that the midfielders have the highest aerobic capacity (Reilly et al., 2000; Matkovic et al., 2003). It has also been reported that vertical jumping ability is greater in forwards and defenders compared to midfielders (Wisloff et al., 1998). In addition, goalkeepers and defenders are taller and have greater body mass compared to midfielders and attackers (Reilly et al., 2000; Franks et al., 1999). There are several factors that could influence the female level of fitness. The nature of the annual soccer calendar and the fact that most female soccer players mainly train and play on a part-time basis could be one of the factors according to Polman (2004). In order to effectively use this small amount of time it is essential to know more about the performance of female soccer players.

The main aim of this study was to describe physical performance characteristics of top Serbia female soccer players. In addition, aim of the study was to examine positional differences in this sample of athletes.

## 2 Method

### 2.1 Subjects

Research was performed on a sample of 22 elite female soccer players from Serbian A-national team (aged  $23.95 \pm 4.52$ , body height  $168.82 \pm 7.19$  cm, body weight  $61.4 \pm 6.0$  kg). The subjects were the following: 2 goalkeepers, 4 attackers, 8 midfielders and 8 defenders (Table 1).

Testing was performed during the preparation of national team, in February 2009. Before testing, subjects gave their approval for this research. The protocol of the study was approved by the Ethical Committee of the Faculty of Sport and Physical Education, University of Nis, according to the revised Declaration of Helsinki. The study protocol was held for every subject. Beside the results, the basic anthropometric parameters

(body height-TV and body weight-MT) and the age of the players were registered in the study protocol. Power and endurance tests were held at the same day.

Table 1. Subject characteristics.

	<b>Mean±SD (n=22)</b>	<b>Goalkeepers (n=2)</b>	<b>Attackers (n=4)</b>	<b>Midfielders (n=8)</b>	<b>Defenders (n=8)</b>
Age (years)	23.9±4.5	23.0±1.4	24.5±2.6	26.2±6.3	21.6±2.2
Body weight (kg)	61.4±6.0	59.5±10.6	59.7±2.9	62.7±7.7	61.37±5.2
Body height (cm)	168.8±7.2	172.5±3.5	164.7±5.0	168.7±8.7	170.0±7.2

## 2.2 Testing procedure

Body height and body weight were measured according to the instructions of the International Biological Program–IBP (Weiner and Lourie, 1969). The body height was measured with a GPM anthropometer (Siber & Hegner, Zurich, Switzerland ) to the nearest 0.1cm. Body weight was obtained by TANITA BC 540 (TANITA Corp., Arlington Heights, IL) to the nearest 0.1 kg.

The tests for the linear speed and agility were performed from a standing start and measured by means of infrared photocells Uno Lux (The Republic Institute for Sports, Belgrade, Serbia). The following tests were used for measurement of speed and agility with and without the ball: 10-m Sprint (S10), Flying 20 m Sprint (LS20), 30-m Sprint (S30), Zigzag Test (CC), Zigzag With the Ball (CCL). Flying 20 m Sprint test assessed the sprinting ability over a short distance, which should be of particular importance for soccer (Hoff and Helgerud, 2004). The running time along 20 m following the 10 m maximal acceleration was measured. As a consequence, the subjects were instructed to run with maximal speed over 30 m, and both the 10 m and the 20 m tests were obtained from the same trial. The Zigzag Test assessed running agility from changes in direction. A zigzag course consisted of 4-5 m sections set out at 100° angles. Zigzag With the Ball is the ability to control the ball while changing direction was assessed. Subjects were instructed to run with the ball as fast as possible along the same zigzag path used in the previous test. Time was recorded in 100ths of a second, and the average value from 3 sprint attempts was taken into consideration as a final result. Before each testing the subjects performed a standard 25 minute warm-up. During the test air temperature ranged from 22°C to 25°C. It began at 10 am and finished by 1 pm. All sprint tests were performed on a grass sports field, and the players wore soccer shoes to replicate the playing conditions.

For the estimation of the explosive strength of lower extremities three tests have been used: Squat jump (SJ), counter movement jump (CMJ) and counter movement jump with arm swing (CMJZ). Ergotester jump system (Globus, Italy) was used to estimate vertical jump height in SJ, CMJ and CMJZ. The tests on the contact platform were done twice with adequate rest between attempts and for further analyses better result was taken. Ten minutes after this tests, physical match performance was measured. Yo-Yo intermittent recovery test level 1 (YYIRL1) was used for measuring the physical match performance (Bangsbo et al., 2008).

## 2.3 Processing the data

The Statistical Package for Social Studies SPSS (v17.0., SPSS Inc., Chicago, IL) was used for statistical analysis. Descriptive statistics were reported as mean  $\pm$  SD for all measures with special analysis for positions in team. A one-way ANOVA was used to examine if differences exist between four positions: attackers, midfielders, defenders and goalkeepers. The statistical significance was set at  $p<0.05$ .

### 3 Results and Discussion

Table 2. General descriptive parameters of the sample.

	<b>X<math>\pm</math>SD (n=22)</b>	<b>Goalkeeper s (n=2)</b>	<b>Attackers (n=4)</b>	<b>Midfielders (n=8)</b>	<b>Defenders (n=8)</b>
SJ (cm)	26.4 $\pm$ 3.5	24.4 $\pm$ 5.8	25.9 $\pm$ 5.3	26.1 $\pm$ 2.6	27.5 $\pm$ 3.3
CMJ (cm)	30.2 $\pm$ 3.5	29.3 $\pm$ 3.2	30.5 $\pm$ 5.9	28.6 $\pm$ 2.5	31.8 $\pm$ 2.9
CMJZ (cm)	35.7 $\pm$ 4.2	33.4 $\pm$ 4.0	37.5 $\pm$ 4.2	32.9 $\pm$ 3.3	38.3 $\pm$ 3.6
YYIRL1 (m)	892.7 $\pm$ 197.6	780.0 $\pm$ 84.8	900.0 $\pm$ 200.0	930.0 $\pm$ 239.8	880.0 $\pm$ 190.0
S10 (s)	1.93 $\pm$ 0.08	2.00 $\pm$ 0.05	1.90 $\pm$ 0.14	1.94 $\pm$ 0.07	1.91 $\pm$ 0.05
LS20(s)	1.41 $\pm$ 0.05	1.43 $\pm$ 0.06	1.39 $\pm$ 0.09	1.40 $\pm$ 0.02	1.43 $\pm$ 0.04
S30(s)	3.34 $\pm$ 0.12	3.43 $\pm$ 0.01	3.30 $\pm$ 0.23	3.38 $\pm$ 0.10	3.31 $\pm$ 0.07
CC(s)	5.68 $\pm$ 0.20	5.62 $\pm$ 0.15	5.66 $\pm$ 0.36	5.72 $\pm$ 0.17	5.66 $\pm$ 0.21
CCL(s)	7.56 $\pm$ 0.39	7.43 $\pm$ 0.76	7.40 $\pm$ 0.44	7.47 $\pm$ 0.34	7.74 $\pm$ 0.35

SJ - Squat jump, CMJ - Countermovement jump, CMJZ - Countermovement jump with arm swing, YYIRL1 - Yo-Yo intermittent recovery test level 1; S10- Sprint 10 m; LS20- Sprint 20 m; S30- Sprint 30 m; CC- Zigzag; CCL- Zigzag with ball

Descriptive statistics showed no significant deviation in body height and weight among tested players depending on the positions in the team (Table 1). The goalkeepers were the tallest in the team with mean value of  $172.5 \pm 3.5$  cm, while the attackers ( $164.7 \pm 5.0$  cm) and the midfielders ( $168.7 \pm 8.7$  cm) were the smallest. The height of the players in this research are similar with the values of elite Croatian (Sporis et al., 2007) and Danish (Krstrup et al., 2005) female soccer players. The major difference is that they possess greater body mass ( $61.41 \pm 6.07$  kg) in comparison to the other researches (Mujiki et al., 2009; Krstrup et al., 2005). Table 2 shows descriptive statistics of tested variables. The YYIRL1 test's results have shown that all positions have similar value within range of 880-930 m. The deviation is noticed within the goalkeepers whose average value was  $780.0 \pm 84.8$  m. The average values of the YYIRL1 test  $892.7 \pm 197.6$  m are much smaller than the values found in the Danish (1379 m) and the Spanish ( $1224 \pm 255$  m) Premier League (Krstrup et al., 2005). The explanation could be found in the fact that during this research the female players were not physically well prepared since the research was carried out during the transition period.

The average values of the height of the vertical jump which are of the lower values than at the Mujiki et al. (2009). Greater body mass could cause the subtraction of the values of the leg's explosive power of the women involved in the research, which was confirmed by the results (Table 2). Linear sprint speed is considered an essential element for successful performance in sports requiring athletes to guard an opposing player or being able to receive a pass (Vescovi et al., 2007). Moreover, a recent study reported that 96% of sprint bouts during a soccer game are shorter than 30 m, 21 with

49% being less than 10 m (Wisløff et al., 2004). Linear sprint times are shown in Table 2. Because of the different protocols and distance during testing the authors could not compare the results with other studies.

Table 3. Results of one-way ANOVA.

	F	p
SJ (cm)	,479	,701
CMJ (cm)	1,149	,356
CMJZ (cm)	3,588	,034*
YYIRL1 (m)	,292	,831
S10 (sec)	,865	,477
LS20(sec)	1,134	,362
S30(sec)	1,041	,398
CC(sec)	,179	,909
CCL(sec)	,919	,453

\* significant difference between defenders and midfielders

SJ - Squat jump, CMJ - Countermovement jump, CMJZ - Countermovement jump with arm swing, YYIRL1 - Yo-Yo intermittent recovery test level 1; S10- Sprint 10 m; LS20- Sprint 20 m; S30- Sprint 30 m; CC- Zigzag; CCL- Zigzag with ball

Nevertheless, the research has shown that elite players who were faster (15 and 30 meters), could jump higher, had better agility, and were more aerobically fit (Vescovi et al., 2006), so we could speculate that our results in sprint and agility tests were lower than those in other studies with elite female soccer players. However, in recent study, vertical jump height was shown to be significantly related to short sprint performance in well-trained elite soccer players. (Chamari et al., 2008). In contrary, Little and Williams' (2005) results suggest that straight speed and agility training methods produce specific gains in performance that have limited transfer to the other performance mode. A one-way ANOVA has shown no significant differences among positions for linear sprinting tests, agility tests with and without the ball and Yo-Yo intermittent recovery test level 1 (YYIRL1). In addition, there were no significant differences among positions for SJ and CMJ tests. The only significant difference among positions was in counter movement jump with arm swing (CMJZ test). Difference was found between defenders and midfielders which may be the result of the fact that defenders are being involved in more frequent bursts of acceleration. In addition, Wisloff et al. (1998) stated that vertical jumping ability is greater in forwards and defenders compared to midfielders.

#### 4 Conclusions

Physical characteristics of elite Serbian female soccer players do not significantly differ depending of their position in the team. The values of their physical performance are lower than those in some other studies that included professional players. These days, the importance of having good physical fitness is essential for elite sport. This is

especially important for soccer. The ability of a player to be quick, powerfully and with great endurance plays a significant role in successful soccer performance.

By examining a variety of performance characteristics, which are believed to be advantageous for competition, and the conditioning training of elite female soccer players, we may be able to enhance ability of selection of the best possible soccer players for the athletic team or to determine the physiological demands of female soccer. Ideally, this would lead to enhanced conditioning and training strategies and improved performance. Several researches has come to conclusion that with intensive SAQ (speed, agility, quickness) training, improvement in the player's power performance could be achieved. Many coaches do not use the SAQ training in their training process because they are afraid of overtraining and injuries. One of the reasons why overtraining occurs in soccer is too much nonspecific endurance and power training (Jovanovic et al., 2010).

A limitation for this study is that no identification of training status was obtained before testing and that the research was carried out during the transition period. So, it was speculated that all participating athletes demonstrated peak performance. Within the constraints of these limitations the findings in the current study indicate little positional variations for elite Serbian female soccer players.

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## **Behaviour patterns of elite coaches working with elite student athletes.**

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### **Abstract**

*Jones (2006) proposed that “coaching remains an ill defined and under theorised field”. Of the studies that have been produced they mostly come from America, little is known about British coaches. The aim of this work was to analyse the behaviour of elite coaches and add to the theory and knowledge in Britain and enable the comparison of their behaviour patterns.*

*The analysis of four elite coaches involved in football, basketball, pole vaulting, and squash working with elite athletes in university was performed through four hours of recording the coaches in their training sessions. The investigation used a combination of the behaviours used by More and Franks (1996) and Tharp and Gallimore (1976) and after hand notating the recordings total amounts of time for each behaviour were calculated and then compared against each other.*

*The results showed the coaches performing consistently throughout their four sessions, and surprisingly there were no significant differences ( $p<0.05$ ) between the behaviours of the four coaches. Instruction, organisation, positive demonstration, and praise were the behaviours that were consistently used more by all coaches. From the findings it was able to produce times for a set behaviour pattern for elite coaches as shown in Table 7.*

*Although the statistical tests showed no significant differences between the coaches, diversity was seen throughout the data sets, suggesting how coaches may be different and universal behaviour sets are not possible. The results stimulate many questions for discussion and further research, including, why coaches are similar, why they are not, how testing procedures may affect the findings and how future research should be performed.*

### **1 Introduction**

Sports' coaching, as a scientific discipline, has grown over recent years and has been recognised as an important process where all stages are linked together rather than a random collection of separate learning environments (Lyle, 2002). A sports coach when giving instruction needs a wide range of skills that vary from planning and organisation of training to the presentation of instruction and feedback information (More & Franks, 1996).

Effective instruction is essential in the quest for the best sporting performance. To be able to have more effective instruction would mean the more the coach's role will benefit an athlete's performance (Franks *et al*, 2001).

Coaches should be able to know if they are effective or ineffective (Pyke, 2001) and, although most coaches don't perform in or have the measures to evaluate their own skills and abilities, analysis of coach behaviour can be very productive (More & Franks, 1996). If a coach was able to review data analyses of their own behaviours, they would be able analyse if they perform in the correct way and hence decide where and how they need to change their behaviours to become more effective and a higher standard coach. Although a variety of sports and levels have been studied, they have mostly come from America, (Millard, 1996; Miller, 1992; Claxton, 1988) little is known about British youth coaches (Cushion, 2001, cited in Smith & Cushion, 2006).

To be able to provide quantitative analysis of such coaches in the instructional process (providing information, coaching) it would help highlight the objective assessment of instructional behaviour and would give information on variables believed to be important in determining effectiveness (Hughes & Franks, 1997).

Therefore the aim of this research was to analyse the behaviours of elite level coaches in Britain, and compare the respective behavioural patterns from both an inter-coach and intra-coach perspective, irrespective of their different sports.

## 2 Methodology

### 2.1 Instruments/Apparatus

The scoring sheet used to transcribe the information collected was a hand notated tally system which compromised a list of the performance indicators being analysed. This list of behaviours and their definitions were produced by the investigator selecting what they perceived to be important performance indicators from the behaviours used in previous research of More and Franks (1996) and Tharp and Gallimore (1976). A definition of each behaviour is shown below:

Table 1. Behavioural category sets and their operational definitions.

<i>Individual Group</i>	a single person. two or more people.
<b>Skill Related</b>	
<i>Instruction</i>	how performance should be performed.
<i>Correct</i>	saying why performance was good.
<i>Incorrect</i>	saying why performance was wrong.
<i>Before</i>	comments made pre-performance/task.
<i>During</i>	while the performance/exercise is being carried out.
<i>Stopped</i>	the coach interrupts performance (stops it) to comment.
<i>After</i>	performance/exercise is finished.
<i>Demonstration</i>	performance is re-enacted by coach or someone else.
<i>Positive demonstration</i>	demonstration of a correct performance.
<i>Negative demonstration</i>	demonstration of an incorrect performance.
<i>Questioning</i>	asks the athlete about performance, e.g. what are the four principles of play when defending in football?

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<b>Non Skill Related -</b>	
<i>Praise</i>	verbal/non verbal compliments relative to performance.
<i>Scold</i>	verbal/non verbal behaviours of displeasure towards a performance.
<i>Hustle</i>	comments of encouragement, or effort, e.g. hurry up, let's go.
<i>Organisation</i>	detail of how to function, e.g. start over there, change positions.
<i>Non specific</i>	comments not related to performance/the training session.
<i>Behaviour</i>	refers to the athletes conduct.
<i>Silence</i>	when no comments are being said, e.g. when none of the other behaviours are being used.
<b>Behaviours not categorised -</b>	
<i>Other</i>	comments that are not related to the behaviours above, this could range from humour, questions not related to performance, comments when refereeing a game situation, giving definitions, describing situations etc.
<i>Unrecordable –</i>	comments that were not coded, this could be from not being able to hear the comments, possibly from equipment faults, unable to understand the coach, unsure of what was meant.

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The recording equipment used to gather the data included a Sony HDR-HCIE digital camera and a Sennheiser EW500 microphone.

Reliability was performed by using an intra-operator re-test method. By analysing the two sets of data it was possible to calculate percentage error (Hughes et al., 2002) to show the margin of difference possible due to operator error. The difference between the two pilot tests when the intra-operator test was applied on a 60 min coaching session, resulted in 15 seconds of difference, this was a small difference between the two, and was put down to observer error. The percentage error test, ( i.e. % error =  $[(V_1 - V_2)/V_M] * 100$ , (where  $V_M$  is the mean of the 2 tests) ), gave a result of 0.054. This is a small error margin, which would suggest the data gathering methods were reliable.

## 2.2 Participants

The investigation involved four coaches, three of the subjects were male, along with one female. The sports being analysed were two from team sports and two from individual sports, to be able to get a range of data collected to investigate the comparison between coaching within the different sports. The sports involved were basketball, squash, pole vault, and football. The analysis of the four elite coaches was performed on four hours of video recording of the coaches regular coaching/training sessions.

Time was an issue within the investigation therefore affecting the amount of subjects able to use and the time eligible to collect data from them, e.g. data would have to be collected from a small section of the season instead of having data spread from a range of sessions throughout the season, e.g. beginning, middle and end. And, very importantly, the 4 sessions for each coach were randomly collected - no chance to organise homogeneity of intent in the sessions.

Due to the restriction of easily accessible subjects available to the investigation, the study could only provide a small population. The investigation used coaches that were

available from one university; therefore other elite coaches from around the country were not taken into consideration. This is also the case for the athletes whom they were coaching; all athletes although being of high standard (nationally ranked or equivalent), were from the same university so a range of subjects from different areas was not possible.

### **2.3. Procedure**

Once the consent of the coaches and their athletes had been obtained, a pilot test was performed to enable practice time with the hand notation system. The data were collected over a four week period by recording the coaches in their normal coaching environment, with the digital camera and microphone, during the training sessions of the athletes for a total of four hours each, broken down into one hour sessions at a time, although the squash recording had one half an hour session and a hour and a half session as part of its data collection. Once all information was collected the data analysis was performed by replaying the video footage and notating the data onto the tally sheets to find the results of the experiment.

### **2.4. Design and Analysis**

When viewing the recorded information, the investigator recorded how long each behavior was performed along with if it is used in a group or individual situation before, during, after or when a performance is stopped onto the scoring sheet. This information was then calculated in the Microsoft Excel to gain a total amount of time for each behaviour, as well as being described as a percentage of the overall session in relation to the other performance indicators. The results of each coach was placed into the software package SPSS to perform a non parametric independent Kruskal-Wallis test to see if there was a significant difference with the results. Then the coaches were compared against each other, using the percentages from the behaviours in relation to the whole 14400 seconds of recording to see if there was a relationship between each coach and their coaching behaviours.

## **3 Results and Discussion**

### **3.1 Variation within**

#### **3.1.2 Coach A**

Coach A (basketball) had large differences between the total percentages of the behaviours used. When examining the individual data for each session it can be seen there are differences in each behaviour, this is reflected in the p values from a Friedman significance test shown in Table 6. Instruction for example was used for 707 seconds in one session and only 356 seconds in another. Questioning was another behaviour where differences were apparent, having 33 seconds between the highest and lowest recordings. Praise, scold, correct and other also showed differences in one behaviour through the four sessions. Similarities were also found however, e.g. hustle, incorrect, behaviour, all show that their use was kept the same during the sessions. These are shown in the standard deviation scores in table 2, with some producing scores over 100 and others below 10.

### **3.12 Coach B**

The results of coach B (pole vault) again showed differences in their data; however it was different behaviours that produced the differences. Instruction was kept consistent as were praise, scold, and organisation. Negative demonstration, correct, questioning all show areas of difference. Differences were also seen where correct and incorrect were used more compared with other coaches.

### **3.13 Coach C**

The football coach had two behaviours that were far apart from the others, instruction (17.5%) and organisation (6.1%) were used a lot more than the others that all produced percentages around 2% or below. Despite this instruction and organisation still showed variation in its use, both showing standard deviation results of 100 or more. The other behaviours were more consistent, with their standard deviations being a lot less.

### **3.14 Coach D**

Significant differences within the data were apparent (Table 6). Instruction, positive demonstration, organisation and praise, all had large differences noticed between the four training sessions. These were attributed to the very different intentions expressed by the coach in the aims of each of his sessions. A few standard deviations scores would suggest that some behaviours were less fluctuating, including correct, negative demonstration, and scold.

## **3.2 Variation between coaches**

Table 2. Times the basketball coach spent using each behaviour.

Behaviour	Basketball				Overall total secs)	Totals (%)
	Time on each session (secs)					
instruction	410	356	406	707	1879	13.0
correct	18	2	5	26	51	0.4
incorrect	29	24	27	52	132	0.9
Positive demonstration	213	160	54	251	678	4.7
negative demonstration	27	13	23	31	94	0.7
organisation	168	168	127	224	687	4.8
hustle	21	27	27	24	99	0.7
praise	83	26	101	83	293	2.0
scold	21	7	1	2	31	0.2
non specific	0	0	0	2	2	0.0
behaviour	0	0	0	0	0	0.0
questioning	9	18	3	36	66	0.5
unrecordable	28	5	273	139	445	3.1
other	164	50	91	82	387	2.7
silence	2409	2744	2462	1941	9556	66.4
<b>Total (not including silence)</b>	<b>1191</b>	<b>856</b>	<b>1138</b>	<b>1659</b>	<b>4844</b>	
Total (including silence)	3600	3600	3600	3600	14400	

All coaches showed differences in their own data, and when the coach's data were compared against the others, differences were still noticeable. The mean score for the

basketball coach when giving praise was shown as 73 seconds (table 2); this is very different to the pole vault coach who had a score of 173 seconds. Other examples are apparent where there seems to be big differences between coaches, e.g. instruction, pole vault = 338, basketball = 470, football = 630. Many of the standard deviations also have a large range, e.g. the football coach has a deviation of 100 for organisation, and basketball has 160 for instruction, this demonstrates how the coach's performance of that behaviour could change by that number either up or down, meaning there is a large range of time where the use of the behaviour could be.

Table 3. Times the Pole Vault coach spent using each behaviour.

Behaviour	Pole Vault				Overall total (secs)	Totals (%)
	Time on each session (secs)					
instruction	336	304	271	439	1350	9.4
correct	60	77	44	42	223	1.5
incorrect	48	65	112	149	374	2.6
Positive demonstration	96	61	92	107	356	2.5
negative demonstration	15	6	9	8	38	0.3
organisation	132	185	99	144	560	3.9
hustle	22	9	17	23	71	0.5
praise	133	163	131	122	549	3.8
scold	3	4	7	0	14	0.1
non specific	4	6	25	8	43	0.3
behaviour	0	0	0	2	2	0.0
questioning	48	18	22	13	101	0.7
unrecordable	77	0	20	55	152	1.1
other	68	113	61	80	322	2.2
silence	2558	2589	2690	2408	10245	71.1
<b>Total (not including silence)</b>	<b>1042</b>	<b>1011</b>	<b>910</b>	<b>1192</b>	<b>4155</b>	
Total (including silence)	3600	3600	3600	3600	14400	

Jones (2002) examined the timing of instruction when performing their case study on a single coach; they found that 61% of comments made were during a performance of the athletes, second was by stopping an exercise with 30% and after an exercise was performed only 9% on instruction was given. The coaches used in the present investigation produced different results compared to Jones (2002) as well as different results to each other. The basketball coach gave most instruction before an exercise (41.2%), the pole vault coach gave 61.7% of their instruction after exercise, and the football coach gave most during (32.5%), while the squash coach gave the majority of their instruction before exercise (49.5%). This is an area that would warrant further research into why comments happen when they do.

Borrie (1996, pp 246) stated that “it is now widely accepted that there is no one single personality that is ideal for coaching”, (pp 248) “it is now accepted that there is no universal behaviour pattern that provides optimal coaching effectiveness in all situations”. Borrie (1996) claimed that research shows that the characteristics of an athlete, e.g. age, maturity, experience, and ability control the type of coaching behaviours produced by the coach. As the present investigation involved athletes all

within two to three years of each other, all playing at a high standard, this could explain why results were similar, as Borrie's literature would suggest they all want/need the same type of coaching.

Table 4. Times the football coach spent using each behaviour.

Behaviour	Football				Overall total (secs)	Totals (%)
	Time on each session (secs)					
instruction	702	734	575	509	2520	17.5
correct	0	0	2	0	2	0.0
incorrect	47	33	23	16	119	0.8
Positive demonstration	68	144	58	44	314	2.2
negative demonstration	0	2	0	2	4	0.0
organisation	299	308	171	104	882	6.1
hustle	61	49	47	19	176	1.2
praise	41	39	66	43	189	1.3
scold	17	31	10	8	66	0.5
non specific	3	13	0	5	21	0.1
behaviour	18	11	44	3	76	0.5
questioning	32	26	19	36	113	0.8
unrecordable	6	14	286	52	358	2.5
other	79	71	70	62	282	2.0
silence	2227	2125	2229	2697	9278	64.4
<b>Total (not including silence)</b>	<b>1373</b>	<b>1475</b>	<b>1371</b>	<b>903</b>	<b>5122</b>	
Total (including silence)	3600	3600	3600	3600	14400	

Table 5. Times the squash coach spent using each behaviour (normalised).

Behaviour	Squash				Overall total (secs)	Totals (%)
	Time on each session (secs)					
instruction	434	139	328	511	1412	9.8
correct	4	10	13	18	45	0.3
incorrect	18	9	40	32	99	0.7
Positive demonstration	38	29	105	116	288	2.0
negative demonstration	10	0	10	18	38	0.3
organisation	42	48	90	228	408	2.8
hustle	28	11	8	16	63	0.4
praise	124	32	86	19	201	1.4
scold	4	2	2	14	22	0.2
non specific	0	0	0	4	4	0.0
behaviour	0	0	0	2	2	0.0
questioning	2	6	18	39	65	0.5
unrecordable	18	5	0	59	82	0.6
other	94	54	120	102	370	2.6
silence	2784	3254	2780	2422	11240	78.1
<b>Total (not including silence)</b>	<b>816</b>	<b>346</b>	<b>820</b>	<b>1178</b>	<b>3160</b>	
Total (including silence)	3600	3600	3600	3600	14400	

Table 6. The p values from a Friedman significance test when the coaches four sessions are compared against themselves and when the four coach's data were compared against each other.

<b>basketball</b>		<b>pole vault</b>		<b>football</b>		<b>squash</b>	
N	14	N	14	N	14	N	14
Chi-square	11.390	Chi-square	1.147	Chi-square	5.776	Chi-square	17.885
df	3	df	3	df	3	df	3
Asymp.	.010	Asymp.	.766	Asymp.	.123	Asymp.	.000
Sig.		Sig.		Sig.		Sig.	

### 3.3 Similarities between coaches

However in each of the coach's results, many similarities were provided as well. The first comparison was that silence was the most used behaviour by every coach (66.4%, 71.1%, 64.4%, 79.7%), this would be where the coach is watching/monitoring the athletes when they are performing in exercises/drills. As the sessions being recorded were the athletes training sessions then it would seem normal that they were performing in many exercises, therefore right for the coach to be watching these, to be able to analyse the performances. As this seems obvious it is the other behaviours that the coach performs around the exercises that should be looked at with interest as these are what affect the athlete and overall performance of the session/skill. Without including silence therefore, the percentages of skill related and non skill related comments were calculated. The data showed that skill related comments were the most common by every coach roughly by a 60 – 40 split. Although similar for the coach in this investigation it was not for Jones (2002), she found that the majority of the comments were non skill related (57%), this would show a difference between elite level coaches.

The most common, and regularly used behaviour with all coaches, was instruction. This set of data is similar to those of Jones (2002), as the highest skill related comment was instruction with the majority of 33% of the 43% skill related comments; Tharp and Gallimore (1976) also found that the majority (over half) of comments made by their coaches were instructional, where the coaches in their experiment were predominantly engaged in instruction. As a lot of previous research has also found results similar to these where instruction is a large part of the coaching behaviours, then it would seem that these results help prove that elite coaches use and need a lot of instruction in their coaching to help the athletes. This is supported by Hodges and Franks (2004), who claim that it appears decisive that coaching includes comments of informational content. However Harris-Jenkins and Hughes (1995) discovered different results, showing organisation was the largest behaviour used, although these differences in the data can be rationalised as the coaches were working with youngsters (other research was with the elite) who may need treating differently and just need to be set up ready to play (organisation) as not so much detail in performance is needed.

All coaches produced demonstrations during their sessions and again of similar numbers, this information would therefore suggest that to help athletes and be a good

coach positive demonstration is required when in a coaching environment. Negative demonstration was not used much by any of the coaches (0.7% being the highest and 0% the lowest). This is thought to be due to coaches only reinforcing correct performance, and getting the athletes to model that. Negative demonstration was mainly used to help the coach describe and show the athlete how they went wrong, therefore helping to correct performance.

The results showed the coaches performing consistently throughout their four sessions, and surprisingly there were no significant differences ( $p<0.05$ ) between the behaviours of the four coaches. Instruction, organisation, positive demonstration, and praise were the behaviours that were consistently used more by all coaches. From the findings it was able to produce aggregate times for a model set of behaviour patterns for elite coaches as shown in Table 7.

Table 7. Summary analysis of the behaviour patterns of the coaches.

<b>Behaviour</b>	<b>% used</b>
instruction	12.4
correct	0.6
incorrect	1.3
positive demonstration	2.5
negative demonstration	0.3
organisation	4.4
hustle	0.7
praise	2.2
scold	0.2
non specific	0.1
behaviour	0.1
questioning	0.6
other	2.4
silence	70.0

#### 4 Conclusions

It was found that 2 elite coaches had no significant differences within their training sessions, 2 elite coaches had significant differences within their training sessions, but overall they were producing consistent behaviour patterns across the 14400 seconds of coaching.

The coaches had some significant differences between their behaviour patterns when compared against each other, showing significant difference between the coaching of team and individual sports.

Instruction, organisation, positive demonstration, and praise were the most common and frequently used behaviours.

These results suggest that elite coaches would perform in a similar manner within themselves and against each other when presented with the same type of athlete and environment with the same behaviours emerging the most.

#### *Future Directions*

The experiment could be developed to help provide more results and results that have more meaning and plausibility; this could be done in many ways.

Firstly to have more sessions in which the coaches would be analysed, this would help provide more data therefore having a bigger collection of the coach's behaviours which would produce more accurate stats on their performances.

If time permitted this could be done so the sessions recorded were stretched out over the length of a sporting season therefore seeing the coach at different times and how possible differences in their actions instead of just over a four week period. More coaches could be used within the investigation, again this would help in the clarity of the results as more data would be collected, seeing if it really is the same for all coaches.

This is also the case for having a larger variety of coaches, having coaches from others sports, and/or more than one coach from a single sport to see if there is a relationship.

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## The effect of match status on attacking strategies in the English Championship

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### Abstract

*Jones, James and Mellalieu (2004) found that the duration of possession was related to successful performance in the English Premier league and suggested this was primarily a function of skill level as opposed to strategy differences. Similar to Lago and Martin (2007) they also found that, independent of team level, teams had longer possessions when winning than when losing. Twelve matches from the 2010/11 season involving four English Championship teams (one league lower than the Premier) were analysed to assess whether strategy differences could be discerned between teams deemed as successful and unsuccessful. Two teams were classified as successful as they were in the top six league positions throughout data collection and two teams as unsuccessful as they occupied positions within the bottom six. Successful teams had longer possessions than unsuccessful teams when winning (mean = 18.21 seconds cf. 12.44 seconds; Mann Whitney U = 6911.5, p < .001) and drawing (mean = 20.50 seconds cf. 14.21 seconds; Mann Whitney U = 4323.0, p < .01). The sample did not contain periods when the successful teams were losing preventing this comparison although similar to previous research the unsuccessful teams had longer duration possessions when losing (mean = 14.09 seconds) in comparison to winning (Mann Whitney U = 5125.0, p < .05). The method of getting the ball into the final third differed between the successful and unsuccessful teams ( $\chi^2$  square = 22.99, df = 2, p < .001) with the successful teams preferring to use a pass to feet rather than an aerial pass which was the preferred method of the unsuccessful teams (Fig. 1). Both successful and unsuccessful teams did not alter their style of play in relation to match status. It therefore appears that ball entries into the final third appears to discriminate between successful and unsuccessful Championship teams with patterns of play maintained irrespective of match status. However the small sample analysed here may mean that these results only reflect these teams' performance.*

### 1 Introduction

Since Reep and Benjamin's seminal work in the 1960's (Reep and Benjamin, 1968) on passing frequencies leading to goal scoring, much scientific research has centred itself around team strategies and how best to score goals. Subsequent research has seemingly

created two contrasting schools of thought, namely those who advocate ‘possession’ football (e.g. Hook and Hughes, 2001; Grant, Williams and Reilly, 1999), characterised by patient build up of play, and those who advocate the direct approach to goal or ‘long ball game’, which suggests that getting the ball into the opposition penalty area as quickly and as often as possible will create more goal scoring opportunities (e.g. Bate, 1988).

More recently, research has attempted to describe team behaviours in response to match events or variables, as final score line by itself is insufficient in describing how a team has performed and is often influenced by chance (Lago, 2005). One such variable which can potentially affect performance is ‘evolving score line’. This refers to how the score changes through a match. For instance does a team have more possession of the ball when winning, as opposed to drawing or losing, or likewise increase the number of penalty area entries when in winning positions. A more detailed analysis of performance therefore allows a manager/coach a better understanding of how their team reacts to different situations in competitive conditions.

Jones, James and Mellalieu (2004) used evolving score to evaluate possessions for successful and unsuccessful teams. Their definition of evolving score was ‘all possessions that were categorised as taking place in a ‘drawing’ status and continue as such until a goal is scored.’ Their results suggested that successful teams had significantly longer possessions than unsuccessful teams irrespective of match status. Furthermore, both successful and unsuccessful teams had longer durations of possession when losing. Lago and Martin (2007) showed similar findings with possessions of Spanish La Liga teams (2003-4) having significantly longer possessions when in losing positions, as opposed to drawing or winning. Findings also suggested that match venue was linked with possession; with home teams having an average of 6% more possession than their opponents. The authors acknowledged that this may have been dependent on opposition strength.

The following investigation will analyse English Championship teams in an attempt to analyse whether any strategic differences could be detected between those teams deemed successful and unsuccessful. Specifically, attacking strategies will be looked at to determine if there are any fundamental differences in how these teams attempt to enter into the oppositions final third. Evolving score will be used to examine if behaviours change as a result of match status, e.g. longer passing sequences leading to final 1/3 entry when winning. Unlike, Jones, James and Mellalieu (2004) who excluded possessions of under 3 seconds, all controlled possessions which enter into the oppositions final third will be included for analysis. This is based on the findings by Horn, Williams and Ensum (2002) who found that 64% of possessions within zone 14 (the area directly in front of the penalty area) came from possessions of between 0.5 – 2.5 seconds. Also 46% of off target attempts from zone 14 were from possessions of just one second. If possessions of under 3 seconds were excluded then all of such possessions would be lost from any subsequent analysis. Indeed, these possessions may well be indicative of a ‘high press’ strategy to win the ball in advanced positions.

## 2 Method

Digitally captured match footage was transferred onto Focus X 2 ([www.elitesportsperformance.com](http://www.elitesportsperformance.com)) analysis package. During analysis footage was played back at a rate of 75% of normal match play speed to make identification of analysis criteria easier to record, i.e. eliminate miss keys. If the analyst was unsure of

an event then the footage was rewound and played back to ensure that coding was performed reliable (playback rate speed could also be altered to a slower speed at the analysts discretion).

## 2.1 Coding

The point at which the analysed team gained possession was recorded along with the area in which this event occurred (using pitch schematic illustrated in Fig. 1). Once the area start button was pressed, the time of the match would automatically be recorded. Footage was then played to the conclusion of the possession. If the possession passed into the attacking final third footage was played back with the method of ball transfer, from which area did the transfer occurred and the number of passes in the possession all recorded.

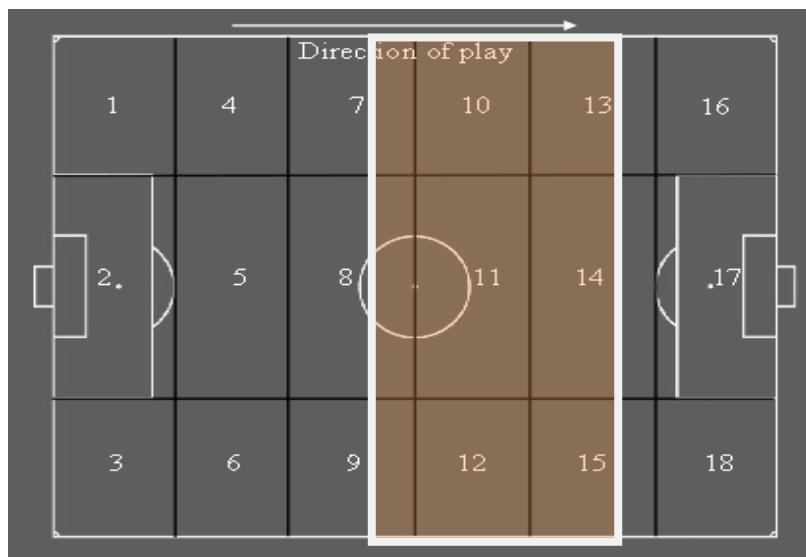


Figure 1. Pitch divided into 18 zones (attacking third highlighted).

## 2.2 Reliability

To ensure that data collection depicted a true representation of the events recorded a reliability study was performed to ensure consistency within the analysts coding process. One match was selected at random from the 12 available. This match was coded on two separate occasions, with a 3 week period between each event to negate any learning effect on the analyst. On completion the two data sets were compared using Bland and Altman limits of agreement ( ) to detect any significant differences in the coded results.

## 2.3 Statistical Analysis

Since the data was primarily frequency data non parametric statistics were used. The chi square test of independence was used to assess differences between successful and unsuccessful teams.

## 3 Results

Possessions which resulted in the ball being under control within the final (attacking) third of the pitch lasted on average 16.26 seconds (Fig. 2) with possession durations being skewed in favour of lower duration possessions.

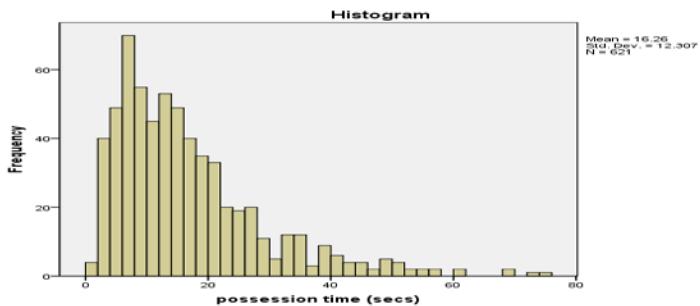


Figure 2. Frequency histogram of possession durations.

Successful teams had significantly longer duration possessions than unsuccessful teams when in drawing ( $U = 4323.0$ ,  $p < .01$ ) and winning ( $U = 6911.5$ ,  $p < .001$ ) positions (Fig. 3). No data was available for successful teams in a losing situation.

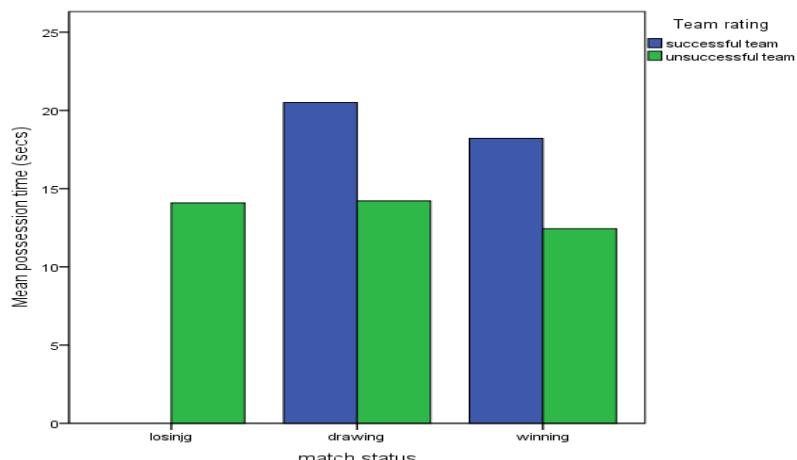


Figure 3. Possession durations for successful and unsuccessful teams for winning, drawing and losing situations.

Successful teams preferred to use a pass to feet rather than an aerial pass whereas the unsuccessful teams tended to play similar amounts of each pass ( $\chi^2 = 22.99$ ,  $df = 2$ ,  $p < .001$ ; Fig. 4).

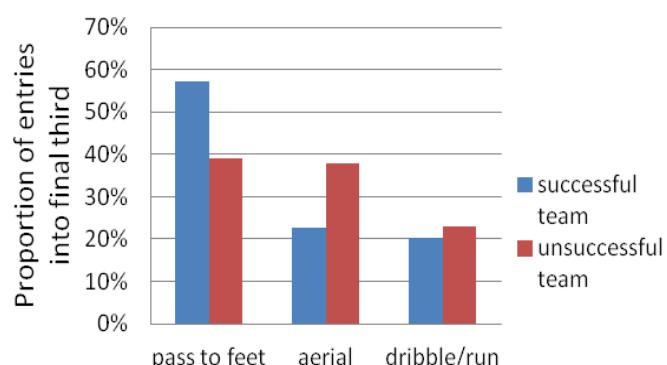


Figure 4. Method of ball entries into the final third by successful and unsuccessful teams.

Neither successful ( $\chi^2 = 0.05$ ,  $df = 2$ ,  $p = .97$ ) or unsuccessful ( $\chi^2 = 3.78$ ,  $df = 4$ ,  $p = .44$ ) teams altered their method of getting the ball into the final third in relation to match status (Fig. 5).

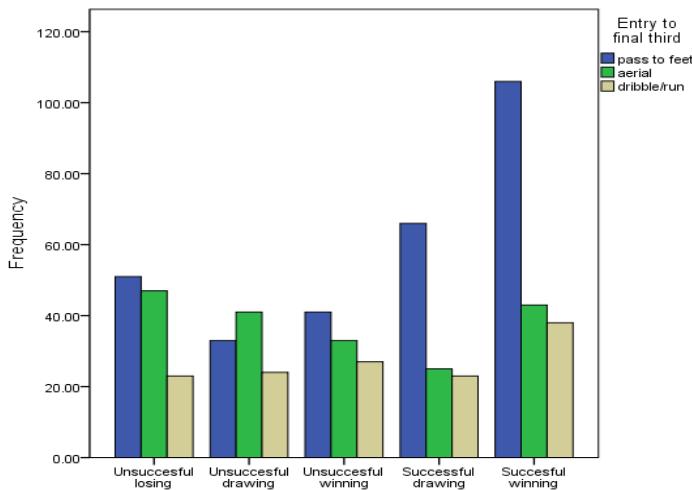


Figure 5. Method of ball entries into the final third by successful and unsuccessful teams for winning, drawing and losing situations.

#### 4 Discussion

The current investigation showed that successful teams had significantly longer possessions than unsuccessful teams when in both drawing and winning positions. This replicates findings by Jones, James and Mellalieu (2004) and Lago and Martin (2007). A lack of available data made any conclusions on successful team's behaviours winning in losing positions impossible to make. Jones, James and Mellalieu (2004) state that including equal numbers of matches where successful and unsuccessful teams are in winning, losing and drawing positions may not portray a true reflection of a successful team. For this reason the current data set picked matches for teams which were met the criteria for successful and unsuccessful at random. Jones, James and Mellalieu (2004) also suggested that successful teams kept possession better than unsuccessful teams when in winning positions and that this may be a tactic both to create scoring chances and prevent opposition chances. It appears that this is replicated in Championship teams.

Successful teams were shown to prefer to use passes to feet as opposed to aerial passes. Unsuccessful teams tended to play similar amounts of each type of pass. It may be concluded that this is due to the successful teams' ability to impose their style on match play, whereas unsuccessful teams were forced into more hasty aerial passes. It could also be suggested that it this attacking style that determines if a team is successful or not.

Neither successful nor unsuccessful teams changed their methods of ball transfer into the final third in relation to score line. This suggests that Championship teams play to their pre defined tactics and try to implement them irrespective of match situations.

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## Pace as an influencing factor in basketball

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### Abstract

*The purpose of the current study was to identify the critical performance indicators that distinguish between winning and losing performances in three different clusters based on the game pace (fast, average and slow rhythm), and to find the characteristic features of winning performances from different paced periods of basketball games.*

*Post event data analysis of all 26 games played by a Hungarian 1<sup>st</sup> division basketball team (Falco KC Szombathely) during the regular season in 2007/2008 was undertaken on shooting performance, rebounding performance, steals, turnovers, assist passes, shot blocks and suffered fouls. Types of offense were also recorded, as well as the type of defensive pressure on the shooting player. Data analysis was undertaken separately by quarters in order to consider the fluctuation of pace within matches. Based on the average number of team's ball possessions (Min = 15; Max = 24;  $m = 19.33$ ;  $SD = 1.62$ ), quarters were classified into three groups (low, average and high paced quarters) by using k-means cluster analysis. A series of Wilcoxon signed ranks tests were used for 29 variables to identify the indicators that differentiated between winning and losing performances at three different types of quarters. Kruskal Wallis H test was used to identify significant differences between the game related statistics of winning team performances at fast, average and slow paced quarters, and a series of Bonferroni adjusted Mann Whitney U post hoc tests were employed where there were significant differences between the three samples.*

*Winning and losing team performance in high paced quarters indicated that winning teams could be described as having better shooting performance, more effective defensive performance through steals and defensive rebounding as well as having more easy scoring opportunities from fast breaks. For average paced periods, 3 point shooting and domination in offensive and defensive rebounding differentiated winning and losing performance. During low paced periods winning teams had higher 3 point shooting percentages, scored more effectively from close distance and had significantly higher number of suffered fouls followed by more successful free throw performance than losing teams. Kruskal-Wallis tests indicated significant differences for winning performances at fast, average, and slow paced periods for the number of steals, the number of shooting opportunities under minimal defensive pressure, the number of fast breaks and the amount of scored points. Post hoc testing of differences between individual pairs of samples revealed that slow periods can be distinguished from fast and average paced quarters for all of the four performance indicators, but no significant differences were found for winning performances between fast and average paced quarters.*

*The results of the study indicated that for different paced periods, different sets of performance indicators distinguished winning teams from losing ones. The differences between winning team performances at high, average and low paced periods could be attributed to indicators related to fast break situations.*

## 1 Introduction

The purpose of the current study was to identify the critical performance indicators that distinguish between winning and losing performances in three different clusters based on the game pace (high, average slow rhythm) and to find the characteristic features of winning performances from different paced periods of basketball games.

Basketball is a time-dependent, goal throwing invasion game (Hughes and Bartlett, 2002), where duration of each ball possessions is limited by strict rules. Teams are forced to accomplish their offences by shooting attempts within the shot clock limit. Duration of ball possessions used up for offences are influenced by several factors such as offensive and defensive style of teams (Oliver, 2004), game situations at an actual score advantage or disadvantage ...etc. One of the most important indicators that may extend the duration of pall possessions is the offensive rebound. Getting an offensive rebound means that the shot clock is restarted and the ball is kept in offence; therefore teams have another scoring opportunity. The rhythm of play during a period can be determined based on the frequency of ball possession changes. The pace of play often changes within teams and within basketball games. Similarly to pace, score difference is also fluctuates and winning teams do not always win all the quarters, despite the eventual victory (Choi et al, 2006). Therefore in the current research, determination of game rhythm and data gathering of winning and losing performances was undertaken separately by quarters.

However crucial indicators that determine success in basketball were published by several authors (Akers et al, 1991; Choi et al, 2006; Dezman et al, 2002; Ibanez et al, 2003; Ittenbach et al, 1992; Ittenbach and Esters, 1995; Jukic et al, 2000; Mendez and Janeira, 2001; Reano et al, 2006a, 2006b; Sampaio and Janeira, 2003; Sampaio et al, 2010; Tirinic et al, 2002; Tsamourtzis et al, 2002) only few of these papers considered the importance of fluctuation of play within games. In a study of Choi et al (2006), analysis of performance variability relies on the fluctuation of outcome scores by quarters. Obtaining data from archival datasets that contain accumulated performance indicators of whole matches does not allow researchers to analyse the variability of performances within games. Moreover, those publications that process datasets of all the games from a whole championship, often use data normalization in order to hide differences occurred in game rhythm (Sampaio and Janeira, 2003; Reano et al, 2006a, 2006b) and do not consider pace as an influencing factor in basketball. Oliver (2004) also suggested applying data normalization when analysing score sheets so that longer term performances of several teams could be compared. However measuring performance per ball possession is an appropriate technique for the process of identifying winning and losing performances, this technique ignores pace differences within and between games and it is not necessary to use for comparison of data from single games. In a study of Sampaio et al (2010) the dominance of Team USA at the Beijing Olympic Games (2008) was analysed from the aspect of game pace. Pace was

described by the amount ball possessions per quarters. The researchers examined the game-related statistics that discriminate between fast- and slow-paced games played by USA's team, and key performance indicators relating to point differentials were also identified, but differences between winning and losing performances at different paced periods were not analysed. It was concluded by the authors that at fast-paced games, Team USA were able to make more interceptions that were followed by effective field-goal shooting.

Reviewing the research literature in basketball exposed that different game types based on the pace as an influencing factor has not been considered so far when distinguishing indicators between winning and losing team performances were analysed.

The rationale of the study is to provide important findings for coaching process in basketball. Based on the results, coaches will be able to obtain usable information in order to work out the winning strategy for those special score advantageous and disadvantageous situations when the rhythm of play has to be increased or decreased.

## **2 Methods**

### **2.1 Subjects and equipments**

Post event data gathering was undertaken from all 26 games played by a Hungarian 1<sup>st</sup> division basketball team (Falco KC Szombathely) during the regular season in 2007/2008. Focus X2 performance analysis software was used for data collection that was made separately by quarters in order to consider the fluctuation of pace within matches. Winning performances were determined based on the results of quarters. Performance data were collected from shooting performance (2 point successful and unsuccessful shots divided into shots from close distance and from far distance; successful and unsuccessful 3 point shots and free throws), rebounding performance in offence and in defence, steals, turnovers, assist passes, shot blocks, and suffered fouls. Types of offenses were also observed (fast break, offense against unsettled defence and against set defence), as well as the type of defensive pressure on the shooting player (without pressure, half or maximum pressure). Additionally, shooting percentages and offensive and defensive rebounding rates were calculated.

### **2.2 Processing the data**

Data of winning and losing performances from 104 quarters were organized into SPSS. 18. statistical package, in order to find differences that distinguish between two team performances while considering the fluctuation of rhythm within basketball games.

Based on the idea of Sampaio et al (2010), pace of the quarters were determined by the average number of ball possessions of the two opponents. The number of ball possessions can be estimated from standard statistical data (Oliver, 1991, 2004; Sterbenz, 2006) with the following equation:

$$\text{Ball possessions} = \text{Field Goal Attempts} + (\text{Free Throw Attempts} \times 0.4) + \text{Turnovers} - \text{Offensive Rebounds}$$

Offences terminate with either free throws or field goal attempts or turnovers. Oliver (1991, 2004) found that about 40 percent of free throw attempts end possession. Offensive rebounds are considered as part of ball possessions; therefore, have to be

deducted from the formula. Deviate from the suggestions of Oliver, the occurrences of free throw situations were precisely counted from the event list of the gathered data.

Based on the average number of team's ball possessions (Min = 15; Max = 24; M = 19.33; SD = 1.62), quarters were classified into three groups by using k-means cluster analysis. The final cluster centres are 17.4 ball possessions per team at slow paced quarters (n = 28), 19.2 at average paced (n = 46) and 21.3 at fast paced quarters (n = 30). Data from 4 average paced quarters in which the outcome score was tied were not considered while performance differences were tested between winning and losing performances.

Table 1. Analysis of fast paced and average paced quarters.

Performance Indicators	Fast paced quarters (n=30)		Average paced quarters (n=42)	
	Winners (mean $\pm$ SD)	Losers (mean $\pm$ SD)	Winners (mean $\pm$ SD)	Losers (mean $\pm$ SD)
Successful 3 point shots	2.9 $\pm$ 1.6**	1.7 $\pm$ 1.2	3.0 $\pm$ 1.7**	1.7 $\pm$ 1.3
3 point attempts	6.3 $\pm$ 1.9	5.3 $\pm$ 2.3	6.6 $\pm$ 2.1**	5.2 $\pm$ 2.1
%successful 3 point attempts	44.7 $\pm$ 23.5*	31.4 $\pm$ 24.1	44.2 $\pm$ 20.9**	31.0 $\pm$ 20.1
Successful far 2 point shots	1.0 $\pm$ 1.1*	0.5 $\pm$ 0.9	1.1 $\pm$ 1.1	0.8 $\pm$ 1.0
Far 2 point attempts	2.9 $\pm$ 1.7	2.3 $\pm$ 1.9	2.5 $\pm$ 1.6	2.3 $\pm$ 1.3
%successful far 2 point attempts	32.5 $\pm$ 32.7*	15.0 $\pm$ 23.3	38.1 $\pm$ 36.1	31.5 $\pm$ 35.8
Successful close 2 point shots	5.3 $\pm$ 2.3	4.9 $\pm$ 2.2	4.7 $\pm$ 2.3	4.0 $\pm$ 1.7
Close 2 point attempts	7.8 $\pm$ 2.7	8.6 $\pm$ 2.6	7.7 $\pm$ 2.6	7.5 $\pm$ 3.0
%successful close 2 pt attempts	68.9 $\pm$ 19.4*	56.7 $\pm$ 18.2	60.5 $\pm$ 18.5	55.7 $\pm$ 21.1
Successful free throws made	6.4 $\pm$ 4.1*	4.4 $\pm$ 3.1	4.7 $\pm$ 2.7	3.6 $\pm$ 2.7
Free throw attempts	7.5 $\pm$ 4.3	6.5 $\pm$ 4.2	6.0 $\pm$ 3.3	5.1 $\pm$ 3.6
%successful Free throws	82.8 $\pm$ 19.4**	65.8 $\pm$ 22.6	74.3 $\pm$ 25.7	66.4 $\pm$ 29.8
Offensive rebounds	2.5 $\pm$ 1.6	2.4 $\pm$ 2.2	3.2 $\pm$ 1.7**	2.0 $\pm$ 1.3
Defensive rebounds	7.6 $\pm$ 2.1***	5.3 $\pm$ 1.9	7.0 $\pm$ 2.1***	5.3 $\pm$ 1.9
Total rebounds	10.2 $\pm$ 2.2**	7.8 $\pm$ 3.2	10.2 $\pm$ 2.9***	7.2 $\pm$ 2.2
Offensive rebounding %	29.4 $\pm$ 13.9	21.8 $\pm$ 17.0	35.8 $\pm$ 15.5***	21.6 $\pm$ 13.6
Defensive rebounding %	76.6 $\pm$ 16.3*	64.7 $\pm$ 18.0	76.3 $\pm$ 16.7**	62.2 $\pm$ 15.8
Steals	2.5 $\pm$ 1.6*	1.6 $\pm$ 1.2	2.1 $\pm$ 1.3	1.5 $\pm$ 1.2
Turnovers	3.4 $\pm$ 1.6*	4.4 $\pm$ 1.9	3.0 $\pm$ 1.6*	3.7 $\pm$ 1.4
Assist passes	4.2 $\pm$ 2.2**	2.4 $\pm$ 1.6	3.4 $\pm$ 1.5**	2.3 $\pm$ 1.6
Blocked shots	0.6 $\pm$ 0.6	0.4 $\pm$ 0.6	0.8 $\pm$ 0.9	0.6 $\pm$ 0.8
Suffered fouls	6.4 $\pm$ 2.5	6.1 $\pm$ 2.5	5.8 $\pm$ 1.8	5.3 $\pm$ 2.2
Shots under min. def. pressure	6.7 $\pm$ 2.8*	5.1 $\pm$ 2.3	5.9 $\pm$ 2.8	5.0 $\pm$ 2.0
Shots under half def. pressure	2.8 $\pm$ 1.9	2.7 $\pm$ 1.6	3.1 $\pm$ 1.4	2.4 $\pm$ 1.4
Shots under max. defensive press	7.3 $\pm$ 2.5	8.4 $\pm$ 2.7	7.9 $\pm$ 2.3	1.5 $\pm$ 2.6

Fast breaks	$3.1 \pm 1.9^*$	$2.2 \pm 1.3$	$2.3 \pm 1.4$	$1.7 \pm 1.1$
Offenses against unsettled def	$1.3 \pm 1.2$	$0.9 \pm 1.3$	$0.9 \pm 1.0$	$0.7 \pm 0.8$
Offenses against set defence	$15.6 \pm 3.4$	$15.6 \pm 3.2$	$16.0 \pm 2.5^*$	$14.8 \pm 2.1$
Scored points	$27.7 \pm 4.5^{***}$	$20.2 \pm 4.8$	$25.1 \pm 4.6^{***}$	$18.4 \pm 3.3$

A series of Wilcoxon signed ranks test were used for 29 variables to identify the crucial indicators that differentiate between winning and losing performances at three different types of quarters. The level of significance was set at  $p < 0.05$ .

Kruskal Wallis H test was used to identify significant differences between the game related statistics of winning team performances at fast-, average-, and slow-paced quarters. The level of significance was determined at  $p < 0.05$  when Kruskal Wallis H tests were used. Application of Kruskal Wallis H test in SPSS does not provide any post hoc tests. Therefore, a series of Bonferroni adjusted Mann Whitney U tests were employed (recommended by O'Donoghue, 2010) to find differences between individual pairs of samples where there were significant differences between the three samples. In order to avoid type I error, the Bonferroni adjusted level of significance was determined at  $p < 0.017$  by dividing the threshold p value (0.05) by the number of pairs of groups ( $n=3$ ).

### 3 Results

Table 2. Analysis of low paced quarters.

Performance Indicators	Slow paced quarters (n=28)	
	Winners (mean $\pm$ SD)	Losers (mean $\pm$ SD)
Successful 3 point shots	$2.6 \pm 1.4$	$2.0 \pm 1.4$
3 point attempts	$6.0 \pm 2.6$	$6.6 \pm 2.0$
%successful 3 point attempts	$47.1 \pm 23.1^{**}$	$27.7 \pm 17.3$
Successful far 2 point shots	$1.0 \pm 1.1$	$0.9 \pm 0.9$
Far 2 point attempts	$2.5 \pm 1.7$	$2.3 \pm 1.6$
%successful far 2 point attempts	$36.0 \pm 34.0$	$36.3 \pm 35.9$
Successful close 2 point shots	$4.0 \pm 1.9^*$	$3.0 \pm 1.8$
Close 2 point attempts	$6.4 \pm 2.0$	$6.7 \pm 2.4$
%successful close 2 pt attempts	$63.4 \pm 23.0^{**}$	$43.6 \pm 20.5$
Successful free throws made	$5.1 \pm 2.8^{**}$	$3.0 \pm 2.1$
Free throw attempts	$6.2 \pm 3.2^{**}$	$4.2 \pm 2.1$
%successful Free throws	$83.4 \pm 16.3^*$	$64.7 \pm 33.1$
Offensive rebounds	$2.7 \pm 1.8$	$3.0 \pm 2.0$
Defensive rebounds	$7.1 \pm 2.0^{***}$	$4.8 \pm 1.5$
Total rebounds	$9.7 \pm 2.6^*$	$7.8 \pm 2.4$
Offensive rebounding %	$32.6 \pm 18.7$	$28.2 \pm 16.5$
Defensive rebounding %	$69.2 \pm 16.8$	$64.3 \pm 18.4$
Steals	$1.2 \pm 1.0$	$1.2 \pm 1.4$
Turnovers	$2.5 \pm 1.5$	$2.8 \pm 1.4$
Assist passes	$3.0 \pm 1.1$	$2.7 \pm 1.6$
Blocked shots	$0.5 \pm 0.7$	$0.4 \pm 0.7$
Suffered fouls	$5.9 \pm 1.6^{**}$	$4.7 \pm 1.6$
Shots under min. def. pressure	$4.7 \pm 2.1$	$4.7 \pm 1.8$

Shots under half def. pressure	$2.9 \pm 1.6$	$3.0 \pm 1.7$
Shots under max. defensive press.	$7.3 \pm 2.5$	$7.9 \pm 2.4$
Fast breaks	$1.4 \pm 1.1$	$1.2 \pm 1.2$
Offenses against unsettled defence	$0.9 \pm 0.6$	$0.6 \pm 0.8$
Offenses against set defence	$15.0 \pm 2.6$	$15.7 \pm 2.4$
Scored points	$23.5 \pm 4.4^{***}$	$16.6 \pm 3.4$

For average paced quarters, Wilcoxon signed ranks test expanded 11 performance indicators that distinguished winning and losing teams. Table 1 shows that the number of defensive rebounds, the amount of total rebounds and the offensive rebounding rate were the most important ones ( $p < 0.001$ ).

Analysis of slow paced periods showed that there were 9 discriminative performance indicators that differentiated successful and unsuccessful performances (Table2). The highest level of difference can be seen at the number of defensive rebounds ( $p < 0.001$ ). Kruskal-Wallis test disclosed significant differences between winning performances at fast-, average-, and slow-paced periods for the number of steals ( $p < 0.01$ ), the number of shooting opportunities under minimal defensive pressure ( $p < 0.05$ ), the number of fast breaks ( $p < 0.01$ ) and for the amount of scored points ( $p < 0.01$ ). Testing differences between individual pairs of samples did not reveal any distinguishing indicators when winning performances from fast- and average-paced quarters were compared. The Bonferroni adjusted Mann Whitney post hoc test exposed significant differences for the number of steals ( $U = 345.0$ ,  $z = -3.0$ ,  $p < 0.05$ ), the number of easy shots under minimal defensive pressure ( $U = 329.0$ ,  $z = -3.1$ ,  $p < 0.05$ ), the number of fast breaks ( $U = 277.5$ ,  $z = -3.8$ ,  $p < 0.05$ ) and for the scored points ( $U = 381.5$ ,  $z = -2.5$ ,  $p < 0.05$ ), when average-paced and slow-paced winning periods were analysed. Post hoc testing of differences between fast- and slow-paced quarters showed that the number of steals ( $U = 218.5$ ,  $z = -3.2$ ,  $p < 0.05$ ), the number of shooting opportunities under minimal defensive pressure ( $U = 181.5$ ,  $z = -3.7$ ,  $p < 0.05$ ), the number of fast breaks ( $U = 143.5$ ,  $z = -4.4$ ,  $p < 0.05$ ) and the scored points ( $U = 184.0$ ,  $z = -3.7$ ,  $p < 0.05$ ) all distinguished between the two samples.

Table 3. Comparison of winning team performances from fast paced, average paced and slow paced quarters.

Winning team performances Performance Indicators	Fast paced quarters (n=42) (mean $\pm$ SD)	Average paced quarters (n=38) (mean $\pm$ SD)	Slow paced quarters (n=20) (mean $\pm$ SD)	H values of Kruskal Wallis H
Successful 3 point shots	$2.9 \pm 1.6$	$3.0 \pm 1.7$	$2.6 \pm 1.4$	0.6
3 point attempts	$6.3 \pm 1.9$	$6.6 \pm 2.1$	$6.0 \pm 2.6$	0.9
%successful 3 point attempts	$44.7 \pm 23.5$	$44.2 \pm 20.9$	$47.1 \pm 23.1$	0.4
Successful far 2 point shots	$1.0 \pm 1.1$	$1.1 \pm 1.1$	$1.0 \pm 1.1$	0.2
Far 2 point attempts	$2.9 \pm 1.7$	$2.5 \pm 1.6$	$2.5 \pm 1.7$	1.4
%successful far 2 point attempts	$32.5 \pm 32.7$	$38.1 \pm 36.1$	$36.0 \pm 34.0$	0.4
Successful close 2 point shots	$5.3 \pm 2.3$	$4.7 \pm 2.3$	$4.0 \pm 1.9$	4.1

Close 2 point attempts	$7.8 \pm 2.7$	$7.7 \pm 2.6$	$6.4 \pm 2.0$	5.4
%successful close 2 point attempts	$68.9 \pm 19.4$	$60.5 \pm 18.5$	$63.4 \pm 23.0$	2.8
Successful free throws made	$6.4 \pm 4.1$	$4.7 \pm 2.7$	$5.1 \pm 2.8$	3.2
Free throw attempts	$7.5 \pm 4.3$	$6.0 \pm 3.3$	$6.2 \pm 3.2$	2.0
%successful Free throws	$82.8 \pm 19.4$	$74.3 \pm 25.7$	$83.4 \pm 16.3$	2.6
Offensive rebounds	$2.5 \pm 1.6$	$3.2 \pm 1.7$	$2.7 \pm 1.8$	3.3
Defensive rebounds	$7.6 \pm 2.1$	$7.0 \pm 2.1$	$7.1 \pm 2.0$	2.3
Total rebounds	$10.2 \pm 2.2$	$10.2 \pm 2.9$	$9.7 \pm 2.6$	0.6
Offensive rebounding %	$29.4 \pm 13.9$	$35.8 \pm 15.5$	$32.6 \pm 18.7$	2.8
Defensive rebounding %	$76.6 \pm 16.3$	$76.3 \pm 16.7$	$69.2 \pm 16.8$	3.8
Steals	$2.5 \pm 1.6$	$2.1 \pm 1.3$	$1.2 \pm 1.0$	13.2**
Turnovers	$3.4 \pm 1.6$	$3.0 \pm 1.6$	$2.5 \pm 1.5$	3.9
Assist passes	$4.2 \pm 2.2$	$3.4 \pm 1.5$	$3.0 \pm 1.1$	5.1
Blocked shots	$0.6 \pm 0.6$	$0.8 \pm 0.9$	$0.5 \pm 0.7$	3.3
Suffered fouls	$6.4 \pm 2.5$	$5.8 \pm 1.8$	$5.9 \pm 1.6$	1.1
Shots under min. defensive press	$6.7 \pm 2.8$	$5.9 \pm 2.8$	$4.7 \pm 2.1$	7.0*
Shots under half defensive pres	$2.8 \pm 1.9$	$3.1 \pm 1.4$	$2.9 \pm 1.6$	1.1
Shots under max. defensive press	$7.3 \pm 2.5$	$7.9 \pm 2.3$	$7.3 \pm 2.5$	1.4
Fast breaks	$3.1 \pm 1.9$	$2.3 \pm 1.4$	$1.4 \pm 1.1$	14.9**
Offenses against unsettled defence	$1.3 \pm 1.2$	$0.9 \pm 1.0$	$0.9 \pm 0.6$	2.0
Offenses against set defence	$15.6 \pm 3.4$	$16.0 \pm 2.5$	$15.0 \pm 2.6$	1.7
Scored points	$27.7 \pm 4.5$	$25.1 \pm 4.6$	$23.5 \pm 4.4$	10.0**

#### 4 Discussion

The results of the current study revealed that for different paced periods, different sets of performance indicators distinguished winning teams from losing ones. Winning and losing team performance in high paced quarters indicated that winning teams could be described as having better shooting performance, more effective defensive performance through steals, forced turnovers and defensive rebounding as well as having easier scoring opportunities without defensive pressure from fast breaks. Previous researchers agreed that winning teams create more fast break situations as a consequence of successful defence, moreover, outnumbering fast breaks enhance the efficiency of shooting performance (Ibanez et al, 2003; Sampaio and Janeira, 2003; Tsamourtzis et al, 2002; Tsamourtzis et al, 2005). For average paced periods, mainly 3 point shooting and domination in offensive and defensive rebounding differentiated winning and losing performance. During low paced periods winning teams had higher 3 point shooting percentages, scored more effectively from close distance and had significantly higher number of suffered fouls followed by more successful free throw performance than losing teams. The more effective shooting performance from close distance and the higher number of suffered fouls mean that during low paced periods winning teams in offence dominated the area under the basket either with post plays or with penetrations.

For each type of quarter, the number of defensive rebounds was identified as the most critical discriminative indicator between winning and losing performances. The

importance of getting rebounds both in offence (Dezman et al, 2002; Oliver, 2004) and in defence (Akers et al, 1991; Ittenbach et al, 1992; Ittenbach and Esters, 1995; Mendes and Janeira, 2001; Trninic et al, 2002; Tsamourtzis et al, 2002) was highlighted by previous researchers. One of the most important findings of the current research was that the interpretation of the amount of rebounds as critical performance indicators could be misleading when winning and losing team performances are compared. Because the higher the shooting percentage of a team, the lower the number of opportunities for getting offensive rebounds and the lower the chance for getting defensive rebounds for the opponent. The analysis of fast paced quarters identified significant differences between winning and losing performances for the number of defensive rebounds ( $p < 0.001$ ), but the level of significance was lower when defensive rebounding rate was considered ( $p < 0.05$ ). At average paced periods the level of significance was different between the amount of rebounds and the rebounding rate both in offence and in defence. The most conspicuous difference was occurred at the results of slow paced quarters. The identification of critical performance indicators between successful and unsuccessful teams showed high level of significance when the number of defensive rebounds was analysed ( $p < 0.001$ ). But there was not significant difference identified for the defensive rebounding rate ( $p > 0.05$ ). Therefore, the number of rebounds always should be related to rebounding opportunities both in offence and in defence.

The differences between winning team performances at high, average and low paced periods could be attributed to indicators related to fast break situations. Similarly to the findings of Sampaio et al (2010), winning team performances between fast, average and slow paced quarters can be distinguished by the number of steals that can referred to the efficiency of defensive performance. Due to the higher number of interceptions, the number of fast break situations was increased when the rhythm of play was higher. Creating outnumbering fast breaks accompany effective scoring opportunities without defensive pressure; therefore, the amount of scored points could be increased.

## 5 Conclusions

The results of the current research proved that the intensity of play took influencing effect on basketball performance. The variability of pace within games accompanied the changing performance of basketball teams, because different sets of critical performance indicators were found for fast, average and slow paced periods. The differences between winning team performances at different paced periods could be connected to indicators referred to fast break situations. The number of defensive rebounds was identified as the most important performance indicator that distinguished between winning and losing team performances for each type of quarters. However, interpretation of the amount of rebounds without considering the rebounding opportunities could be misleading. Therefore, rebounding rates should be counted both in offence and in defence, instead of measuring only the number of rebounds.

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## **Players' covered distance according playing level and balance between teams: A preliminary analysis in padel.**

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### **Abstract**

*Paddle has achieved great circulation in South America and Spain, where its practice has become a question of social interest called “paddle phenomenon”. Nevertheless very little is known about performance characteristics. This study analysed distance covered by players along the game, and how playing level and balance between teams were related with it. Fifteen matches (5 for each level: recreational, medium, and high) were analyzed with SAGIT system.*

*Total distance covered by players varied between 2588.6 m and 4035.3. Players' covered distance by game ranged between 130.2 m to high level and 175.4 to medium level. A balance coefficient was calculated as the ratio games/set. Values equal or higher than 9 were considered balanced, and lower than 9 unbalanced. Covered distance in balanced games was 170.8 m, meanwhile in unbalanced games was 140.*

*Playing level and balance between teams seem to be related with players' covered distance in paddle. Balanced games could produce higher covered distance, because teams would need to promote adversary displacements before winning each point. On the other hand, medium level could be related with higher covered distance in each game because at this level players would not fail as much as beginners but still would not have enough skills to perform an efficient attack.*

### **1 Introduction:**

Paddle is a young sport with similar characteristics to tennis in aspects as regulation, technology and tactics, but with differences that confer it singularity. The main differences are that the court is smaller, 20 x10m, the walls are part of the game (ball can rebound on them) and a paddle is used instead of a racquet to hit the ball.

Paddle was devised in Mexico in 1969 and invented by Enrique Corcuera. It has become very popular in Spain and South America (Hoyo, Corrales & Paez, 2008; Moon & Arazuri, 2008). Paddle International Federation was established in Madrid in 1991, and the professional tournament circuit Padel Pro Tour, where the most famous and best players of the world play.

Some reasons to explain the growing popularity of this sport may be that it is: (1) more profitable than other racquet sports. The paddle court is 200 square meters meanwhile the tennis court is near 400. (2) Easier to learn, due to the shorter court and the help of walls, paddle may be practiced with success very early in the initiation process, game characteristics changing according player's technical and tactical improvements. (3) Requires a lower level of physical condition than other sports. With regard to tennis and squash, paddle requires less cardiovascular effort. The heart rate average in paddle is about 148 beat/min (Hoyo et al., 2008) meanwhile in tennis is of 158 beats/min (Torres 2004) and in squash 170 beats/min (Alvero 2006). The VO<sub>2</sub>

consumption in competition is very similar to what is found in tennis (Hoyo et al., 2008).

Although some studies have analysed paddle, the studied variables are still very limited and the findings need to be explored. The objective of this study was to calculate and compare the covered distance of 3 different levels of paddle players (low or recreational, intermediate, and high-elite levels). Our hypotheses were: First that elite players would cover greater distances due a faster pace. Second, that balanced matches would lead to higher covered distances at any level of performance. This study was based on squash studies of covered distances. In one Hughes & Franks (1994) obtained than losers ran more distance, meanwhile in other Vuckovik (2004) found opposite results.

## 2 Methods

### 2.1 Sample

15 paddle matches were recorded in an indoor court. 2 paddle experts classified 5 matches as recreational level, 5 as intermediate and finally another 5 as high- elite level.

### 2.2. Procedure

A digital version of the match was recorded, placing cameras in transverse beams to the court at seven meters height. To set up the cameras in the beams we used a lift platform, and fixed the camera to the beam through a demountable and adjustable tripod called "goril-la".

The cameras were placed in a transverse beams to the court, and were at seven meters height. To set up the cameras in the beams we used lift platform, and fixed the camera in the beam through a demountable, adjustable tripod, whose name is "goril-la".

After each match it was calculated a balance coefficient ( $BC = \text{games} / \text{sets}$ ) to split sample in balanced and unbalanced matches. If one match got a value equal or higher to 9 it was considered as a balanced match. 8 matches were classified as balanced and 7 matches were classified as unbalanced.

### 2.2 Instruments.

We used two Bosch Dinion IP 455 video cameras. The video format of the cameras was mpeg-4. We used Bosch software to convert mpeg-4 format to Windows media video format. Afterwards with a normal video converter we made the change to mpeg-2 format.

These format changes were necessary because the software, called "SAGIT", which we used to track automatically the players path, only accepted MPEG-2 format. In the context of tracking players' movements in sport games the SAGIT tracking system is essentially a measurement system and it has been tested to estimate its errors of measurement (Pers et al., 2002). The SAGIT system was specified by their authors like we describe below:

#### *Calibration module*

The calibration module is used to calibrate each video to the same court coordinate system. During the calibration process, the start and end points of the game in the

video and the type of the game are manually specified and then a small number of key points are placed along the court boundaries following the computer's instructions. In this way, the computer can determine the correspondence between the image and court coordinates. (Vuckovic 2002).

### ***Tracking module***

The tracking module is used to obtain reasonably accurate data about a player's movements around the court. The maximum RMS error of the obtained data varies from 0.3 m under the camera to 0.5 m along the court boundaries (Perš et al., 2002). Players are initialized manually by clicks of the mouse, and then the automatic processing of the video starts. (Vuckovic 2002).

### ***Annotation module***

The annotation module is used to enter manual expert annotations about the events observed on the court. These annotations can then be used to produce high-level game statistics about the number and positions of different elements of the game such as passes, shoots, screens etc. They are perfectly aligned since they are recorded in the same framework as the player motion data. (Vuckovic 2002).

### ***Presentation module***

The presentation module is used to view, export and print the results obtained with the help of the tracking and annotation modules. It can be used to produce appealing visual presentations of the obtained data. (Vuckovic 2002).

## **3 Results**

We calculated the average distance covered by players in each game. Players of intermediate level covered more distance in each one ( $M=170.40$ ;  $SD = 30.84$ ). Players of low level covered less distance ( $M=153.16$ ;  $SD = 24.69$ ) than intermediate level but more than elite level ( $M=145.68$ ;  $SD = 19.66$ ). T tests between elite and intermediate level did not showed significant differences ( $t = -1.51$ ;  $p = .17$ ). The same happened between elite and recreational level ( $t = -.53$ ;  $p = .53$ ), and between intermediate and recreational ( $t = .98$ ;  $p = .36$ ).

On the other hand, balanced matches showed higher covered distance in each game ( $M=170.78$ ;  $SD = 21.92$ ) than unbalanced matches ( $M = 140.00$ ;  $20.39$ ). T tests between balanced and unbalance matches showed significant differences ( $t= 2.80$ ;  $p= .015$ ).

## **4 Discussion**

Although we did not find significant differences in the distance players' covered in each game between playing levels, descriptives showed a tendency that could be verified in a higher sample. In it we hypothesized that the intermediate level would cover more distance in each game than the elite and recreational level. This hypothesis is supported by the idea that at recreational level players would perform more mistakes and consequently games would finish early. On the other hand at elite level players would have more ability to finish points with winner shots, shortening the length of games. At intermediate level players would not fail as much as at recreational level, and moreover players would not be able of finishing with winner points as easily as at elite level,

consequently the length of games being higher and the covered distance in each one increasing.

Balance between teams was related with players' covered distance in each game. We thought that in balanced games teams need more ball shots to get enough advantage to finish the point, because the ability of one team to attack was compensated by the ability of the other to defend. Meanwhile in unbalanced games, points finished earlier by mistake of winner shot, due to the ability of one team to attack was higher than the ability of the other to defend.

More research is necessary to analyse this hypothesis with higher sample. Also would be necessary to analyse covered distance by winners and losers, and also to analyse speed.

Table 1. Study's results.

Level	Match	Balance coefficient (Games/sets) 1>=9	M Distance (m)	M Distance/game (m/game)	M Time (min)	M (SD) Distance (m)	M (SD) Distance/game (m/game)
Elite	1 (3 sets, 34 games)	Balanced	5084	149.5	108.63		
	2 (3 sets, 27 games)	Balanced	3807.2	141	72.93		
	3 (2 sets, 17 games)	Unbalanced	1996.1	117.4	36.96	3498.70 (1163.30)	145.68 (19.66)
	4 (2 sets, 22 games)	Balanced	3788.2	172.2	70.94		
	5 (2 sets, 19 games)	Balanced	2818	148.3	48.92		
Medium	1 (3 sets, 27 games)	Balanced	4887.2	181	92.97		
	2 (3 sets, 32 games)	Balanced	6351.2	198.5	133.99		
	3 (3 sets, 22 games)	Unbalanced	3791.4	172.3	79.98	4035.36 (1689.83)	170.40 (30.84)
	4 (2 sets, 18 games)	Balanced	3280.5	182.3	64.32		
	5 (2 sets, 16 games)	Unbalanced	1866.5	117.9	37.94		
Low	1 (2 sets, 15 games)	Unbalanced	2103	131.4	42.23		
	2 (2 sets, 16 games)	Unbalanced	2239.1	139.9	43.39		
	3.(2 sets, 17 games)	Unbalanced	2710.6	159.4	60.24	2588.68 (548.34)	153.16 (24.69)
	4 (2 sets, 17 games)	Unbalanced	2409	141.7	41.39		
	5 (2 sets, 18 games)	Balanced	3481.7	193.4	69.91		
		Balanced	170.78 (21.92)				
		Unbalanced	140.00 (20.39)				

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## **Tactical and movement analysis of elite racket sports using the Sagit Analysis System.**

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### **Abstract**

*Movement analysis of different sports has enabled a deeper understanding of the demands of each sport both across the sport and also within differences between positions in team sports. The definitive motion analysis of soccer, using hand notation, was by Reilly and Thomas (1976), who recorded and analysed the intensity and extent of discrete activities during match-play. They went on to define fitness and training demands for the different positions in soccer. This template of research has been repeated in most sports. In racket sports there has been little work of this nature, Hughes and Franks (1991) developed a tracking system for squash, which enabled accurate measures of distances travelled, velocities and accelerations. Movements specific to different sports have been analysed (Pereira, Wells and Hughes, 2001; Hughes and Moore, 1998).*

*A major influence on the tactics in racket sports is to dominate the court movement patterns, forcing over-exertion to the opponent. Movement is vital due to the speed and pace of the different games. Pearson (1999) stated that good movement stems from reading the game and watching the ball at all times. Players should never commit themselves to a shot unless they are certain what direction the ball will move in.*

*A full review of recent research will be presented and analysed, demonstrating the needs for this study. The methodology employed will be the SAGIT Observation System (Perš et al., 2001), which will be presented and explained. The aims of the research are:*

1. *To conduct a reliability study on the SAGIT system used for tennis.*
2. *A tactical analysis of shot types played by tennis, squash, badminton and real tennis players.*
3. *Compare the shot selections used by players of different standards playing in a competition situation.*
4. *Compare the distances and velocities covered by players of different standards.*
5. *Analysis of the position of the opponent at the moment the ball is hit (by the opposite player).*
6. *Movement assessed is relation to ball hitting (movements to and from the ball strike).*

*The analyses of the data will be discussed and likely outcomes proposed.*

## 1 Introduction

Movement analysis of different sports has enabled a deeper understanding of the demands of each sport both across the sport and also within differences between positions in team sports.

General, rudimentary and unsophisticated forms of notation have existed for centuries. Hughes and Franks (1997) suggested that research shows that the earliest recorded form of music notation was conceived in the eleventh century, although it did not become established as a uniform system until the eighteenth century.

Historical texts give substantial evidence pointing to the emergence of a crude form of dance notation much later, in about the fifteenth century. They also stated that the early attempts at movement notation may well have 'kept step' with the development of dance in society, and as a consequence the early systems were essentially designed to record particular movement patterns as opposed to movement in general.

It would seem natural, therefore, that dance notation actually constituted the 'starting base' for the development of a general movement notation system. Arguably the greatest development in dance notation was the emergence of the system referred to as 'Labanotation' or 'Kinetography-Laban', so-called after its creator, Rudolph Laban in 1948. Laban highlighted three fundamental problems encountered in the formulation of any movement notation system:-

1. Recording complicated movement accurately.
2. Recording this movement in economical and legible form.
3. Keeping abreast with continual innovations in movement.

As already mentioned, the development of Labanotation represented a major factor in the evolution of notation. The next 'step' in the development of movement notation came in 1947 with the conception of another form of dance notation, Choreology, published in 1956, by Jean and Rudolph Benesh. In this form of notation, five staves formed the base or matrix for the human figure.

i.e.	_____	Top of Head
	_____	Top of Shoulder
	_____	Waist
	_____	Knees
	_____	Floor

All notation was completed on a series of these five line grids with a complex vocabulary of lines and symbols.

The major underlying disadvantage of both the Benesh and Laban methods of notation in terms of sport is that they are both primarily utilized for the recording of patterns of movement rather than its quantification. Movement notation systems, developed primarily in the field of expressive movement, gradually diversified into game analysis, specifically sport.

## **2 The need for objective evaluation**

Forms of objective feedback could be qualitative or quantitative. Qualitative information such as ‘good’ or ‘bad’ is not as precise as quantitative. ‘Missed by 25 cm’ would be more quantitative feedback. Both of them depend on the knowledge of performer and lead the learner to the correct response or movement.

In those universities that deliver degrees in sport, it is taught that there are three “simple” components in the elite career life of an athlete to reach their best. These are firstly, long-term preparation (many years hard training), secondly, cutting edge performance by the athlete (provided in competitions), and thirdly, evaluation. Hughes and Franks (2004) have examined different perspectives of performance analysis. This discipline existed already, but they were the pioneers who expanded the area and gave it a new meaning. They defined performance analysis as “an objective way of recording performance so that key elements of that performance can be quantified in a valid and consistent manner” (Hughes and Franks, 1997). They suggested that the main issue of performance analysis is reliable, objective evaluation, and that not only athletes need this form of objective feedback but also coaches. Notational analysis has been identified by Franks (1983) as one of the best forms of quantitative analysis. Franks et al (1983a, cited by Hughes and Franks, 1997) maintained that:-

“if it can be measured - it is fact, if it cannot be measured - it remains opinion', also applies to the coaching arena." (1983b: 77)

Athletes and coaches use notational analysis as a source of feedback to improve their performance. Notational analysis was developed to provide an objective method of assessing sports performance, thereby attempting to eliminate subjective bias and ensure coaching observations are both reliable and accurate. Franks and Miller (1986) provided evidence for the observational deficiencies of coaches, and therefore a method for the collection of reliable and objective performance data would seem important. The weaknesses identified, were; highlighting, memory and using subjective data, leniency error and the halo effect.

The research has also found inconsistencies with subjective analysis. Coaches in Canada remembered correctly 30% of performance (Franks and Goodman, 1983). A soccer study by Franks and Miller (1986) showed that international coaches could only recollect 42% of key factors during a match that determined successful performance. Franks (1993) carried out a study in gymnastics and found that experienced gymnastics coaches were not significantly better than novice coaches at recognising key differences in gymnastics.

## **3 The development of sport-specific notation systems**

The first published research in Notational Analysis was by Fullerton (1912), a mathematical paper, which explored the combinations of players batting, pitching and fielding in baseball, and the probabilities of success. Probably one of the first attempts to devise a notation system specifically for sport analysis was that of Messersmith and Corey (1931), who attempted to notate distance covered by specific basketball players during a match.

Reep and Benjamin (1968) collected data from 3,213 matches between 1953 and 1968. These matches included 9,175 goals, the passes leading to these goals, how possession was gained and the position of these actions were all recorded. It was found that 80% of goals resulted from a sequence of three passes or less. Fifty percent of all goals came from possession gained in the final attacking quarter.

Bate (1988) explored aspects of chance in football and its relation to tactics and strategy in the light of the results presented by Reep and Benjamin (1968) and data from unpublished research collected by C.F.Hughes in 1987. Bate claimed that goals are not scored unless the attacking team gets the ball and one, or more, attacker into the attacking third of the field. The greater the number of possessions a team has the greater chance it has of entering the attacking third of the field, therefore creating more chances to score. The higher the number of passes per possession, the lower will be: the total number of match possessions, the total number of entries into the attacking third, and the total chances of shooting at goal. Thus Bate rejected the concept of possession football and favoured a more direct strategy. He, in conjunction with Reep and Charles Hughes, concluded that to increase the number of scoring opportunities a team should:

1. Play the ball forward as often as possible.
2. Reduce the square and back passes to a minimum.
3. Increase the number of forward passes and forward runs with the ball of 40 yards or more.
4. Play the ball into space as often as possible.

These tactics had a profound effect on British football, as they form the basis of the 'long ball' game, and it spread throughout the British coaching community because the positions occupied by Hughes and Bate.

The first publication of a comprehensive racket sport notation was not until some time later, when Downey (1973) developed a detailed system which allowed the comprehensive notation of lawn tennis matches. Detail in this particular system was so intricate that not only did it permit notation of such variables as shots used, positions, etc., but it catered for type of spin used in a particular shot. The Downey notation system has served as a useful base for the development of systems for use in other racket sports, specifically badminton and squash.

Although some sports have little notational research published, it does not mean that systems do not exist or are not used in these disciplines. For purposes of clarity and reference the following section has been sub-divided into specific sports, even though in some areas there is not a great deal of information to report.

## 4 Tennis

Publishing tennis research with complex hand system was developed by Downey, (1973). This lawn-tennis notation system, established a foundation for the development of other racket sports such as squash and badminton. Notational analysis research in tennis has since diversified into investigation of a variety of different variables, including movement analysis of serve and volley players (Hughes and

Moore, 1998), investigation of timing factors between serves, points and games (O'Donoghue and Liddle, 1998a) and more detailed analysis of areas such as levels of aggression on strokes (Hughes and Tillin, 1994) and causes of players approaching the net (O'Donoghue and Ingram, 2001a). Furlong (1995) analysed the service effectiveness in lawn tennis at Wimbledon and in clay at the French Open in 1992 as a comparison. Furlong (1995) noted both men's and women's, singles and doubles events to standardise for the fastest and slowest surface. The results showed that the service in doubles was the most effective because most serves were slower to compensate for accuracy so that a strong attacking position at the net could be achieved, which would help in scoring more points.

Hughes and Taylor (1998) compared the patterns of play between six top British U18 players in comparison to six top U18 European and three top U18 American / Canadian elite performers. The hand notation system recorded data using symbols based in four positional zones of the court, data gathering was performed post-event from video. These researchers analysed two tournaments just before the 1996 Wimbledon, which are perceived as 'Warm Up' tournaments. These tournaments were Imber Court, London and I.T.F. Group one tournament held in Roehampton, London, both of a grass surface. Eight matches were recorded over the two venues and the following conclusions were generated:

- U18 British players made more unforced errors from the back of the court.
- Europeans seem to hit more attacking shots from the back of the court.
- U18 British players made more defensive shots from the back of the court.
- U18 British players won more points at the net, where Europeans won more at the back of the court.
- U18 British players executed a low number of winning passing shots in comparison to both Europeans and Americans / Canadians.

Most research has been focused around the serve and the differences between patterns of play. Research into the analysis of movement patterns began within the sports of squash and football, nevertheless there has yet to be a transfer of these techniques to the field of tennis.

## 5 Squash

Several systems have been developed for the notation of squash, the most prominent being that by Sanderson and Way (1977). Most of the different squash notation systems possess many basic similarities. The Sanderson and Way method made use of illustrative symbols to notate seventeen different strokes, as well as incorporating court plans for recording accurate positional information. The major emphasis of this system was on the gathering of information concerning 'play patterns' as well as the comprehensive collection of descriptive match data. Sanderson felt that 'suggestive' symbols were better than codes, being easier for the operator to learn and remember, and devised a code system. These were used on a series of court representations, one court per activity, so that the player, action and position of the action were all notated. In addition, outcomes of rallies were also recorded, together with the score and the initials of the server. The position was specified using an acetate overlay with the courts divided into 28 cells. The system took an estimated 5-8 hours of use and practise before an operator was sufficiently skillful to record a full match actually

during the game. Processing the data could take as long as 40 hours of further work. Sanderson (1984) used this system to gather a data-base and show that squash players play in the same patterns, winning or losing, despite the supposed coaching standard of `....if you are losing change your tactics'. It would seem that the majority of players are unable to change the patterns in which they play.

Most of the data that Sanderson and Way presented was in the form of frequency distributions of shots with respect to position on the court. This was then a problem of presenting data in three dimensions - two for the court and one for the value of the frequency of the shots. Three dimensional graphics at that time were very difficult to present in such a way that no data were lost, or, that was easily visualised by those viewing the data. Sanderson overcame this problem by using longitudinal and lateral summations. Not only were the patterns of rally-ending shots examined in detail, but also those shots, (N-1), that preceded the end shot, and the shots that preceded those, (N-2). In this way the rally ending patterns of play were analysed. The major pitfall inherent in this system, as with all long-hand systems, was the time taken to learn the system and the sheer volume of raw data generated, requiring so much time to process it.

All the research carried out on playing patterns in squash have observed male subjects only, apart from a recent study by Hughes, Wells and Matthews (2000) who analysed female squash players. The aim of the study was to define models of patterns of play at different levels in squash for women and analyse the demands placed on players as they ascend through these levels. An additional aim was to define a 'normative profile' and explore how much data were required to reach a 'normal playing pattern'. Using a computerised notation system (Brown and Hughes, 1995) post-event analysis for elite (N=20), county (N=20), and recreational (N=20) were analysed. A dependent t-test was used to establish whether a normative profile had been reached, the profiles of 8 matches were compared with those of 9 and 10 matches, for each of the categories of players. Analysis of variance and chi-squared analysis were used to test for differences in the overall match totals and distributions of shots.

The results produced in this study have clearly distinguished between the playing patterns of women at the different levels of play. It was discovered that elite and county players did establish a playing pattern that could be reproduced reasonably consistently. The recreational players did not produce a normal playing pattern due to lack of significance at a suitable level. Hughes, Wells and Matthews (2000) felt that a normative playing pattern is only achieved when a player plays at top level, the subsequent differences of the recreational player exist because they do not possess a fixed pattern. Their differences were not caused by chance but by the fact that they have no fixed pattern of play. As players work their way up the different standards of play set patterns emerge. The county playing standards showed a set pattern forming, but this will not be fully achieved until that county playing standard reaches the top level of squash, elite level. (Hughes et al., 2000, p91).

Significant differences were produced on a number of key elements of play across the three standards. There was a significant difference in the total number of shots played per match, ( $p<0.05$ ) and standards of play. Also significant differences ( $p<0.05$ ) were found between all three groups for the total number of shots per rally. The conclusions drawn from this study have similarities to that of Hughes (1986) on his work concerning male subjects. The elite players employed an 'all-court' game, using more complex tactics creating more pressure, due to their higher levels of fitness, covering ability, speed and skill levels. County players showed a consistent

attempt on hitting the ball into the back of the court and predominantly on the backhand side. Their shots were less accurate than the elite players, but significantly more accurate than the recreational player. Recreational players adopted a 'hit and run' game due to their inability displaying tactics. They were erratic with their distribution of shots, hitting a high percentage loose to the middle of the court. These studies by Hughes (1986) and Hughes et al. (2000) distinguish between playing patterns of both standards of genders, they are not representative of the junior game in any way. This is due to the differing physiological factors that exist between the two subject areas, for instance being able to retrieve the ball, and also other factors that might contribute to the variance in playing patterns, such as quality of coaching.

Armed with this information the coach can then analyse any technical deficiencies of their players when playing in these particular areas of the court or when playing a certain shot. This in turn will inform the player of tactical considerations of shot sequences. This can be done live in training, or with use of video feedback. Seeing technical faults in the past has been quite difficult on video due to the frame rates. However with introduction of high-speed cameras for feedback purposes, technical analyses of the racket swings and individual player movement can now be scrutinised to the minutest detail.

The definitive motion analysis of soccer, using hand notation, was by Reilly and Thomas (1976), who recorded and analysed the intensity and extent of discrete activities during match-play. They went on to define fitness and training demands for the different positions in soccer. This template of research has been repeated in most sports. In racket sports there has been little work of this nature, Hughes and Franks (1991) developed a tracking system for squash, which enabled accurate measures of distances travelled, velocities and accelerations. Movements specific to different sports have been analysed (Pereira, Wells and Hughes, 2001; Hughes and Moore, 1998).

A major influence on the tactics in racket sports is to dominate the court movement patterns, forcing over-exertion to the opponent. Movement is vital due to the speed and pace of the different games. Pearson (1999) stated that good movement stems from reading the game and watching the ball at all times. Players should never commit themselves to a shot unless they are certain what direction the ball will move in.

## 6 Badminton

Full time notational analyst for the Badminton Association of England, Steve Evans has developed various hand notation systems to provide information on badminton play patterns, work to rest ratios and movement analysis. Using the 1998 ladies singles final of the All England Championship, Evans (1998b) analysed rally-ending situations so as to provide tactical match plans for future training sessions. Within the study it was noted that a low winner to error ratio was apparent. The players also showed an increased amount of errors when playing the clear in comparison to other shots. This could have been due to the surrounding environment or increased pressure, it is usually expected that a clear will produce a low winner to error ratio. The smash though will usually have a winner to error ratio greater than one (in men's singles the ratio is 2.2:1, Evans, 1998a). Within this study only one match was analysed therefore care must be taken when interpreting the data. Evans (1998) outlined that ideally a good player profile can be established by using a collection of

five matches, ‘the more matches one can note the more accurate an emerging pattern will be,’ Evans (1998, p.9).

## 7 Movement analysis

Based upon the work conducted by Reilly and Thomas (1976), on movement duration and intensity in soccer, Hughes, Franks and Nagelkerke (1989) designed a tracking system for squash. The tracking system was designed to be used post-match from video at match speed. A ‘Power Pad’ was used to gather the positional data along with the time base (Hughes, 1998). Accurate tracking was enabled by training a video camera on the ‘Power Pad’ and mixing the image from the camera with the footage of the match and transferring it to a single VDU screen. The image of the representation of the playing area on the ‘Power Pad’ was aligned to exactly meet the dimensions of the court on screen. This allowed the operator to be able to focus upon where they were tracking and where the player was moving at the same time. This was shown to be an accurate and reliable method of gathering information regarding player velocities and accelerations.

This system was utilised by Hughes and Franks (1994) in a study comparing the motions of squash players of differing standards. They recorded the distances moved, the average velocities and the accelerations during rallies of four different standards of players ranging from club level to elite internationals. The mean distance travelled by recreational and regular club players was only 12m, which raised some questions about the type and specificity of the training that these players were performing. The study also showed that the then number 1 player in the world, Jahangir Khan, had a physiological advantage over the other top players in the world. It was found that when the data for Jahangir Khan were compared to that of the top six players, including his own data, his acceleration during a rally was 50% greater than that of his opponents.

Hughes and Moore (1998) analysed the patterns of movement concerned with serve and volley tactics in tennis. They indicated that certain types of movement, like skip-check, combined with the ready position were used almost universally, however, some movements, such as running or jumping through a shot, placed pressure on the player often resulted in them losing the rally. They also suggested that losing players exhibited a higher number of post impact steps away from the midline of the court. Richers (1995) also conducted a study regarding movement and physiological profiling of single tennis. She used a time-motion analysis combined with an assessment of sets and repetitions of continuous foot movements. The research suggested that elite tennis players primarily utilise anaerobic metabolic pathways (ATP-PC and Lactic Acid pathways), and also noted that players took similar repetitions of steps across hard, clay and grass surfaces per set, but significantly higher numbers of sets on both hard and clay surfaces, largely owing to the significantly longer duration of each point on those surfaces.

Liddle & O’Donoghue (1998) investigated rally and rest times for each discipline of badminton (apart from mixed doubles) and found mean rest durations to be longer than mean rally durations for all forms of the game. In men’s singles, mean rally duration was found to be  $9.15 \pm 0.43$ s, whilst the mean rest time was  $13.84 \pm 1.16$ s. These figures differ greatly from those found by Coad *et al.*(1979) and Docherty (1982) (cited in Hughes, M. G., 1994). They found rally length to be around five seconds with five to ten seconds of recovery in between, but did state that the rally length would be expected to be longer at the elite level. However, the study

by Liddle and O'Donoghue (1998) was limited in that only four of each men's and ladies' singles, five men's doubles and four ladies doubles matches were noted. This meant that a restricted study size was examined for each discipline. The analysis (Liddle & O'Donoghue, 1998) was performed live using computer notation during matches. This will have removed inaccuracies that arise from post match analysis, caused by such events as stretching of the videotape due to repeated viewing. Conclusions were drawn from the research that training should be specific to the discipline in which performers participate. This is reinforced by the fact that the Badminton Association of England have appointed specialist singles and doubles coaches in recent times.

Pereira et al. (2001) indicated the importance of movement within the game of squash, a concept that is re-iterated by many tennis professionals, even given the differences in reported rally time, intensity, and rest ratios between the two sports. The principle aim of the research undertaken by Pereira et al. (2001) was to link movement patterns from different areas of the court, to establish a normative movement profile. Within the study, movements were operationalised into categories according to the discrete movements of the sport, and later inter-linked during the data analysis. This enabled different movements, from the initial movements, those to the ball, and those at the time of ball striking to be linked together, and when combined with data on the rally outcome, determine the normative movement patterns of winning and losing squash players. Although the outcomes of the research are not directly comparable to tennis, the methodology used represents a new approach in the analysis of patterns of movement. Wells and Hughes (2001) also conducted a similar study in squash, however their methodology differed to Pereira et al (2001) due to the division of front, back, and middle areas of the court, and further sub-divisions on both the forehand and backhand side. This enabled a more specific and relevant analysis of the movement patterns to be established, and served as an accurate tool for future coaching. Such profiles of movement are not currently available in the field of tennis, and if a reliable and valid measure for these movements in tennis could be produced, it would serve as a valuable resource for both coaches and players alike.

Movement analysis in racket sports has enabled a better understanding of the physical demands of the sports and, as a result, the creation of specific training drills to better prepare the players for matchplay. This information can also be used to help strengthen junior players who are currently finding the transition from the junior game to the senior (professional) sport difficult due to the greater physicality of the senior game (Pearson, 1999).

## 7 Aims of the study

The aim of this study is to compare patterns of play of players to establish if differences exist in movement patterns. It is also an aim of this study to attempt to establish a normative profile for elite male tennis players. The study also aims to add to the framework of current notation research used to aid coaching and teaching relevant on a practical level.

The general aim is to investigate movement patterns and shots played as dependant variables to infer the "decision making" of different levels of tennis players using the SAGIT analysis system.

Tactics will be assessed from shot data i.e. the selection of shots played under different conditions can provide evidence of tactical decision making, e.g. at present

no reliable information has been collected regarding the time available to play shots, this is possible using the SAGIT system.

The review of recent research demonstrates the needs for this study. The methodology employed will be the SAGIT Observation System (Perš et al., 2001), which will be presented and explained. The aims of the research are:-

1. To conduct a reliability study on the SAGIT system used for tennis.
2. A tactical analysis of shot types played by tennis, squash, badminton and real tennis players.
3. Compare the shot selections used by players of different standards playing in a competition situation.
4. Compare the distances and velocities covered by players of different standards.
5. Analysis of the position of the opponent at the moment the ball is hit (by the opposite player).
6. Movement assessed is relation to ball hitting (movements to and from the ball strike).

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## The use of zone 14 as a strategic attacking area in the English Championship

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### Abstract

*Whilst research in performance analysis of soccer has often investigated strategies for success, relatively little attention has been devoted to the so called ‘zone 14’ which seems popular within coaching, particularly in the UK. This area of the pitch is located centrally, directly in front of the 18 yard box (see Fig. 1). Research suggests that successful teams play more passes into this attacking area than unsuccessful teams (Grant, Williams, Reilly and Borrie, 1998) and that the majority of attempts at goal result from assists from this area (Horn, Williams and Grant, 2000). Furthermore, passes played from zone 14 into the penalty area produce four times the number of goals than passes laterally from wing positions (Horn, Williams and Ensum, 2002). Previous research related to zone 14 has been limited to international and English Premier League teams. This paper analysed 12 matches involving four English Championship teams during the 2010/11 season. Two teams were classified as successful as they were in the top six throughout data collection, the two classified as unsuccessful were in the bottom six. The analysed teams had 280 possessions in zone 14 (45.1% of attacks) suggesting Championship teams have an average of about 23 possessions in zone 14 per game (Horn et al. 2002 found Premier League teams averaged 30 per game). Whilst successful teams had slightly less possessions in zone 14 than unsuccessful teams ( $n=134$  vs. 146 respectively), they converted more of them (43.2% vs. 28.8% respectively) into critical incidents (shots) ( $\chi^2 = 4.12$ ,  $df = 1$ ,  $p < .05$ ). This suggests that how possessions are used in zone 14 rather than the frequency of possessions in this area is a performance indicator in English Championship soccer.*

### 1 Introduction

Performance analysis in soccer provides coaches/managers with both technical and tactical information from which future training sessions, formations and line ups can be decided upon. Much of the published research in soccer has centred itself around the effectiveness of attacking strategies, i.e. the best way to create and convert goal scoring chances. Initially such published data advocated a direct approach to goal (Reep and Benjamin, 1967) which has created much debate and rebuttal for those who suggest possession as a key indicator of success (Hughes and Franks, 2005).

Recent trends have moved towards producing a more ‘finer grained’ analysis of performance where authors have attempted to describe performance, not as a whole i.e. final match result, but by elements of match play, such as final third entries, penalty box entries or possession in the opposition half. Much of this research is often developed via analysis of elite teams, such as World Cup, Premier League or UEFA Champions League on the basis that knowing what aspects of these performances contribute most to success potentially account for success in general.

Of particular recent interest within coaching circles is the influence that controlling a particular area of the field within the attacking third, named ‘zone 14’, can have upon a match. This area of the pitch is located centrally, directly in front of the 18 yard box (see Fig. 1). For instance, Grant, Williams, Reilly and Borrie (1998) compared successful (defined as teams reaching the semi-finals) and unsuccessful teams (defined as those who went out in the group stage) on a number of performance outcomes. Analysis was performed on 30 matches played in the 1998 World Cup, with the pitch split into 18 zones of equal size in an attempt to describe more fully activities of match play (for pitch zones see Fig.1). Successful teams were seen to create more goal attempts from possessions with a greater number of passes and for longer durations (>15 seconds) than unsuccessful teams, advocating a patient passing game. Most attempts at goal came from possessions gained in the attacking quarter for both classifications of teams, seemingly advocating a high pressing game for regaining possession. More interestingly successful teams made more passes within zone 14, particularly to ‘danger areas’ zone 16, 17 and 18. Zone 14 was therefore highlighted as an area of critical importance, which if utilised fully could potential increase the number of attempts at goal and thus the chances of scoring a goal.

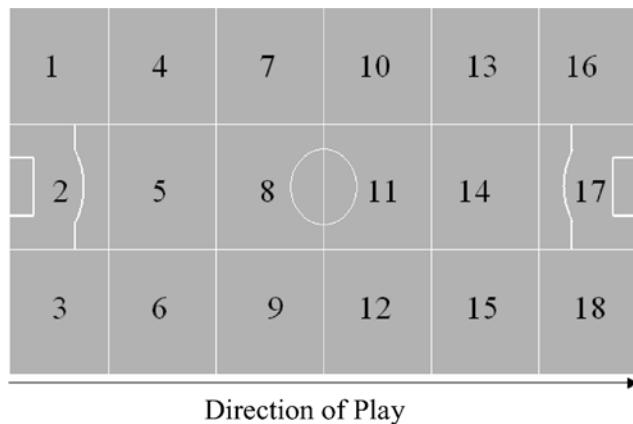


Figure 1. Soccer pitch with 18 zones of equal size

Using the same pitch schematic, Horn, Williams and Grant (2000) performed a detailed analysis of France in the 1998 World Cup and 2000 European Championship, to which they were eventual champions in both. Again zone 14 was highlighted as an area of particular strategic influence with results illustrating that passes from this area created the highest proportion of goals (passes from zone 10 created 1 goal, zone 13 - 1 goal, zone 14 - 7 goals, zone 16 - 1 goal, zone 17 - 6 goals and zone 18 - 1 goal). Furthermore, the majority of attempts on target also came from possessions gained within zone 14.

Horn, Williams and Ensum (2002) concentrated specifically on zone 14 with attempts made to show what percentage of entries into zone 14 resulted in an attempt at goal, using English Premier League teams 2001-2002. Attempts were also made to establish optimal time periods for possession in zone 14, what were the most successful methods of ball entry to zone 14 and was this linked with successful outcomes. All entries into zone 14 were analysed in 10 Premiership matches, with the duration of each possession, method of ball entry (i.e. long aerial pass, short floor pass etc.), action within zone 14, destination of the ball when leaving zone 14 and the final outcome of the possession being recorded. Results suggested that there were on

average 30 possessions per team, per game within zone 14, 26% of which resulted in an attempt at goal. However, the authors suggested that there was a relative low strike rate from shots from zone 14 (goals: attempts ratio) suggesting that chances were not necessarily of a high quality. Transferring the ball from zone 14 to zone 17 (penalty area) resulted in the largest % of goals created from zone 14. This seems logical as moving the ball closer to goal (into the penalty area) maybe hypothesised as making goal chances easier or inhibit defences from making challenges in fear of conceding a penalty. No possession within zone 14 exceeded 15 seconds (n=600), with 64% of them only lasting between 0.5 and 2.5 seconds. This indicated that the area is of primary concern to defences who will attempt to put pressure on the ball in an attempt to stop it entering the penalty area. Conversely, regaining possession in zone 14, along with dribbling, was the most successful form of ball transfer into the area, suggesting that attacking teams will try to press the opposition high up the field.

From the available literature zone 14 appears as an area of strategic importance for both defence and attacking. Exploiting the area in attack is linked to goal scoring and creating shooting opportunities, which in turn highlights the need for a well organised defence to protect the area. Available literature can however be criticized for a variety of reasons. Operation definitions are often omitted or at least unavailable to the reader, e.g. what constitutes a successful tackle? Perhaps more importantly results are often presented in the absence of a robust reliability study, which has been suggested to leave any results and conclusions with limited validity (Hughes, Cooper & Nevill, 2002). Research is often performed on ‘one off, winner takes all’ international tournaments and therefore may not represent the wider footballing community. When analysis has been performed within league tournaments data collection process has been skewed towards analysis of elite teams. For instance, Horn, Williams and Ensum, (2002) analysis of 10 Premiership games included 6 matches which included teams who placed in the top 3 in the final league standings.

In light of such limitations the following paper analysed 12 matches involving four English Championship teams during the 2010/11 season with attempts made to explore the influence and use of zone 14. By doing so attempts will be made to compare results obtained to that of the previous research, and where possible suggest what implications such findings have for coaches and managers. Finally recommendations for future research on zone 14 will be made.

## 2 Method

Digitally captured match footage was transferred into the Focus X2 analysis package (ref). During analysis footage was played back at a rate of 75% of normal match play speed to make identification of analysis criteria easier to record, i.e. eliminate miss keys (see Fig. 2 for an example of the analyst window). If the analyst was unsure of an event then the footage was rewound and played back to ensure that coding was performed reliably (playback rate speed could also be altered to a slower speed at the analysts discretion).

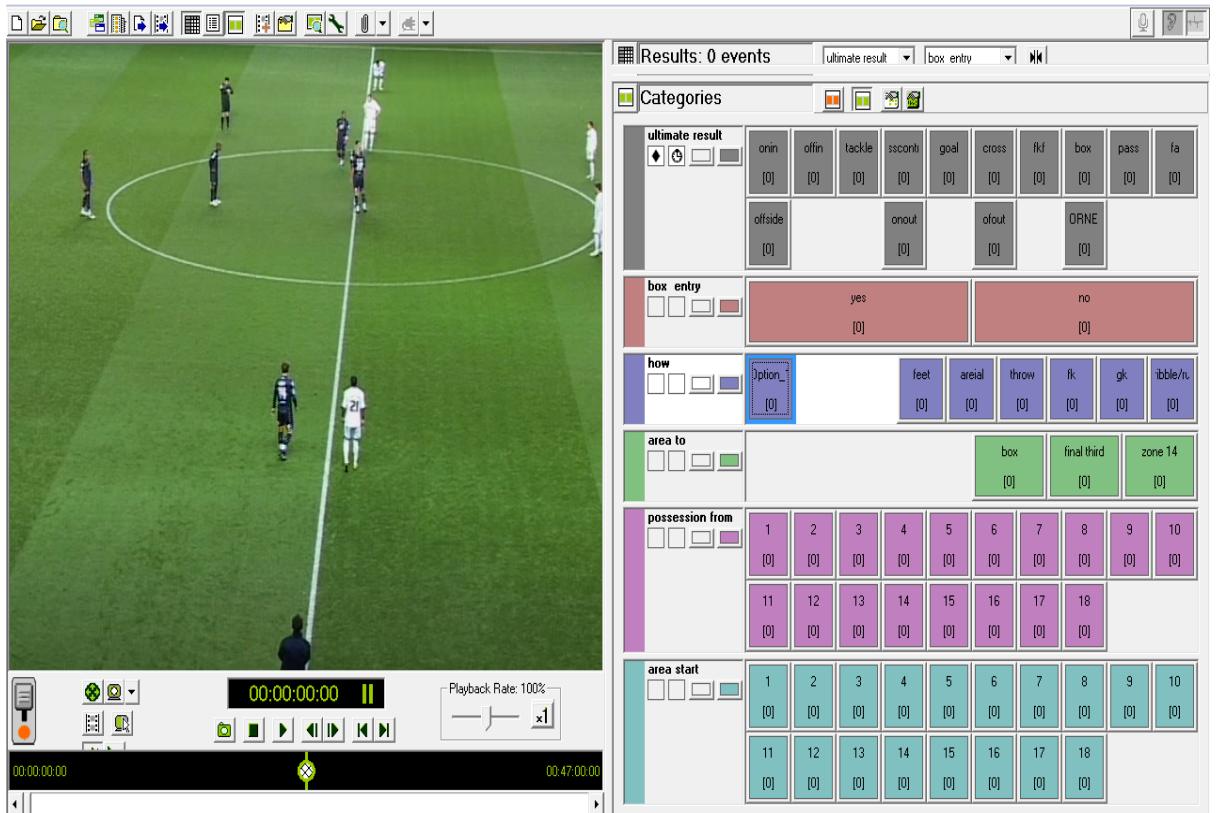


Figure 2. Example of Analyst Coding Window

## 2.1 Coding

The point at which the analysed team gained possession was recorded along with the area in which this event occurred (using pitch schematic illustrated in Fig. 1). Once the area start button was pressed, the time of the match would automatically be recorded. Footage was then played to the conclusion of the possession. This allowed the analyst to know if the possession had moved through zone 14 or to any other final 1/3 area. Footage was then played back with the method of ball transfer, the area from which the ball transfer occurred, the final third area which the possession was passed into i.e. penalty area, zone 14 or other, and the final outcome of the possession (for a full list of operational definitions see Appendix 1.)

## 2.2 Reliability

To ensure that data collection depicted a true representation of the events recorded a reliability study was performed to ensure consistency within the analysts coding process. One match was selected at random from the 12 available. This match was coded on two separate occasions with a 3 week period between each event. This was to ensure that no significant learning process effected results. On completion the two data sets were compared using the techniques advocated by Hughes Cooper Neville (200?). An initial comparison revealed no difference in the length of the data sets. Each coding category was analysed separately and no errors greater than 3.8% were found.

## 2.3 Statistical Analysis

Since the data was primarily frequency data non parametric statistics were used. The chi square test of independence was used to assess differences between successful and unsuccessful teams.

## 3 Results

There were 280 possessions in zone 14 (Fig. 3), which accounted for 45.1% of the attacks analysed. This suggests that English Championship teams have about 23 possessions in zone 14 per game.

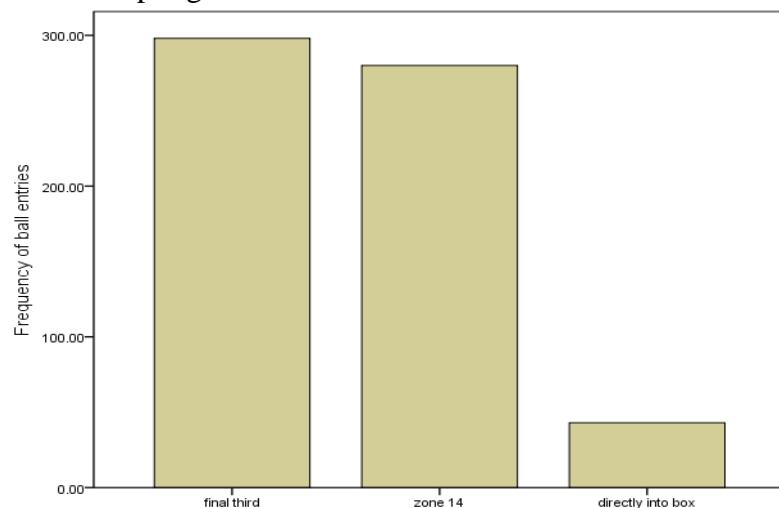


Figure 3. Frequency of ball entries into the final third.

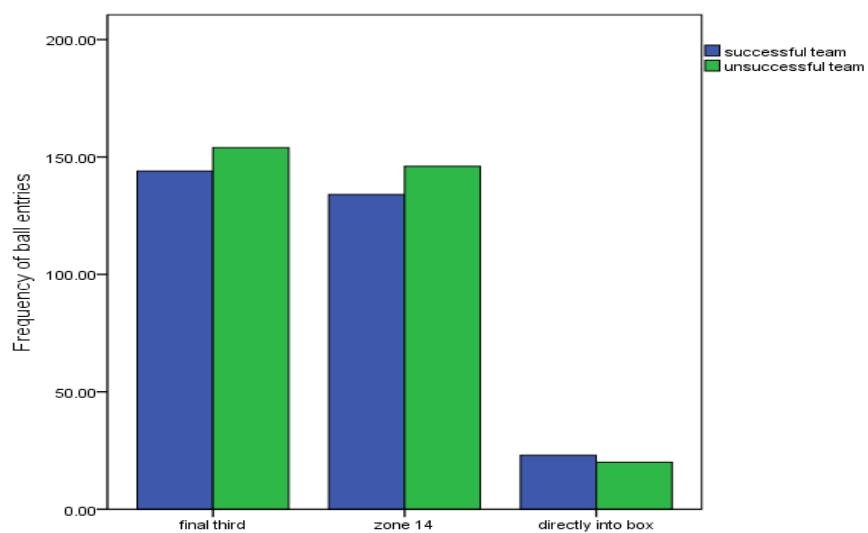


Figure 4. Frequency of ball entries into the final third by successful and unsuccessful Championship teams.

Successful teams had slightly less, but not significantly ( $\chi^2 = 0.48$ ,  $df = 2$ ,  $p = 0.79$ ) possessions in zone 14 than unsuccessful teams with successful and

unsuccessful teams exhibiting very similar proportions of ball entries into the final third (Fig. 4).

The majority of critical incidents were from possessions that used zone 14 with no significant difference between successful and unsuccessful teams ( $\chi^2 = 5.77$ ,  $df = 2$ ,  $p = .06$ ; Fig. 5).

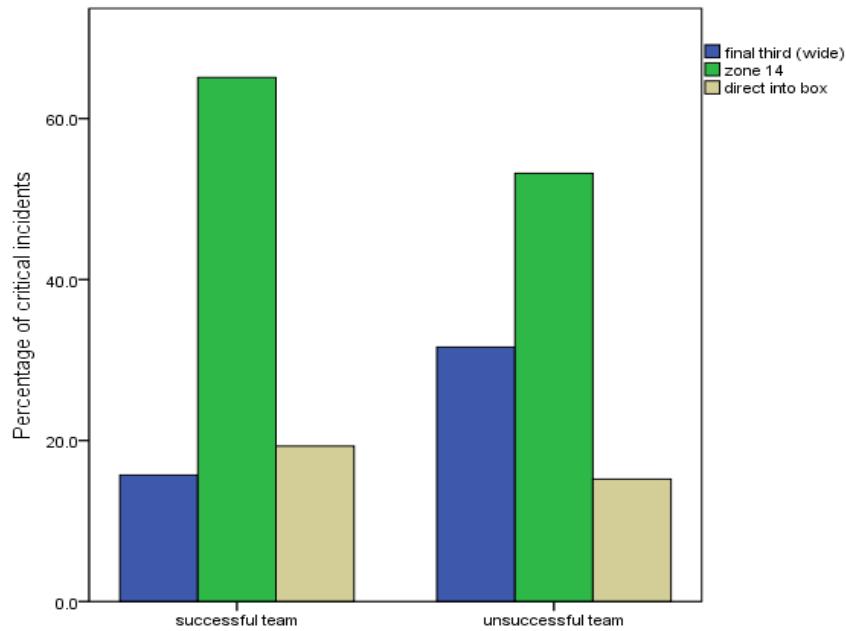


Figure 5. Proportion of critical incidents by final third entry for successful and unsuccessful Championship teams.

Although there was very limited data it seemed that zone 14 appeared to produce more goals than the wide areas of the final third (Fig. 6).

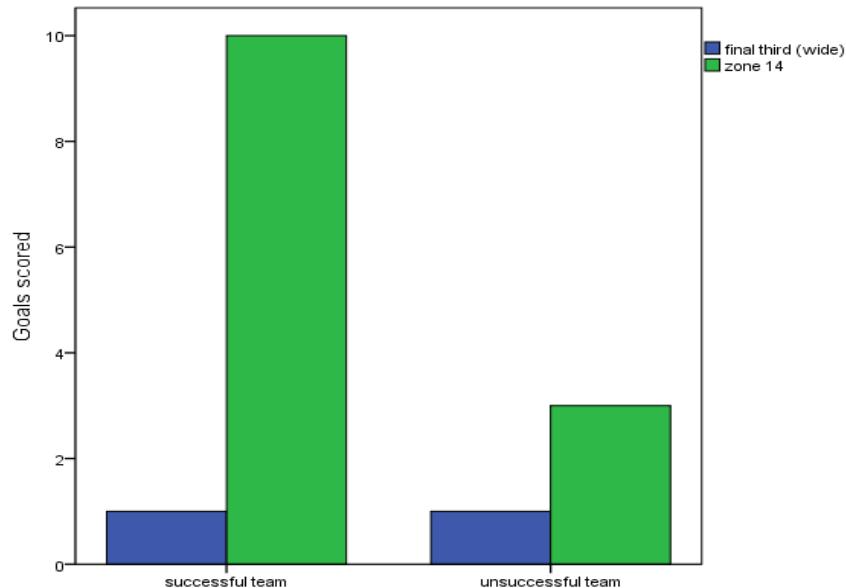


Figure 6. Goals scored from zone 14 and wide areas of the final third.

## **4 Discussion**

The current investigation suggested that Championship teams had on average 23 possessions within zone 14 per game. This accounted for 43.1% of possession within the final third of the pitch. Horn *et al.* (2002) suggested that Premier League teams had on average of 30 possessions within the same zone per game. This difference may potentially be a reflection of differences in strategy or skill between the Premier and Championship teams. When teams were categorised as successful or unsuccessful, results suggested that successful teams had fewer, although not statistically significant, number of possessions within zone 14 than their unsuccessful counterparts. This finding advocates quality over quantity within zone 14, seemingly rejecting the use of the direct method of ball transfer commonly known as the ‘long ball game’. This suggestion is supported by the finding that successful teams converted significantly more possessions in zone 14 into shots at goal. Such findings contradict those of Grant, Williams, Reilly and Borrie (1998) who suggested that successful teams play more passes into zone 14. As Grant *et al.*, (1998) research was performed over 10 years ago it may be feasible to suggest that behaviours within Championship teams have changed as a result of such research, combined with an increase in attention given to scientific research by football coaches and management.

Horn *et al.* (2000) suggested that assists from zone 14 created the highest proportion of goals in France’s World Cup and European Championship winning teams than the other 13 zones. The current investigation supported this finding with possessions using zone 14 producing more goals than wider areas (zone 13, 15, 16 and 18).

Although the current investigation furthered understanding on the importance of zone 14, future research should attempt to explore other facets of match play which may possibly affect behaviours regarding entry into and behaviours once in possession of the ball in zone 14. Several studies have investigated the effect of scoreline on aspects of soccer performance by comparing play in the period where the score was level with play in the period where a team was winning or losing (Jones, James and Mellalieu, 2004; Lago and Martin, 2007).

The current investigation included possessions which started within final third zones as ‘dead ball’ situations, such as corners and free kicks. Future investigations may develop a better understanding of attacking strategies if possessions in final third zones were separated into final third entries that develop from open play and final third entries which start from dead ball situations.

## **5 Conclusions**

Similar to previous studies (Grant, Williams, Reilly and Borrie, 1998; Horn, Williams and Grant, 2000; Horn, Williams and Ensum, 2002), the current investigation highlighted zone 14 as an area of strategic attacking importance within English Championship teams. Results highlighted the importance of the quality of possession within zone 14 over the frequency of entry into the zone.

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## **The efficiency and ergonomics of different data entry systems in real-time and lapsed-time computer notation systems.**

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### **Abstract**

*Computerised notational analysis is now widely used in the sports industry. Most, if not all, professional sports teams or individuals use some form of video analysis through a computer and software packages. However there is little research into the efficiency of match analysis systems, furthermore, the areas of human-computer interaction and artificial intelligence in match analysis systems have also been neglected.*

*Human-computer interaction is the study of the relationship, which exists between human users and the computer systems they use in the performance of their various tasks (Faulkner 1998). Whilst there are many definitions of artificial intelligence, it is first important to understand intelligence. There are very many definitions of intelligence; Negnevitsky (2001) defined intelligence as, ‘The ability to learn and understand, to solve problems and make decisions. The definition offered by Lapham and Bartlett (1995) was, ‘The faculty of understanding’; ‘the action or process of understanding’. Negnevitsky considered artificial intelligence to be a science that aims, ‘To make machines do things that would require intelligence if done by humans’. Lapham and Bartlett expressed the concept as, ‘The capacity of a machine to simulate or surpass intelligent human behaviour’.*

*This paper therefore investigates and discusses the efficiency and ergonomics of selected squash match analysis systems. The three systems analysed were Focus X2 manual system using a mouse, Focus X2 Voice Interactive system and the SWEAT (Murray and Hughes, 2001) system using keyboard data entry. The three systems were analysed in real time match analysis and lapsed time analysis using winner and error analysis. 4 matches were analysed in lapsed time and real time for each analysis system. Whilst the analysis procedure was being completed, video recording of the data entry were recorded. The study investigated data inputs per minute and analysis time, in lapsed time analysis. Whereas in real time analysis the paper examined the analysis times, errors made, error corrections, error correction times and total analysis time. A training study was conducted prior to the efficiency analysis to enable the researcher to gain sufficient learning of systems and prevent bias. A percentage difference calculation stated by Hughes et al. (2002) was used to perform an intra-operator reliability investigation in real time analysis and lapsed time analysis, overall highest errors being 3.9%, which were deemed satisfactory.*

*From the results, it found that the Focus X2 manual system was the most efficient in both lapsed time and real time analysis. The efficiency profiles of*

*the analysis highlight the strengths and weakness of the human computer interaction of the analysis systems. The findings of the study also concluded that from the three-match analysis systems there were significant ergonomic characteristics that affected the operator in the case of repetitive injuries. Furthermore, discussions into the development of technology to enhance the efficiency and ergonomic characteristics of match analysis software and computers. It was found from the study that more research into human computer interaction is required and also to research the use of artificial intelligence and the application to performance analysis.*

## 1 Introduction

As new technology is developing, sports can benefit through the application of performance analysis to provide detailed information during and after the performance. Furthermore, performance analysis and analysts can benefit through the improvements in Human Computer Interaction (HCI). Human-computer interaction is a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them (Baecker et al., 1992). From a computer perspective, the focus is on interaction and specifically on interaction between one or more humans and one or more computational machines. It should be clear that the role of HCI in system design is to enhance the quality of the interaction between human and computer systems. (Preece, 1994). Furthermore, it can be said that artificial intelligence has a part to play in the development of performance analysis data efficiency through computer systems.

Artificial intelligence (AI) is concerned with the design of intelligent computer programs, which simulate different aspects of intelligent human behaviour. In particular, the focus has been on representing knowledge structures that are utilised in human problem solving. AI knowledge and methods, such as the use of production rules, have been applied to HCI in connection with the development of tutoring and expert systems with intelligent user interface. However, the relationship of AI and HCI is mainly concerned with user interaction with an intelligent interface (Preece 1994).

The implementation of ergonomics in system design should make the systems work better by eliminating aspects of system functioning that are undesirable, uncontrolled or unaccounted for, such as inefficiency, fatigue, user difficulties and apathy.

The aim of this study was to build efficiency profiles of the three match analysis systems:-

-  Focus X2 manual (mouse),
-  SWEAT (keyboard) system and
-  Focus X2 Voice Interactive system

to enable efficient and reliable data to be completed in Lapsed time and real time analysis and identify ergonomic positive or negative characteristics for the operators usage of squash match analysis systems.

This paper therefore investigates and discusses the efficiency and ergonomics of selected squash match analysis systems. The three systems analysed were Focus X2 manual system using a mouse, Focus X2 Voice Interactive system and the SWEAT (Murray and Hughes, 2001) system using keyboard data entry.

## 2 Method

### 2.1 Introduction

The three systems were analysed in real time match analysis and lapsed time analysis using winner and error analysis. 4 matches were analysed in lapsed time and real time for each analysis system. Whilst the analysis procedure was being completed, video recording of the data entry were recorded. The study investigated data inputs per minute and analysis time, in lapsed time analysis. Whereas in real time analysis the paper examined the analysis times, errors made, error corrections, error correction times and total analysis time. A training study was conducted prior to the efficiency analysis to enable the researcher to gain sufficient learning of systems and prevent bias. The same researcher conducted all match analysis. To provide valid and reliable results a training study was conducted using all three systems in lapsed time and real time until the researcher's learning continuum curve 'plateaued' to indicate that the learning phase was over (figure 1).

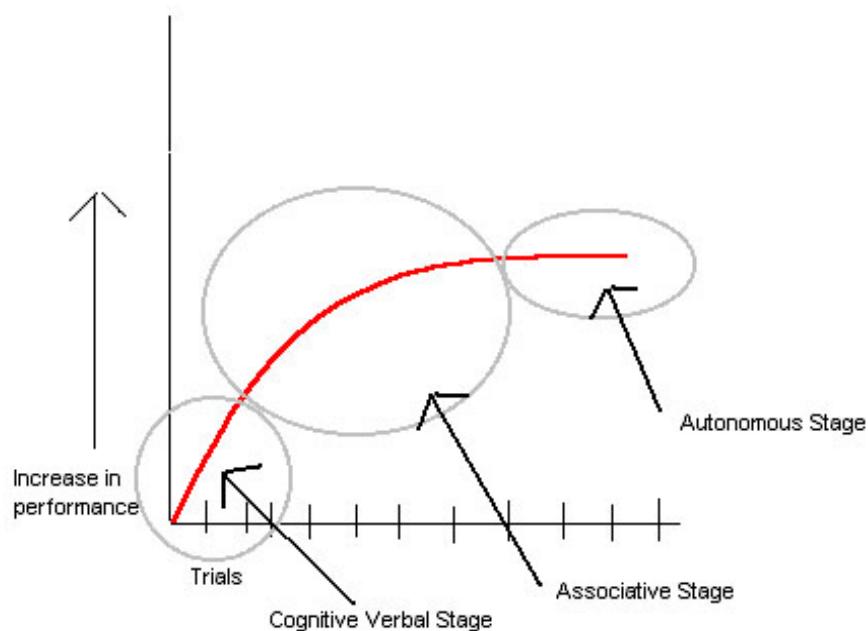


Figure 1. Graphical depiction of the three stage learning curve.

From the training study an intra-observer reliability test was conducted to deem this study valid and reliable. Following the completion of the training study and reliability test the researcher, and acceptable results from these, the research then progressed to the main study. In the analysis of efficiency and ergonomic characteristics 4 matches were analysed using each system in lapsed time and real time analysis, which meant each match will be analysed 6 times. To prevent the researcher memorising the match play and affecting the results of the study, the matches were randomised to improve validity and reliability.

To analyse ergonomic characteristics of the match analysis systems data entry procedure, video recording of the procedures were recorded. These video recordings enabled the researcher to identify ergonomic positives and negatives such as repetition stress on wrist whilst inputting data. Furthermore, the video enabled the researcher to identify areas of analyses that added increasing time to the analysis procedure and finally error correction and correction time.

From the lapsed time efficiency analysis method the results investigated the time taken to analyse the matches (broken-down into games), data entries per minute, shot statistics, court positioning and game statistics. Subsequently, the real time analysis investigated analysis times (per game), errors made, error corrections, error correction time, total analysis time, game statistics, court positioning and shot statistics. To analyse efficiency times between rallies for all matches were recorded to further the investigation in data input efficiency.

## **2.2 Equipment**

### ***Hardware***

Sony Vaio Laptop  
Microphone Head set  
Stopwatch  
Panasonic Wide Lens HD Camcorder  
Tripod

### ***Software***

Excel  
Focus X2 manual Analysis System  
Focus X2 Voice Interactive Analysis System  
Squash 2000 Analysis System

## **2.3 Data Collection System**

Three analysis systems Focus X2, Focus X2 Voice Interactive and Squash 2000 systems were investigated during ‘real time’ and ‘lapsed time’ match analysis using the same individual analyst. From the completion of the training study, 4 matches were analysed ‘real time’ using the three software packages. During the analysis the analysts was videoed to enable indications of errors made and timely areas of data entry. This same procedure was conducted using the ‘lapsed time’ software. To prevent the analyst becoming too familiar with the match play, randomisation of the order of matches being analysed changed during each software package analysed. For each software package a similar performance indicator template was devised to produce consistency of the study.

The performance indicators used in the study had operational definitions set to provide specific indications of all actions of performance to enable reliability in analysis (Table 1). The squash court was divided into a 4 x 4 cell, labelled 1 – 16 (figure 2, this was the same as that used by Murray and Hughes (2001)).

### ***‘Real Time’ Analysis Procedure***

Before the commencing of the analysis a Panasonic Wide Lens Camcorder was set up, to video the match analysis procedure, and was stopped at the completion of the

data entry. In the use of the two Focus systems the matches were captured onto the computer before commencing the analysis.

Due to the analysis being conducted real time the match duration was taken as the analysis time. However, if error corrections had to be completed after the match finishes a stopwatch was started and stopped on completion. Then the two times were added together to give overall analysis time. The analyst commenced the analysis on the start of the game.

This procedure was completed for all the real time analysis systems investigated within this study.

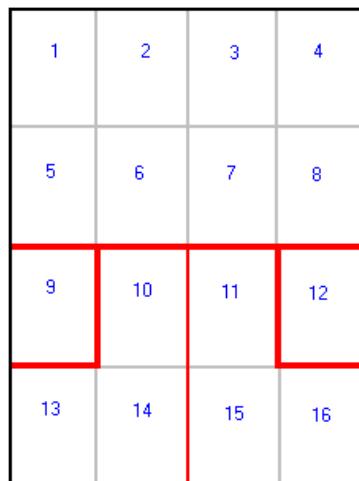


Figure. 2, The squash court divisions (Murray and Hughes, 2001)

Table, 1. Definitions of squash terminology

<b>Skill</b>	<b>Definition</b>
Boast	A shot, which strikes the sidewall before hitting the front wall.
Volley Boast	A shot which is hit before the ball has bounced, and hits the sidewall before hitting the front wall
Back wall boast	A shot which strikes the back wall before hitting the front wall
Reverse Boast	A shot, which strikes the opposite wall, than you are playing the shot from and then strikes the front wall.
Triple boast	Like a boast, but played at the front of the court.
Drive	A shot, which is hit straight to the back of the court.
Cross Drive	A shot, which is hit cross the court to the back of the court.
Cross Volley	A shot that is hit before the ball has bounced and is hit cross the court
Drive	landing in the back of the court.
Volley	A shot that is hit before the ball has bounced
Drop	A shot hit with great touch so that it dies close to the front wall
Volley drop	A shot that is played to the front of the court before the ball bounces.
Cross Volley Drop	A shot that is played cross to the front of the court before the ball

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	bounces.
Kill	A shot, which is hit hard and short on the court.
Volley Kill	A shot, which is hit hard and short on the court before the ball bounces.
Lob	A shot hit upward and softly on the front wall that arcs high off the front wall and comes down deep in the backcourt
Serve	A shot that starts of the rally by being hit onto the sidewall above the service line and lands in the opponents side within the back of the court.
Let	A situation in which a point is replayed
Stroke	Where interference occurs and yourself or opponents wins the rally

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### ***'Lapsed Time' Analysis Procedure***

Before the commencing of the analysis a Panasonic Wide Lens Camcorder was set up, to video the match analysis procedure. As the match analysis starts, a stopwatch was started to measure the time taken to complete process. In the use of the two Focus systems the matches were captured onto the computer before commencing the analysis.

The analysts commenced the match analysis, using the template devised for each system. During the lapsed time match analysis the analysts was able to use the power of pause and rewind to enable correction and justification of shots and positioning. When the data entry was completed the stopwatch was stopped and the time taken was recorded. Following this the video camcorder was stopped. This process was then completed for all the analysis systems being investigated in the lapsed time match analysis study.

### **2.4 Training Study/Reliability**

To enable the analyst to have an equally efficient knowledge of the use of these analysis systems, a training period was set up to enable improvements in using each of these systems. During the training period a single match was analysed, then every other day the match was re-analysed until the time in which it took to analyse the match stabilised and errors reduced to an acceptable level, which was deemed 10% for this study (Hughes et al, 2002). This was conducted for all the real time and lapsed time match analysis systems. A percentage difference calculation, suggested by Hughes et al. (2004), was used to perform an intra-operator reliability investigation in real time analysis and lapsed time analysis, overall highest errors being 3.9%, which were deemed satisfactory (Howells, 2006).

### **2.5 Data Population**

The actual data population used in this study was not deemed very important, but as most analysis is of elite athletes, then this was thought appropriate. The data population were matches of international standard professionals, all ranked within the top ten in the world rankings. The matches were taken from 2004-2008 season tournaments around the world. The broadcast coverage is public domain information that the subjects give permission to be broadcast. This was a condition of their entry to the tournaments. Nevertheless, player identities were kept confidential.

### 3 Results and discussion

#### 3.1 Training Study/Reliability

The training studies enabled the investigation of the ergonomics and efficiency of performance analysis systems. This training allowed the investigator to complete an inter-observer reliability study. The variables that were central to this investigation, and their reliability, were examined using an intra-operator percentage difference calculation. The three specific variables were, whether the player hit a winner or error, let or stroke, shots played and finally rally number.

Table 2. Times taken for data gathering in real and lapsed time .

#### LAPSED TIME

Lapsed time Analysis (Focus x2 Manual) Training Study					
	Test 1	Test 2	Test 3	Test 4	Test 5
Analysis Time	18 mins 30 secs.	14 mins 47 secs	10 mins 16 secs	7 mins 34 secs	7 mins 36 secs
Lapsed time Analysis (Focus Voice Interactive) Training Study					
Analysis Time	20 mins 12 secs	18 mins 35 secs	14 mins 28 secs	12 mins 31 secs	11 mins 54 secs
Lapsed time Analysis (SWEAT) Training Study					
Analysis Time	19 mins 52 secs	16 mins 18 secs	13 mins 42 secs	12 mins 37 secs	12 mins 36 secs
					12 mins 27 secs

#### REAL TIME

Match Analysis (Squash SWEAT system) Training Study 'real time'					
	Test 1	Test 2	Test 3	Test 4	Test 5
Analysis Time	10 mins 32 secs	10mins 32 secs			
Real Time Match Analysis (Focus x2 Voice Interactive) Training Study					
Analysis Time	7 mins 36 secs				
Real Time Match Analysis (Focus x2 Voice Manual) Training Study					
Analysis Time	11 mins 10 secs				

Table 2, Lapsed time analysis training study using the 3 systems.

	Focus x2 Manual					SWEAT						Focus Voice Interactive				
	Test 1	Test 2	Test 3	Test 4	Test 5	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 1	Test 2	Test 3	Test 4	Test 5
No. of Rallies	17	17	17	17	17	21	21	21	21	21	21	18	18	18	18	18
W's Played	9	8	8	8	8	10	10	10	10	10	10	9	8	8	8	8
Errors Played	7	8	8	8	8	6	6	6	6	6	6	8	9	8	8	8
Drives	5	5	5	5	5	8	8	8	8	8	8	2	3	3	3	3
Boasts	2	2	2	2	2	3	4	4	4	4	4	2	2	2	2	2
B Wall Boasts	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cross Drives	0	0	0	0	0	2	1	2	2	2	2	3	3	3	3	3
Cross VDrives	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1
Volley Drive	2	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0
Drop	6	6	6	6	6	3	3	2	2	2	2	4	4	4	4	4
Volley Drop	1	2	2	2	2	1	1	1	1	1	1	3	3	3	3	3
Cross V Drop	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kill	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0
Volley Kill	1	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
Lob	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cross Lob	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0
Lets	0	0	0	0	0	3	4	4	4	4	4	0	0	0	0	0
Strokes	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1

Table 3. Real Time Training Study using 3 systems.

	Focus x2 Manual					SWEAT					Focus Voice Interactive				
	Test 1	Test 2	Test 3	Test 4	Test 5	Test 1	Test 2	Test 3	Test 4	Test 5	Test 1	Test 2	Test 3	Test 4	Test 5
Total Shots	18	18	18	18	18	178	183	172	173	173	17	17	17	17	17
W's Played	9	9	8	8	8	12	12	12	12	12	7	8	8	8	8
Errors Played	8	8	8	8	8	4	4	4	4	4	9	8	8	8	8
Drives	3	3	3	3	3	5	4	4	4	4	5	4	4	4	4
Boasts	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Cross Drives	0	0	0	0	0	4	3	3	3	3	0	0	0	0	0
Cross VDrives	3	3	3	3	3	0	0	0	0	0	0	0	0	0	0
Volley Drive	1	1	1	1	1	0	1	1	1	1	0	0	0	0	0
Drop	0	0	0	0	0	3	2	3	3	3	0	0	1	1	1
Volley Drop	3	4	4	4	4	1	3	2	2	2	5	5	6	6	6
Cross V Drop	5	4	4	4	4	2	2	3	3	3	3	3	2	2	2
Kill	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Volley Kill	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lob	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0
Cross Lob	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lets	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Strokes	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0

## **Reliability study:**

Table 4. Lapsed time reliability results.

	T1 v T2	T2 V T3
	%	%
Rallies	0	0
Type of shot	1.9	0
Volley Drop	3.9	0

Table 5. Real time reliability results.

	T1 v T2	T2 V T3
	%	%
Rallies	0	0
Type of shot	3.7	0
Volley Drop	0	1.8

## **4.4 Efficiency Study Results:**

### **4.41 Lapsed Time Efficiency**

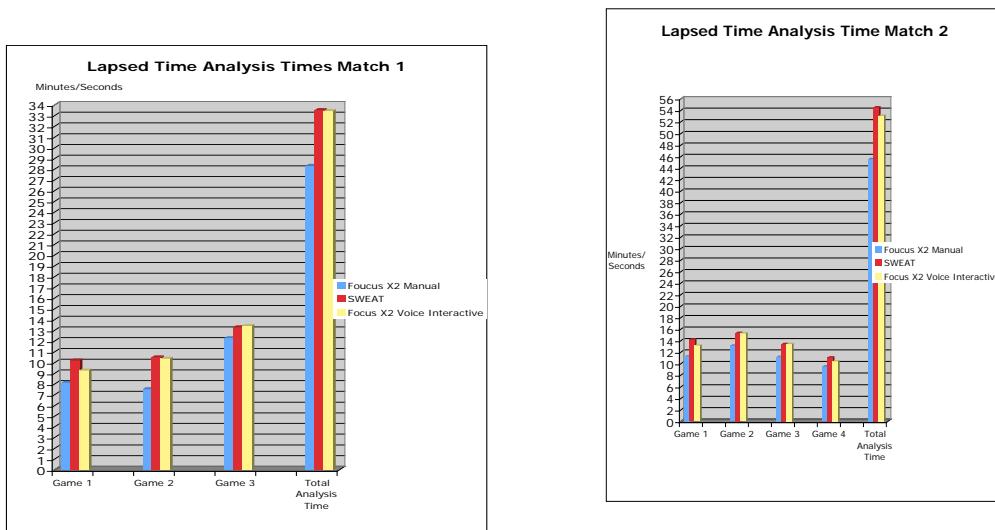


Figure. 3. Graphical model of Lapsed time Analysis Time Match 1 .

Figure.4. Graphical model of Lapsed time Analysis Time Match 2.

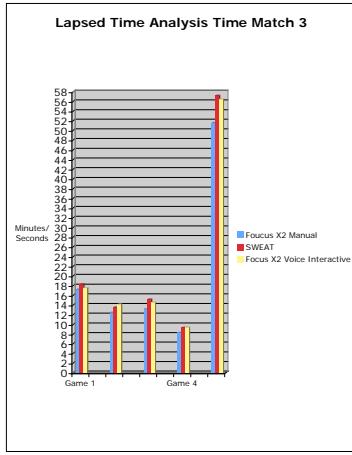


Figure. 5, Graphical model of Lapsed time Analysis Time Match 3

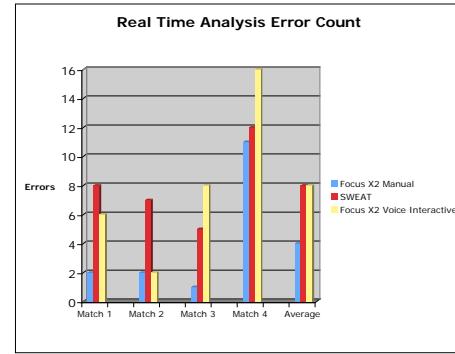


Figure. 8, Graphical model of Real Time Analysis Error Count

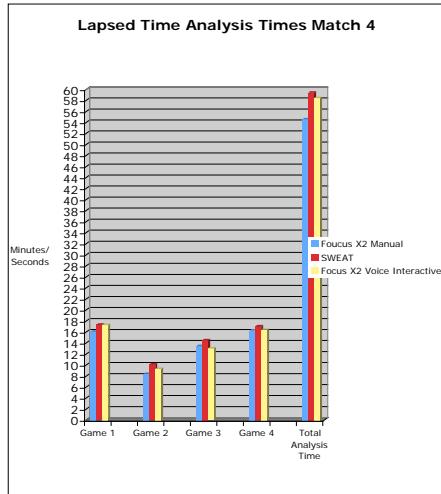


Figure. 6, Graphical model of Lapsed time Analysis Time Match 4

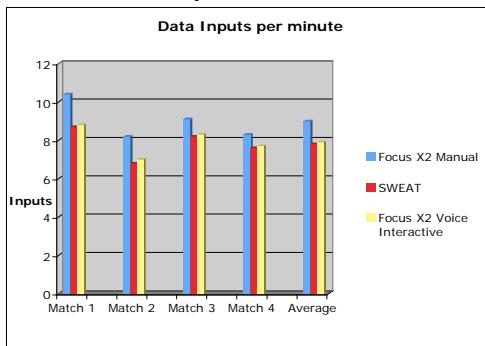


Figure. 7, Graphical model of Data Inputs per minute

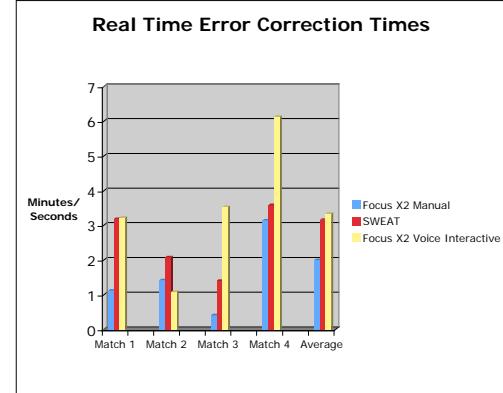


Figure. 9, Graphical model of Real Time Analysis Error Correction Time

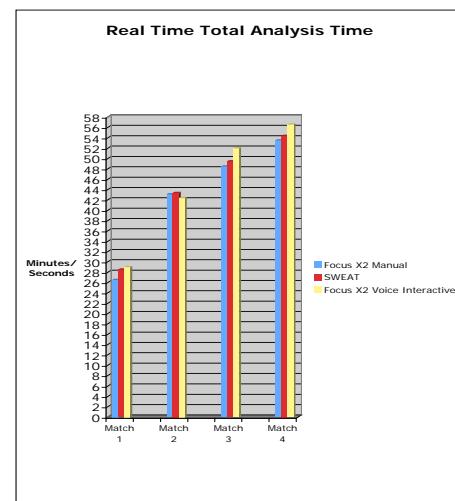


Figure. 10, Graphical model of Real Time, Total Analysis Time

## 4.42 Real Time Efficiency

### ***Focus X2 Manual system***

The results produced from this investigation highlighted that the Focus X2 manual input through a mouse is the most efficient in the study. This is witnessed through both the lapsed time analysis and real time match analysis. This could be suggested to be due to the researcher having previous usage experience of this system. However, to reduce bias in the study there was significant training on the SWEAT system and Voice interactive system that enabled valid and reliable results.

The times shown in the lapsed time tests show the greatest efficiency rating (Figures 3, 4, 5, 6). The lapsed time analysis times 28 mins 33 secs match 1, 45 mins 58 secs match 2, 51 mins 57 secs match 3, and match 4 54 mins 58 secs do not show much of a difference to that of the real time analysis times 25 mins 38 secs match 1, 41 mins 27 secs match 2, 48 mins 08 secs match 3, and match 4, 54 minutes 58 seconds, highlighted efficiency.

From the lapsed time tests the results furthered the suggestion of the efficiency of the Focus X2 system, through the number of data inputs completed ever minute with an average of 9 (inputs a minute) - in comparison SWEAT system produced an average data input a minute of 7.8 (inputs a minute) and voice interactive 7.9 (inputs a minute) retrospectively (Figure 7).

The real time match analysis results showed the systems efficiency through the error count being continuously lower than that of the corresponding analysis system. The Focus X2 manual average error count was 4, whereas the SWEAT system had an average of 8, and the voice interactive average also being 8. However, due to the two Focus X2 systems, manual and Voice Interactive, having similar error correction times.

### ***SWEAT system***

On the completion of the tests the results showed that the SWEAT system required the most training, (see Table 2), 6 tests required. This could be a consequence of the researcher having minimal contact with this system before the study, unlike in the two corresponding systems where the researcher had previous experience. The difference between the SWEAT system and the Focus X2 Manual and Voice Interactive is the ease of immediate use. Both the mouse and the microphone are easier to pick up and use than the keyboard with short cut keys. This reiterates the importance of training, to train the use of short cut keys and the coordination of processing inputted data. A study by Debaere et al (2003) investigated changes in brain activation during the acquisition of a new bimanual coordination task and it was observed that activation changes account for the transition from highly attention-demanding task performance, involving processing of sensory information and corrective action planning, to automatic performance based on memory representations and forward control. This shows that through training the brain in task performance can improve human memory of task and coordination, this is also demonstrated in the training study results.

The real time analysis results produced some findings that were opposite to the expectations. The hypothesis stated the real time analysis to be the most efficient system but the results showed this was not the case. Analysis times produced from the tests showed that in real time analysis SWEAT system was the second faster system (Figure 10) with times of 28 minutes 56 seconds (match1) compared to 26 minutes 50 seconds (match1) using Focus X2 Manual. However, the results did highlight that the analysis conducted using the SWEAT system produced the most amount of errors in match 1: 8 and match 2: 7 input errors (figure 8). This could be a result of a slip of a finger by the operator, in addition when using SWEAT system one would had to scroll to find performance indicator required in the short period of time between the rallies. The most efficient characteristic of the SWEAT system was the time

in which it took to edit the errors made. The editing facility is very quick as all the operator had to do was highlight the error and key the correct statistic into the data timeline.

From the lapsed time analysis of the SWEAT analysis system it was shown that there was a great difference between the Focus X2 manual system (figures 3, 4, 5, 6). and the SWEAT system. Though this wasn't expected from the results at the beginning of the study, the researcher found that the time was taken in the lapsed time analysis from the system not having the footage as part of the system. As a DVD player was required, it meant that every time a rally ended the DVD player had to be paused, data had to be inputted and if required, footage rewound and then the DVD being started again. Whereas, on the Focus X2 manual system and the Voice interactive system the video is on the software allowing quick pause and rewind and data can be inputted there and then. These results announce that the SWEAT analysis system is most efficient as a statistical system used in real time analysis to allow the athlete to gain game data to help improve performance. Nevertheless, if video footage feature would be added to the SWEAT system then the efficiency and feedback characteristic would be enhanced. This would allow a coach to use the video footage as a tool for player development in the review stage after the performance to back up statistics with actual footage this was view in a study by Brown et al (2008) into Split Screen System to Analyse Coach Behaviour: In a Case Report of Coaching Practice, it was found that the coach found the video sequence feedback to be more useful than the quantitative information produced. This backs up what is suggested in this study that the SWEAT system requires a video input device to improve feedback to player and will enhance efficiency of analysis. Allowing the athlete to visualise corrections required and new tactical profiles on opponents.

### ***Focus X2 Voice Recognition system***

Through the investigation it has been shown that the results from the Focus X2 Voice Interactive system are the least efficient in winner and error match analysis in squash real time analysis. This is witnessed through the error count being largest in match 3 and 4 (Figure 8) 8 and 16 input errors retrospectively. Nevertheless, it has been calculated and, the average error count for the study was Voice Interactive 8 errors inputs SWEAT 8 (error inputs) and Focus X2 Manual 4 (error inputs). This shows identical error inputs to that of the SWEAT system, however, from analysing the error correction times the Voice Interactive System has the largest average correction time (3 minutes 50 seconds) than that of the SWEAT system (2 minutes 56 seconds). This highlighted the Voice interactive system as being the least efficient system in real time winner and error squash match analysis.

However, from the results of the Lapsed time match analysis the Voice Interactive system is suggested to be the second most efficient system of the study. This is illustrated from the systems data input per minute capabilities leading to an average of 7.9 data inputs a minute which is larger than that of the SWEAT systems average 7.8 data inputs a minute, though smaller than Focus X2 manual 9 data inputs a minute. Whilst the Voice Interactive system had a larger data entry average, the actual analysis times seen in the results show some anomalies to the suggestion that the Voice Interactive system is second most efficient. In match 1 games 2 (10 minutes 36 seconds) and 3 (13 minutes 41 seconds) (Figure 3) it can be seen that the actual analysis times are larger than that of the SWEAT analysis times (Figure 3). Nevertheless, as game 1's time was smaller this created the Voice Interactive system having the larger data input a minute statistic. Further anomalies were found in the results data for match 4 game 3 where the analysis times were greater in the Voice Interactive analysis, this is suggested to be because of error whilst rewinding footage leading to enhancing of time causing the anomaly.

## 4 Conclusions

From this investigation it can be concluded that there are revealed differences in the efficiency profiles of the three squash match analysis systems analysed. This is evident by the indication of the Focus X2 manual (mouse) system being most efficient in real time and lapsed time analysis. Furthermore after conducting the comparative case study on the three-match analysis systems, indications of ergonomic characteristics, positive and negative, occurred through the usage of these systems.

This study confirms that future technological development can influence the efficiency and ergonomics of squash match analysis systems.

Finally it is suggested that the application of artificial intelligence be investigated for the extending the automation of data entry in performance analysis as conducted in athlete/coaching analysis, as suggested by Bartlett (2004) to optimise performance and human computer interaction of match analysis systems.

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# In search of nexus between attacking game-patterns, match status and type of ball recovery in European Soccer Championship 2008.

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## **Abstract:**

*The current study aimed to identify patterns of the successful attacking phases according to the type of ball possession recovery and match status (winning, drawing or loosing) of winning teams participating in the EURO 2008.*

*This is a lag-log study, according to a follow-up, nomothetic and multidimensional design, matching field formats with a system of categories. After outlining the protocol and determining the observation reliability (Cohen's Kappa>0.88), seven matches (fourteen observations) of the EURO 2008 were coded.*

*Using the Software for Visualization and Registration of the Offensive Phase in Soccer (Barreira et al., 2010), 761 attacks, 10007 multievents and 38846 events were recorded and analysed by the SDIS-GSEQ Software (Version 5.0.77, October, 1, 2010, Bakeman & Quera, 1995). All the periods without full observation, and exceeding the regular time, were excluded.*

*The goals scored, shots on target and wide shots ( $n=1.7\%$ ;  $n=4.4\%$ ;  $n=10.0\%$ , respectively) showed the tendency to occur from an indirect ball recovery. Corner kicks induced a high probability ( $z=3.87$ ) of causing wide shots, attesting that this type of behaviour probably bring on a marked unbalance in the opponent defensive dynamics. Unsuccessful attacks (ball out of the field or intervention of the opponent goalkeeper) showed the tendency to occur after a defensive action followed by pass, goal kick or free kick ( $z=2.77$ ;  $z=3.67$ ;  $z=4.36$ , respectively). When loosing ( $n=103$ ), the teams showed the tendency to improve ball possession in mid offensive zones ( $z=2.00$ ). When winning ( $n=108$ ), teams frequently performed defence/attack transition behaviours to get closer to the opponent goal. While drawing ( $n=540$ ), teams tended to vary the offensive methods to score a goal. In all the contexts of match status considered, the central offensive zone tended to be the most used to shoot.*

## **Key-words:**

Observational Methodology; Sequential Analysis; Soccer match analysis; European Championship 2008

## **1 Introduction**

Soccer matches have been mostly studied from a dichotomous perspective, related to attack and defence game phases. As these two opposite circumstances occur simultaneously, they involve the confrontation between order, organization and safety, while defending, and disorder, creativity and risk, while attacking (Silva et al., 2005).

Actually, it is unanimous that the moments of changing ball possession involve behaviours, which meaning to the match needs to be known. After ball recovery, and inversely after ball lost—transition moments—both teams compete to get advantage in time and space, developing individual and collective behaviours to improve their own organization levels, and to decrease the opponent team's balance. Although Romero Cerezo (2000) referred that transitions are moments with no organization, including chaotic behaviours, Barreira and Garganta (2007), and Barreira et al. (2010) observed that transitions could be trained to improve the patterns of play and probably reduce the game uncertainty and improve this attitude-changing efficacy.

In the current study, the Organization Model of the Soccer Game, proposed by Barreira and Garganta in 2007 was used (Figure 1), to systematize the offensive and defensive phases of the game, including the transitions. In this model, two types were proposed: interphase transition, and state transition, depending on the way the ball is recovered, indirect or direct, respectively.

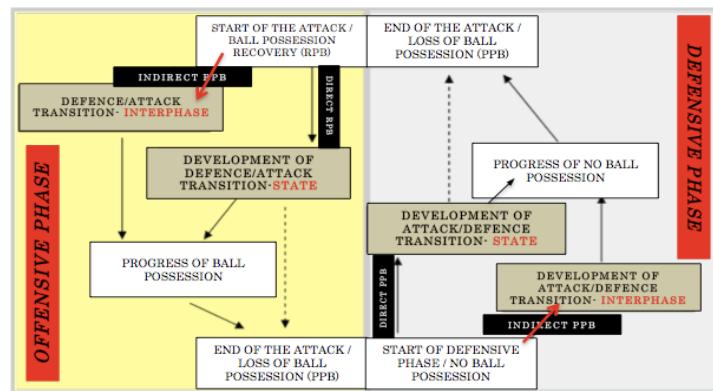


Figure 1. Organization Model of the Soccer Game (Barreira & Garganta, 2007).

According to Hughes and Bartlett (2002), Soccer is a “goals game”. However, the variance of the match score is not on a sufficient amount that allows identifying statistical determinants, due to the low number of goals scoring in matches (Lago & Martín, 2006).

This means that it might be more difficult to discriminate the match play patterns performed by winning teams when compared with defeated teams. Regarding the overall statistics of the World Cups, the average of goals scored per game has been decreasing, e.g., from Uruguay 1930 to Germany 2006, there was a reduction of 1.66 goals per game in average (3.89 to 2.23, respectively) (Castellano Paulis, 2009). Therefore, most studies considered that score opportunities (shots) and time of ball possession are the main tactical performance indicators to succeed in Soccer (Hughes & Bartlett, 2002).

Ball possession has been considered one of the most frequently used performance indicator in Soccer (Garganta, 2000; Hughes & Bartlett, 2002; Hughes, 2003; McGarry & Franks, 2003). One of the forceful evidences is the correlation observed between the ability to maintain the ball possession for long-standing periods of time and the success of attacking sequences (Bate, 1988; Jones et al., 2004). In fact, Grant et al. (1999), and Hook and Hughes (2001) reported that the most successful teams in both the World Cup 1998 and the Euro 2000 tended to maintain ball possession for longer periods than unsuccessful teams. Also, in the English Premier League, Jones et al. (2004) observed that the duration of ball possession was related to successful performance, while Bate (1988) added that the more ball possessions a team had, the greater the chance of entering the attacking third of the field, and

consequently more goal-scoring opportunities were created. Griffiths (1999) studied the winning team of the World Cup 1998—France—and found that the team was able to create more shots on goal than the opponent teams, and had the ability to retain ball possession for long periods. The author added that the French team attacked preferably through the wings, creating significantly more crosses than their opponent teams. Barreira et al. (2010), also investigating a specific team—Spain, the Euro 2008 champion—similarly observed that the team preferred the utilization of crosses from the left to the central path of the offensive sector, in contexts of numerical superiority, suggesting that in modern Soccer successful teams tend to attack preferably from wings. However, other studies found that crosses did not maintain positive relationship with finalization behaviours, as shot on goal (Hughes et al., 1988; Silva et al., 2005).

The behaviours carried out by Soccer players during matches seem to be affected by variables such as match location, match status and quality of the opposition (Taylor et al., 2008). Some authors concluded that the final match score states only the team who won the match, but no complementary indicators to assess the performance of one player or team can be obtained (Hughes & Bartlett, 2002; Ensum et al., 2005). For instance, when considering the match outcome as a win (e.g., a 1–0 win) for a team that scored a goal in the 85<sup>th</sup> minute, no account would be taken of the fact that for 95% of the match the teams were drawing. Therefore, the present study intended to state the influence of the match status (winning, drawing, and loosing) on the attacking patterns of the most successful teams participating in the Euro 2008. Accordingly, Taylor and Williams (2002) studied the World Cup 2002 winning team, and observed a relationship between the end of the offensive phase and the type of ball possession recovery, suggesting that the ball possession recovery in the defensive area resulted in more attempts on goal than for the other teams of the tournament.

Because Soccer game is a tactical wholeness, the offensive game-patterns evidenced by a team are closely associated with defensive patterns, and vice-versa, behaving the cooperation-opposition context, as the individual and collective constraints. Soccer game is characterized by its successive alternation of states of order and disorder, stability and instability, uniformity and variety (Garganta, 2001). However, it is also possible to observe, even only by the intuition or empirical experiences, behaviours that occur with unambiguous frequency and sequentially all over the match(es). Consequently, a model of analysis that achieves the specific complexity of the Soccer game in natural contexts has been proposed for match analysis—the Observational Methodology, in particular the Sequential Analysis—. This method enables the inclusion of the temporal constraints of the Soccer game, with a continuous analysis of the team(s), match event(s), and/or player(s), etc. More than a quantification of actions, this model permits the qualification of the quantities, establishing relations of the behaviours in the context they occur.

The present study focused on attacking phase—moments when teams had ball possession—. Accordingly, the defence/attack transition-state was defined to start from the attack scenarios preceded by a direct ball possession recovery, and to finish when the attacking player took the ball out of the pressure zone, maintaining the context of interaction without opponent pressure.

## 2 Method

### 2.1 Design

In the present investigation, eight teams were observed. In each match, two teams were followed all over the match time, regarding their interdependence and interaction, with one of

the teams being particularly registered and analysed, consequently demonstrating heterogeneous responses to the match events. Thus, this study was included in the quadrant IV: a follow-up, nomothetic and multidimensional study (F/N/M) (Anguera, 2001). The adoption of this F/N/M design led to a series of decisions being made regarding the type of data, structure of the observation instrument, data quality control, and data analysis.

## 2.2 Sample

All the teams that reached the play-off of EURO 2008 were observed from the quarter- to the final phase, and data were registered. Both teams were studied separately in each match, amounting two observations per match, e.g., a total of 14 observations (761 offensive sequences), with an average of 54 attacks per game, as shown in Table 1.

Table 1. Number of offensive sequences per match in the EURO 2008 play-off.

<b>EURO 2008 play-off phase</b>	<b>Observation Unit / Match</b>	<b>Observed Team</b>	<b>Final Result</b>	<b>Number of offensive sequences</b>
Quarter final	1. Portugal vs. Germany	Portugal	2-3	40
Quarter final	2. Portugal vs. Germany	Germany	2-3	40
Quarter final	3. Holland vs. Russia	Russia	1-1	49
Quarter final	4. Holland vs. Russia	Holland	1-1	54
Quarter final	5. Spain vs. Italy	Italy	0-0	47
Quarter final	6. Spain vs. Italy	Spain	0-0	82
Quarter final	7. Croatia vs. Turkey	Turkey	1-1	41
Quarter final	8. Croatia vs. Turkey	Croatia	1-1	50
Semi-final	9. Russia vs. Spain	Russia	0-3	49
Semi-final	10. Russia vs. Spain	Spain	0-3	76
Semi-final	11. Germany vs. Turkey	Turkey	3-2	56
Semi-final	12. Germany vs. Turkey	Germany	3-2	46
Final	13. Germany vs. Spain	Germany	0-1	62
Final	14. Germany vs. Spain	Spain	0-1	69
<b>Offensive Sequences: Total / Average</b>				<b>761 / 54 per game</b>

Matches—observation units—were observed and analysed in the regular time (90 minutes), and excluded the offensive sequences without full observation. Additionally, the offensive sequences were divided according to the evolving match status: winning, drawing, or loosing. Therefore, while loosing, there were registered sequences in five matches, resulting in 108 attacks, 1411 multievents, and 5436 behaviours. While drawing, 550 attacks were distributed for 14 matches, corresponding to 7614 multievents, and 29559 behaviours. While winning, attacks were observed in five matches, corresponding to 103 attacks, 1267 multievents, and 4917 behaviours.

Reliability was assessed using the EURO 2008 final match, with the respective inter-observer agreement. The first 30 minutes of the match Germany versus Spain were coded, with the reliability evaluated by the function “compute Kappa” of the SDIS-GSEQ software (version 5.0.77, October, 1, 2010, Bakeman & Quera, 1995). Bakeman & Gottman (1989) preconized that to have stability in the observations, Kappa value has to be superior to 0.75 in all the instrument’s criteria. In this study, Kappa values recorded from 0.88 to 0.98, with the lowest value ( $k=0.88$ ) in criterion 6—Centre of the game—and the highest in criterion 1—Start of the offensive phase—and criterion 4—Patterns of field space position—( $k=0.97$  and  $k=0.98$ ; respectively).

## 2.3 Instruments

### 2.3.1 Observation instrument

One basic requirement to use the Observational Methodology is to create an *ad hoc* instrument (Hernández Mendo et al., 2000). In the present study, field formats were combined with a system of categories simultaneously to answer a theoretical agreement and to follow the study particularities (Anguera, 1991). The instrument had seven criteria and a total of 80 behaviours, each of them represented by a different code:

1. Start of the offensive phase;
2. Development of defence/attack transition-state;
3. Progress of ball possession;
4. Finishing of the offensive phase;
5. Patterns of field space position (Garganta, 1997) (Figure 2.) (E/ME);
6. Centre of the game/Ball position (Barreira & Garganta, 2006) (E/ME);
7. Spatial patterns of teams' interaction, including position of the players with the ball and opponents (Castellano Paulis, 2000) (E/ME).

The first four criteria represented the behaviours, and the fifth was a structural criterion, dividing the field in 12 zones/categories (Garganta, 1997; Figure 2). The sixth and seventh criteria characterized the interactional contexts, regarding the relations of opposition and cooperation between teams and players.

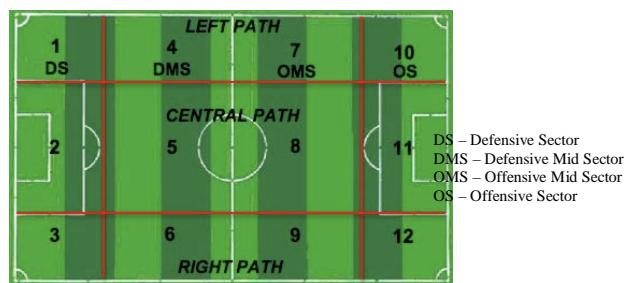


Figure 2. Patterns of field space position divided in twelve zones/categories (adapt. Garganta, 1997).

Criteria 5, 6, and 7 respected the conditions of exhaustiveness and mutual exclusivity (E/ME). For the other criteria (1 to 4), it was possible to incorporate other categories to the instrument to optimize the quality and the reliability of the observation process and final product. Thus, all the behaviours that occurred in the match were possible to register, although each behaviour corresponded only to one category and code (Table 2).

Table 2. Observation Instrument (Barreira et al., 2010)

CRITERION 1	CRITERION 2	CRITERION 3	CRITERION 4	CRITERION 5	CRITERION 6	CRITERION 7
START OF THE OFFENSIVE PHASE (I)	DEVELOPMENT OF DEFENCE/ATTACK TRANSITION (DT)	PROGRESS OF BALL POSSESSION (DP)	FINISHING OF THE OFFENSIVE PHASE (F)	PATTERNS OF FIELD SPACE POSITION (G)	CENTRE OF THE GAME / BALL POSITION (CJ)	Spatial Patterns of Teams Interaction (CEI)
DEFENCE/ATTACK TRANSITION- STATE	Development of the defence/attack transition-state (TEDA) by a positive short pass (DTpec)	Progress of ball possession (DP) by a positive short pass (DPPep)	SUCCESSFUL ATTACK	Zone one (1)	PRESSURE (P)	Ball in the Gk vs. Attacking line (VAD)
Ball possession recovery (RPB) by interception (IEi)	Development of the TEDA by a negative short pass (DTpen)	Progress of ball possession by a negative short pass (DPPen)	Shot wide (FrF)	Zone two (2)	Relative numerical Inferiority (Pr)	Rear line vs. Attacking line (ATAD)
RPB by tackle (IED)	Development of the TEDA by a positive long pass (DTplp)	Progress of ball possession by a positive long pass (DPPlp)	Shot on target (FrD)	Zone three (3)	Absolute numerical Inferiority (Pa)	Rear line vs. Middle line (ATM)
RPB by the intervention of the Goalkeeper (Gk) in defensive phase (IEgr)	Development of the TEDA by a negative long pass (DTpln)	Progress of ball possession by a negative long pass (DPPln)	Shot stopped by the opponent with no continuation of ball possession (Frad)	Zone four (4)	Pressure in numerical equality (Pi)	Rear line vs. Exterior zone (ATE)
RPB by a defensive action followed by pass (IEp)	Development of the TEDA by a positive cross (DTczp)	Progress of ball possession by a positive cross (DPCzp)	Goal Scored (Fgl)	Zone five (5)	NO PRESSURE (SP)	Middle line vs. Attacking line (MAD)
DEFENCE/ATTACK TRANSITION-INTERPHASE	Development of the TEDA by a negative cross (DTczn)	Progress of ball possession by a negative cross (DPCzn)	UNSUCCESSFUL ATTACK	Zone six (6)	No pressure in numerical equality (SPI)	Middle line vs. Middle line (MM)
Start / Restart of the offensive phase (IICg)	Development of the TEDA by ball conduction (DTed)	Progress of ball possession by ball conduction (DPed)	Loss of ball possession by an error of the ball carrier/opponent's intervention (exception for the Gk) (Fbad)	Zone seven (7)	Relative numerical superiority (SPr)	Middle line vs. Rear line (MAT)
Ball possession recovery by opponent's violation to the Laws of the Game (III)	Development of the TEDA by dribble (Ix1) (DTd)	Progress of ball possession by dribble (Ix1) (DPd)	Loss of ball possession by an error of the ball carrier / opponent Gk intervention (Fgrad)	Zone eight (8)	Absolute numerical superiority (SPa)	Attacking line vs. Middle line (ADM)
Ball possession recovery by Corner kick (IIC)	Development of the TEDA by reception / control of the ball (DTre)	Progress of ball possession by reception / control of the ball (DPre)	Throwing the ball out of the pitch (FT)	Zone nine (9)		Attacking line vs. Rear line (ADAT)
Ball possession recovery by Goal kick (IIPb)	Development of the TEDA by duel (DTdu)	Progress of ball possession by duel (DPdu)	Violation of the laws of the game (Fl)	Zone ten (10)		Exterior zone vs. Rear line (EAT)
Ball possession recovery by Ball in the ground (IIBs)	Development of the TEDA by shot (DTsr)	Progress of ball possession by shot (DPr)		Zone eleven (11)		Attacking line vs. opponent's Goalkeeper (ADV)
Ball possession recovery by Throw-in (IIL)	Development of the TEDA by an opponent's intervention with no success (DTse)	Progress of ball possession by an opponent's intervention with no success (DPse)		Zone twelve (12)		
	Development of the TEDA by the intervention of the Gk in offensive phase (DTgro)	Progress of ball possession by the intervention of the Gk in offensive phase (DPgro)				
	Development of the TEDA by the intervention of the Gk in defensive phase (DTgra)	Progress of ball possession by the intervention of the Gk in defensive phase (DPgra)				
		Progress of ball possession by opponent's violation to the Laws of the Game (DPI)				
		Progress of ball possession by Corner kick (DPe)				
		Progress of ball possession by Goal kick (DPPb)				
		Progress of ball possession by Ball in the ground (DPbs)				
		Progress of ball possession by Throw-in (DPLL)				

## 2.32 Recording and Analysing instruments

The Software for Visualization and Registration of the Offensive Phase in Soccer (Barreira et al., 2010) was created to reduce time spent in the observation process and errors when compared with the hand notation system. Consequently, it could improve the study reliability. Before registering the sequence, the observer categorized the match status, the competition phase, and match time. Registration software followed the analysis software language—SDIS-GSEQ software (Sequential Data Interchange Standard - Generalized Sequential Querier; Version 5.0.77<sup>65</sup>, October, 1, 2010, Bakeman & Quera, 1995). Data were exported to one Excel database, and then to the analysis software. The recording instrument included a Coding Manual, which incorporates the definitions of the codes that governed its use.

Data were submitted to a descriptive and a sequential analysis. Sequential analysis technique allows verifying the probability of significant associations (positive and negative) between the different behaviours on the Soccer game. Thus, achieving the z value, it is permitted to find out the strength of the relations between the behaviours and its sequentially.

## 3 Results and Discussion

### 3.1 Ball possession recovery

To analyse the associations between ball possession recovery and the end of the attack, a retrospective analysis was used, which did not follow the conventional rules of Sacket (1979) to find out the behaviours' patterns max-lag. To increase the significance level of the results and thus determine the associations between categories with 99% of certainty, values of  $z \geq 2.58$  or  $\leq -2.58$ , to  $p \leq 0.01$  or  $p \geq -0.01$ , respectively, were considered.

Wide shot game-patterns showed a positive relation with ball recovery by interception ( $z=2.82$ ) in lag -11. Wide shots were also verified after a ball recovery by corner kick (IIc) in lag -10 ( $z=2.70$ ; Figure 3) and in lag -2 ( $z=3.03$ ). As illustrated in figure 4, an intervention by the opponent goalkeeper occurred after a ball possession recovery by corner kick. Then, a throw-in of the observed team in zone 10 was performed, succeeding a cross in the same zone, with an intervention of an opponent player that originated another corner kick. This was performed in zone 10, with the ball reaching the zone 11 in context of attacking line versus the opponent's rear line. There, a shot was made, and the final wide shot occurred after a rebound, in context of no pressure in numerical equality in the centre of the game.

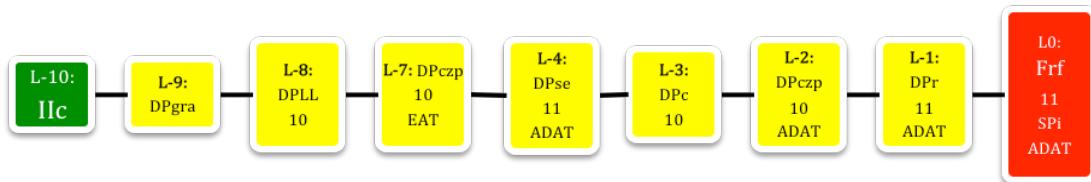


Figure 3. Attacking game-pattern resulting in a wide shot.

In the EURO 2008 play-off matches, the inside shot game-patterns showed a positive relation with ball recovery by throw-in, foul and opponent interception. The regaining by interception occurred immediately before the shot on goal in zone 8 or 11 ( $z=3.56$  and  $z=2.59$ ; respectively), showing that once a team recovered the ball in central offensive zones, it might have caused inside shots without scoring a goal.

A probability of goals being preceded by a throw-in was observed ( $z=2.58$ ; Figure 4). After this action, it was verified a ball progression ( $z=4.11$ ) in the same lateral wing, from zone 7 to 10 ( $z=3.00$ ), with a cross to the central offensive zone in interactional contexts of exterior zone versus rear line ( $z=3.35$ ). On the central offensive zone, it was created a situation of attacker(s) against goalkeeper ( $z=6.67$ ), which resulted in a shot with no goal scored. In the rebound, the goal was scored in a relative numerical superiority and a situation of attacker(s) against goalkeeper.

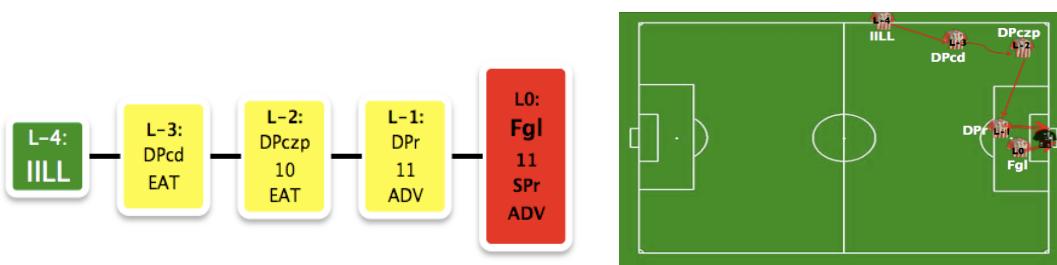


Figure 4. Goal game-pattern after a throw-in ball recovery (IILL).

Also, it was found the probability of goals being preceded by an indirect free kick on zone 10 ( $z=4.86$ ) in lag -2. Then, this set piece was performed in two ways (Figure 5): (i) passing to zone 10, followed by a cross ( $z=6.10$ ); and (ii) pass to the central offensive zone, where a shot with no goal was performed ( $z=4.50$ ). In both situations, the attack ended with a goal on zone 11 ( $z=6.19$ ) in situations of attacker(s) against the opponent goalkeeper, with relative numerical superiority ( $z=2.77$ ).



Figure 5. Goal game-patterns succeeding an indirect free kick.

In the EURO 2008 play-off, a probability of a goal to occur in the central offensive zone (11), in interactional contexts of relative numerical superiority (SPr), and in situations of attacker(s) against goalkeeper (ADV) was observed.

Unsuccessful attacks (ball out of the field and intervention of the opponent goalkeeper) showed the tendency to occur after a defensive action followed by pass ( $z=2.77$ ), goal kick and free kick ( $z=3.67$  and  $z=4.38$ , respectively). It was observed that the end of the attack caused by error of the player with the ball or the opponent intervention (exception for the goalkeeper) (Fbad) was probably inhibited by ball recovery by the goalkeeper and throw-in ( $z=2.70$  and  $z=2.60$ ; respectively).

There were found relations between the types of ball possession recovery and the zones where it occurred (Figure 6). In the beginning of the offensive phase (lag 0), it was verified a tendency of a direct ball possession recovery to be performed in the mid-defensive zones, when compared with the defensive ones. Thus, it was observed a higher probability of a direct ball recovery by tackle ( $z=2.94$ ), and by defensive action followed by pass ( $z=3.00$ ) made in the central mid-defensive zone (5), while there were found inhibitory relations between zone 2 and recovery by tackle ( $z=-4.58$ ) and interception ( $z=-4.06$ ). However, the central defensive zone (2) was positively associated with the goalkeepers' behaviours (IEgr,  $z=13.70$ ; IIpb:  $z=13.64$ ). The lateral defensive zones tended to be associated with a ball recovery by tackle (1:  $z=3.12$ ), which can be explained by the higher frequency of 1x1 situations in the offensive lateral zones, respecting the binomial risk versus safety. Throw-ins were performed homogeneously all over the lateral wings, though the more probability of occurrence in zones 4 and 9 ( $z=4.68$  and  $z=5.98$ ; respectively).

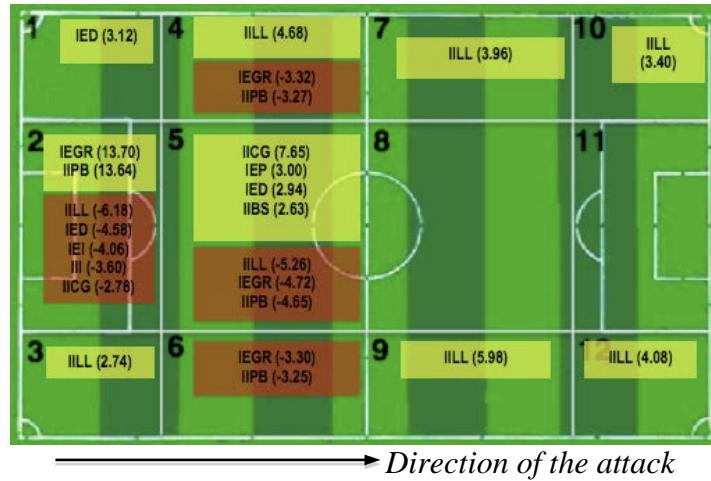


Figure 6. Associations (positive in yellow; negative in red) between field zones and type of ball possession recovery, regarding z values in the moment of ball recovery.

Consequently, teams probably assumed a defending strategy in which teams performed their defending behaviours in the mid-defensive zones, in particular in the central zone (5), opposing the defensive ones (2).

### 3.2 Match Status

When the teams were winning ( $n=103$ , observed in 5 matches), the tendency was to use behaviours of defence/attack transition after recovering the ball in defensive and mid-defensive zones. Accordingly, wide shots (figure 7) tended to be preceded by a long pass from mid-defensive zones to the left offensive one (10:  $z=2.62$ ) in defence/attack transition. An opponent performed unsuccessfully and the ball carrier dribbled one opponent, and performed a positive cross to the central offensive zone (11:  $z=2.60$ ), where the wide shot was performed.

However, it was found an exception to the goal patterns (figure 8). Goals tended to be preceded by an attack carried out with behaviours of development of ball possession in the left lateral wing (4:  $z=2.62$ ; 7:  $z=2.70$ ). A cross ( $z=2.59$ ) in zone 10 was performed, resulting in an unsuccessful shot. In the rebound, the goal was scored in a situation of attacker(s) against goalkeeper.

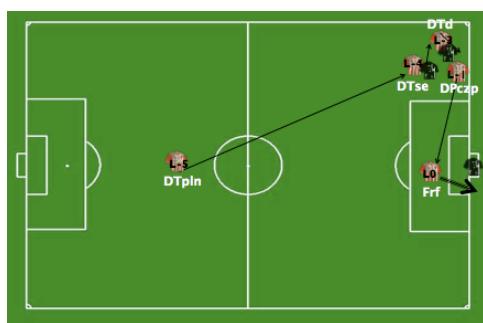


Figure 7. Wide shot pattern when teams were winning.



Figure 8. Goal pattern when teams were winning.

When loosing ( $n=108$ , observed in 5 matches), teams tended to use behaviours of development of ball possession to get near to the opponent goal, except for the end of the

attack with goal. In contrary to those of the winning teams, the wide shot patterns of the loosing teams (Figure 9) tended to be characterized by the use of development of ball possession behaviours. Teams tended to use the central mid-offensive zones to reach the opponent's goal and, probably because of the numeral inferiority in these zones, the attack ended with no success.

On the other hand, opposing to the goal patterns found in the moments when teams were winning, the loosing moments were characterized by defence/attack transition behaviours. There were found two patterns of scoring goals, both finishing in the central offensive zone (11: z=3.15). The first pattern—illustrated with red arrows in figure 11—showed the utilization of the left wing, and the goal was performed after a positive cross. The second pattern—blue arrow in figure 10—presented the use of the central path, with the individual behaviours (DTcd: z=4.86; DTd: z=4.93) being chosen to reach the opponent goal.



Figure 9. Wide shot pattern when teams were losing.

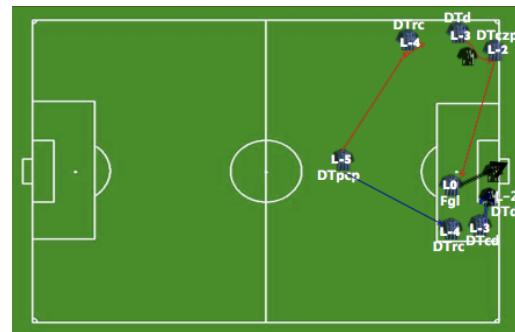


Figure 10. Goal pattern when teams were losing.

While drawing (n=550, observed in 14 matches), teams tended to vary the offensive method to score a goal, performed positive crosses in transition state (z=5.33), and kept ball possession (z=4.57) once the ball reached the left offensive zone (z=2.23).

In these contexts of match status (winning, loosing and drawing), the zone 11 tended to be used to shoot (z=2.57; z=3.15; z=4.09, respectively).

Regarding the occupation of the field, the loosing teams tended to play mainly in zone 8 (z=4.67), and finished the majority of the attacks with a shot without goal scored. On the other hand, the winning teams frequently used the offensive zones in the moments that preceded the shot, getting advantage of the opponent's lower defensive balance. The tendency seemed to be that the team with a score disadvantage had a relative unbalance when attacking, allowing the opponents to penetrate in the defensive zone with transition behaviours. However, this study confirmed that the winning team tried not to allow the loosing team to enter in the defensive zone, pushing their offensive players to midfield zones.

#### 4 Conclusions

The attempts to shot (goal scored, inside and outside shot) seem to be related with indirect ball possession recovery, in particular the free kick and throw-in. The direct recovery by interception appears to be linked to short duration attacks. Unsuccessful attacks occurred predominantly after a defensive action followed by pass, goal kick, or free kick.

It seems that the attacking patterns of successful teams participating in the EURO 2008 play-off were constrained by the match status. When defeated, the teams might become more offensive, even neglecting the defensive organization; whereas when winning, the foremost

aim might consist in not allowing the opponents to get near the goal, and then using short duration attacks to achieve the opponent defensive zones.

In the EURO 2008 play-off games, the teams tend to assume a defending strategy and tried to perform their defending behaviours in the mid-defensive zones, in particular in the central zone (5). This tendency was mainly observed when the teams were winning, by moving defensive lines backwards, and by performing short duration attacks. Thus, teams tend to increase the aggressiveness when the opponent players achieve the mid defensive zones, trying to recover directly the ball to perform defence/attack transitions.

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# Attacking game-patterns in Soccer. A sequential analysis of the World Cup 2010 winner team

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## Abstract

*The present study aimed to account tactical behaviours performed by Spain national Soccer team during the World Cup 2010.*

*To set the observation and data gathering, field formats were combined with a system of categories, according to seven criteria: Start of the offensive phase; Development of defence/attack transition; Progress of ball possession; Finishing of the offensive phase; Patterns of field space position; Centre of the game / Ball position; Spatial patterns of teams interaction, including position of the players with the ball and opponents.*

*After outlining the protocol and determining the observation reliability (Cohen's Kappa>0.90), four matches of the World Cup 2010 were coded (1/8 finals; 1/4 finals; 1/2 finals and final - four observations). Using the Software for Visualization and Registration of the Offensive Phase in Soccer (Barreira et al., 2010), 42 positive attacks and 802 multievents were recorded and analysed using the GSEQ Software, Version 5.0.77(Bakeman & Quera, 1995).*

*The goals scored were mainly preceded by behaviours in zones near the opposite goal (left and central offensive), and elapsed from the development of ball possession through a corner kick and defence/attack transition-state through shooting. Successful finishing of the offensive phase—shot on target—tended to be preceded by a context of interaction of absolute and relative pressure, both in left mid-offensive zone. Wide shots tended to occur in central mid-offensive zone in a context of numerical equality without pressure.*

## Key-words:

Sequential Analysis; Soccer match analysis; World Cup 2010; Spain national team

## 1 Introduction

Soccer can be characterized by the permanent relations of cooperation and opposition between players and teams. Hedergott (1978), Teodorescu (1984) and Bayer (1987) suggest, in soccer, two phases: the offensive and the defensive. If the team has the ball possession, means that they are attacking, and if the team doesn't have the ball, means that they are defending, to Bayer (1994) that is the difference between those two phases.

This study focused on the offensive phase, stated by Teodorescu (1984) as the moment(s) when a team has ball possession and tries to score a goal, without violating the laws of the game. Lago and Anguera (2002) state that the attack is the most important phase in Soccer game because it allows the team to be victorious in the matches and consequently in the competitions.

The Organization Model of the Soccer Game, proposed by Barreira and Garganta in 2007 was used (Figure 1) to systematize the offensive and defensive phases of the game, including

the transitions. In this model, two types were suggested: Interphase transition, and State transition, depending on the way the ball is recovered, indirect or direct, respectively.

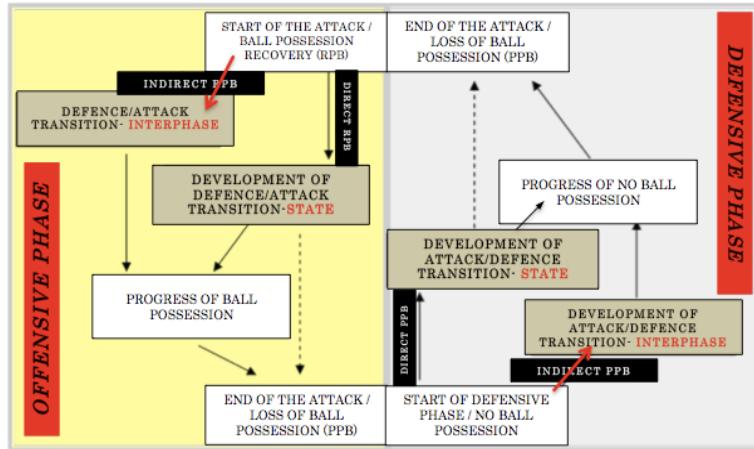


Figure 1. Organization Model of the Soccer Game (Barreira & Garganta, 2007)

Castellano Paulis (2000) defined ball possession as the moment when a player/team maintains the ball under control and has the possibility to develop or end the attack.

While attacking, team players may coordinate their behaviours to maintain their organization levels and, simultaneously, to create unbalance in the opponent's defense. According to Castelo (1996) one of the most complex problems in Soccer is to preserve the relations between the players in relation to an organized level—teams global organization— what depends on the way as the players develop their relations with their teammates.

The competitive level currently evidenced in Soccer has increased for players and teams. One of the ways used to understand and scrutinize individual and collective performance in Soccer is Match Analysis. The purpose of this study is to report the offensive tactical behaviors performed by Spain national soccer team during the World Cup 2010, using the Observational Methodology and, particularly, the Sequential Analysis technique.

## 2 Method

### 2.1 Design

In the present analysis, the World Cup 2010 winner team—Spain— was followed all over the matches' regular time. Tactical behaviours were registered and analysed, demonstrating heterogeneous responses to match events. The current idiographic and multidimensional study complies an intensive diachronic design (Anguera, 1997, 2001). The adoption of this design leads to a series of decisions being taken according to the type of data, the structure of the observation instrument, the data quality control and data analysis.

### 2.2 Sample

Four Spain matches were observed from the 1/8 finals to the final phase, and data were registered. Positive attacks—ending with a shot— were registered from a total 42 positive offensive sequences, as shown in Table 1.

Table 1. Number of Spain positive attacks per match in the Word Cup 2010 play-off.

WORLD CUP 2010 play-off	Observation Unit / Match	Final Result	Number of positive attacks
1/8 finals	Spain vs. Portugal	1x0	9
¼ finals	Spain vs. Paraguay	1x0	9
½ final	Germany vs. Spain	0x1	12
Final	Netherlands vs. Spain	0x1	12

The sample sequences were observed and analysed in the regular time (90 minutes), and all the situations without full observation were excluded.

Reliability was assessed through the observation of the WC 2010 final match, with the respective intra-observer agreement. The first 30 minutes of the match Spain versus Netherlands were coded two times by the same observer, with an interval of 15 days. The function “compute Kappa” of the SDIS-GSEQ software, version 5.0.77 was used (Bakeman & Quera, 1995).

Bakeman & Gottman (1989) stated that to have stability in the observations, Kappa value has to be higher than 0.75 in all the instrument’s criteria. In the current study, Kappa values recorded from 0.91 to 0.96, with the lowest value ( $k=0.91$ ) in criterion 6—Centre of the game—and the highest in criterion 1—Start of the offensive phase—and criterion 4—Patterns of field space position—( $k=0.95$  and  $k=0.96$ ; respectively).

## 2.3 Instruments:

### 2.3.1 Observation instrument

Field formats were combined with a system of categories in order to answer a theoretical agreement and to follow the study particularities (Anguera, 1991).

The instrument combines field formats with a system of categories and includes seven criteria and 80 behaviours, each of them represented by a different code:

- 8. Start of the offensive phase;
- 9. Development of defence/attack transition-state;
- 10. Progress of ball possession;
- 11. Finishing of the offensive phase;
- 12. Patterns of field space position (Garganta, 1997a) (Figure 2.) (E/ME);
- 13. Centre of the game/Ball position (Barreira & Garganta, 2007) (E/ME);
- 14. Spatial patterns of teams’ interaction, including position of the players with the ball and opponents (Castellano Paulis, 2000) (E/ME).

The first four criteria represented the behaviours, and the fifth was a structural criterion, dividing the field in 12 zones/categories (adapt. Garganta, 1997a; Figure 2). The sixth and seventh criteria characterized the interactional contexts, regarding the relations of opposition and cooperation between teams and players.

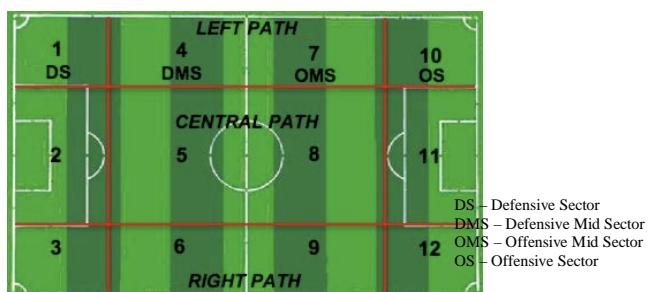


Figure 2. Patterns of field space position divided in twelve zones/categories (adapt. Garganta, 1997a).

Table 2. Observation Instrument (Barreira et al., 2010).

CRITERION 1	CRITERION 2	CRITERION 3	CRITERION 4	CRITERION 5	CRITERION 6	CRITERION 7
START OF THE OFFENSIVE PHASE (I)	DEVELOPMENT OF DEFENCE/ATTACK TRANSITION (DT)	PROGRESS OF BALL POSSESSION (DP)	FINISHING OF THE OFFENSIVE PHASE (F)	PATTERNS OF FIELD SPACE POSITION (Z)	CENTRE OF THE GAME/BALL POSITION (CJ)	SPATIAL PATTERNS AND INTERACTION (CX)
DEFENCE/ATTACK TRANSITION- STATE	Development of the defence/attack transition-state (TEDA) by a positive short pass (DTpcp)	Progress of ball possession (DP) by a positive short pass (DPpcp)	SUCCESSFUL ATTACK	Zone one (1)	PRESSURE (P)	Ball in the Gk vs. Attacking line (VAD)
Ball possession recovery (RPB) by interception (IEi)	Development of the TEDA by a negative short pass (DTpen)	Progress of ball possession by a negative short pass (DPpen)	Shot wide (FrF)	Zone two (2)	Relative numerical Inferiority (Pr)	Rear line vs. Attacking line (ATAD)
RPB by tackle (IED)	Development of the TEDA by a positive long pass (DTplp)	Progress of ball possession by a positive long pass (DPplp)	Shot on target (FrD)	Zone three (3)	Absolute numerical Inferiority (Pa)	Rear line vs. Middle line (ATM)
KPB by the intervention of the Goalkeeper (Gk) in defensive phase (IEgr)	Development of the TEDA by a negative long pass (DTpln)	Progress of ball possession by a negative long pass (DPpln)	Shot stopped by the opponent with no continuation of ball possession (FrD)	Zone four (4)	Pressure in numerical equality (Pi)	Rear line vs. Exterior zone (ATE)
RPB by a defensive action followed by pass (IEp)	Development of the TEDA by a positive cross (DTczp)	Progress of ball possession by a positive cross (DPczp)	Goal Scored (Fgl)	Zone five (5)	NO PRESSURE (SP)	Middle line vs. Attacking line (MAD)
DEFENCE/ATTACK TRANSITION-INTERPHASE	Development of the TEDA by a negative cross (DTczn)	Progress of ball possession by a negative cross (DPczn)	UNSUCCESSFUL ATTACK	Zone six (6)	No pressure in numerical equality (SPI)	Middle line vs. Middle line (MM)
Start / Restart of the offensive phase (Iieg)	Development of the TEDA by ball conduction (DTed)	Progress of ball possession by ball conduction (DPed)	Loss of ball possession by an error of the ball carrier/opponent's intervention (exception for the Gk) (Fbad)	Zone seven (7)	Relative numerical superiority (SPr)	Middle line vs. Rear line (MAT)
Ball possession recovery by opponent's violation to the Laws of the Game (III)	Development of the TEDA by dribble (1x1) (DTd)	Progress of ball possession by dribble (1x1) (DPd)	Loss of ball possession by an error of the ball carrier / opponent Gk intervention (Fgrad)	Zone eight (8)	Absolute numerical superiority (SPa)	Attacking line vs. Middle line (ADM)
Ball possession recovery by Corner kick (IIC)	Development of the TEDA by reception / control of the ball (DTre)	Progress of ball possession by reception / control of the ball (DPr)	Throwing the ball out of the pitch (Ff)	Zone nine (9)		Attacking line vs. Rear line (ADAT)
Ball possession recovery by Goal kick (IIPb)	Development of the TEDA by duel (DTdu)	Progress of ball possession by duel (DPdu)	Violation of the laws of the game (Fi)	Zone ten (10)		Exterior zone vs. Rear line (EAT)
Ball possession recovery by Ball in the ground (IIBs)	Development of the TEDA by shot (DTs)	Progress of ball possession by shot (DPr)		Zone eleven (11)		Attacking line vs. opponent's Goalkeeper (ADV)
Ball possession recovery by Throw-in (IIIIL)	Development of the TEDA by an opponent's intervention with no success (DTse)	Progress of ball possession by an opponent's intervention with no success (DPse)		Zone twelve (12)		
	Development of the TEDA by the intervention of the Gk in offensive phase (DTgro)	Progress of ball possession by the intervention of the Gk in offensive phase (DPgro)				
	Development of the TEDA by the intervention of the Gk in defensive phase (DTgra)	Progress of ball possession by the intervention of the Gk in defensive phase (DPgra)				
		Progress of ball possession by opponent's violation to the Laws of the Game (DPI)				
		Progress of ball possession by Corner kick (DPC)				
		Progress of ball possession by Goal kick (DPPb)				
		Progress of ball possession by Ball in the ground (DPbs)				
		Progress of ball possession by Throw-in (DPLL)				

Criteria 5, 6, and 7 comply with the conditions of exhaustiveness and mutual exclusivity (E/ME). For the other criteria (1 to 4), it was possible to incorporate further categories in the instrument in order to optimize the quality and the reliability of the observation process and the outcome. Therefore, match behaviours were registered each one corresponding to a single category and code (Table 2).

### 2.3.2 Recording and Analysing instruments

The Software for Visualization and Registration of the Offensive Phase in Soccer (Barreira et al., 2010) was created to reduce errors and the time spent in the observation process.

Registration software followed the analysis software language—SDIS-GSEQ software (Sequential Data Interchange Standard - Generalized Sequential Querier; Version 5.0.77, October, 1, 2010, Bakeman & Quera, 1995). Data were exported to an Excel database, and

subsequently to the analysis software. The recording instrument includes a Manual with the code definitions.

Data were submitted to a descriptive and a sequential analysis. Sequential analysis technique allows verifying the probability of significant associations (positive and negative) between different behaviours of the Soccer game. After determining the z value, it was feasible to identify the extent of the relations between the behaviours and its sequentiality.

### 3 Results and Discussion

In contrast with other team sports, e. g. Basketball and Handball, in Soccer only 1% of the attacks per game in average ends with a goal (Dufour, 1993). According to Szwarc (2004) and Lago-Peñas et al. (2010) winning teams in Soccer tend to have more effective attacks than the opponents. Accordingly, attacks ending with goal scoring (Fgl), shot on target (Frd), wide shot (Frfr) and shot stopped by the opponent (Frad) were considered as successful finishing of the offensive phase.

Wide shot was frequently performed in zone 8 ( $z=2.78$ ), with numerical equality without pressure in the centre of the game (SPi:  $z=2.88$ ) (Figure 3), while the shot into the target without goal—shot on target— (Figure 4) tended to be preceded by a numerical equality with pressure (Pi:  $z=3.19$ ). Also, shots on target rarely occurred in numerical equality without constraints in the centre of the game (SPi:  $z=-2.20$ ), concluding that shooting into the goal was performed with constraints, opposing the wide shot game-patterns.

It was found an inhibitory relation between wide shots and the central offensive zone (11:  $z=-2.74$ ), showing in moments preceding wide shots behavior players were far from the goal when compared with goal patterns.



Figure 3. Wide shot game-pattern



Figure 4. Inside shot game-pattern

Shot stopped by the opponent (Figure 5) was probably preceded by a player running with the ball ( $z=3.41$ ) in zone 7 ( $z=2.56$ ), between the mid line of the observed team and the opponent's rear line ( $z=5.48$ ). It was also verified interactional contexts of absolute pressure—observed team has three or more players less than the opponent in the centre of the game ( $z=2.80$ ).



Figure 5. Shot stopped by the opponent game-patterns

It was observed the major exploitation of the left mid-offensive wing to reach upper offensive zones. Thus, the players running with the ball moved the centre of the game from the left to

the central wing, whereas there was numerical inferiority probably inducing the shot stopped by the opponent.

The conclusions of the work carried out by Castellano Paulis et al. (2008) were confirmed in the present study. The decrease of number of goals scored since World Cup 1930 was extended to the World Cup 2010 by Spain, the winner team, showing only four goals scored in play-off games, winning all the matches by 1-0. We added that Spain's goal against Holland in the final match was not analyzed because Holland was playing with one player less, being this sequence excluded.

According to Hughes and Franks (2005), 80% of goals scored in Soccer matches were performed in short duration attacks, with players touching the ball in a maximum of four times. Garganta et al. (1997b) found that 93% of the behaviours leading to a goal were preceded by attacks with no more than three passes. This was confirmed by goal patterns found on Spain, occurring predominantly after shooting in a development of defence/attack transition (DTr:  $z=2.23$ ) (Figure 6), in contexts of confrontation between attacker(s) and opponent's goalkeeper (ADV:  $z=3.81$ ) or after corner kicks (DPc:  $z=2.23$ ) (Figure 7). Griffiths (1999) found similar results when analyzing France, world champion 1998, reaching a high number of goals from corner kicks and crosses into the opponent's area.

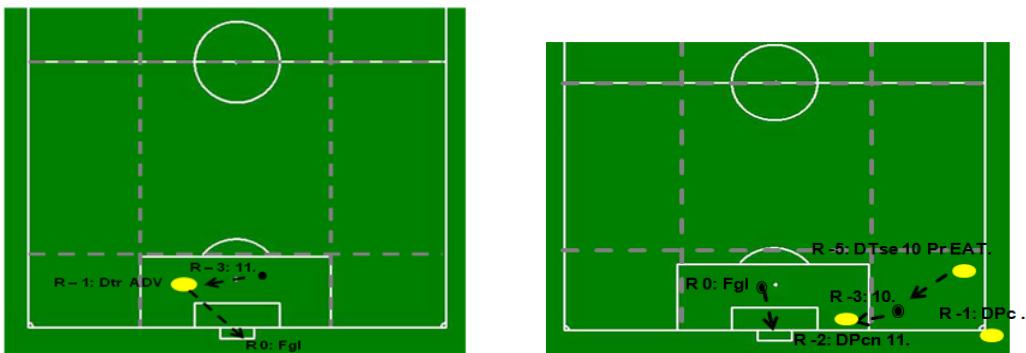


Fig. 6. Goal game-patterns after rebound. Fig. 7. Goal game-patterns after corner kick.

Hughes (1990) suggested a direct style of play in Soccer as the most productive method and some researchers (Garganta et al., 1997b) state that a direct style of play can lead to a higher goal-scoring percentage. However, team's efficacy seems to depend mainly on their capacity to change the rhythm of the game, to vary the attacking methods and to apply different styles of play to surprise the opponent (Garganta, 1997a).

The goal pattern of Spain team (Figure 6) started with a dribble ( $z=3.31$ ) in lag-5 in left offensive zone ( $10: z=2.16$ ), in a context of relative pressure—observed team has one or two players less than the opponent in the centre of the game ( $Pr: z=2.07$ )— and with the confrontation between the exterior zone of the observed team and the opponent's rear line (EAT:  $z=2.12$ ). Then, predominantly by dribble or cross into the opponent's central defensive zone ( $11: z=2.76$ ), a shot was performed (DTr:  $z=2.23$ ) and the goal occurs mainly after a rebound in situation of attacker(s) versus goalkeeper ( $z=3.81$ ).

Goal game pattern after corner kick occurred in defence/attack transitions (Figure 7) frequently started with an opponent's unsuccessful intervention ( $z=3.31$ ) in left offensive zone ( $10: z=2.16$ ) with relative pressure ( $Pr: z=2.07$ ) and with the confrontation between exterior zone of the observed team and the opponent's rear line (EAT:  $z=2.17$ ). The relative pressure in the left offensive zone tends to lead to a corner kick (DPc:  $z=2.23$ ), resulting in a goal.

## 4 Conclusions

Attacks performed by the Spanish national team in 1/8 finals, quarter finals, ½ final and final matches resulting in a goal were frequently preceded by individual behaviours (1x1 or running with the ball) and crosses, in offensive zones (10 and 11). Offensive sequences tended to start thought the lateral wings, progressing with the predominant use of individual behaviours (1x1 or running with the ball) to achieve the opponent's central defensive zone and score the goal. Moreover, goal happened after corner kicks.

Shots made in mid-offensive zones tended to be less effective than shots in offensive zones, probably because of numerical inferiority by the team who has the ball. When the ball reaches the opponent's defensive zone, the interactional context became favourable to the attackers. Thus, the shots in zone 11 tend to reach the target.

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## Performance analysis – the future

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### Abstract

*“Know your enemy as you know yourself and you need not fear one hundred battles;  
know yourself but not the enemy, for every victory gained you will also suffer a defeat;  
know neither the enemy nor yourself and you will succumb in every battle.”  
Sun Tzu, 652.*

*The demands and skills are defined by the different roles that the Performance Analyst can take the role of: Consultant, Researcher or Teacher. The most recent developments in hardware and software will be explored and proposals for their application be made, for example, see Figure 1.*

### Future of Performance Analysis

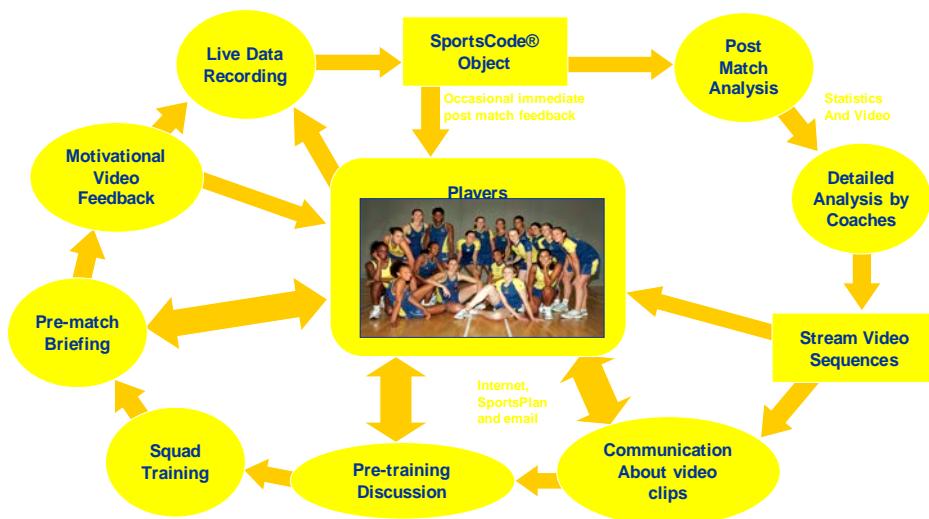


Figure 1. Example of applied analyses and feedback using computerized analyses (Mayes, O'Donoghue, Garland & Davidson, 2009).

Hughes (2004) suggested that the main skill required by consultant Performance Analysts are:-

- Performance Indicators,
- Reliability,
- Discriminate between PI's,

- *Empirical Profiling,*
- *Comparing data, and*
- *Modelling and Prediction.*

*The current advances in research will be reviewed in these areas and suggestions for future work discussed.*

## 1 Introduction

*Vision is perhaps our greatest strength.. it has kept us alive to the power and continuity of thought through the centuries; it makes us peer into the future and lends shape to the unknown.- Li Ka Shing .*

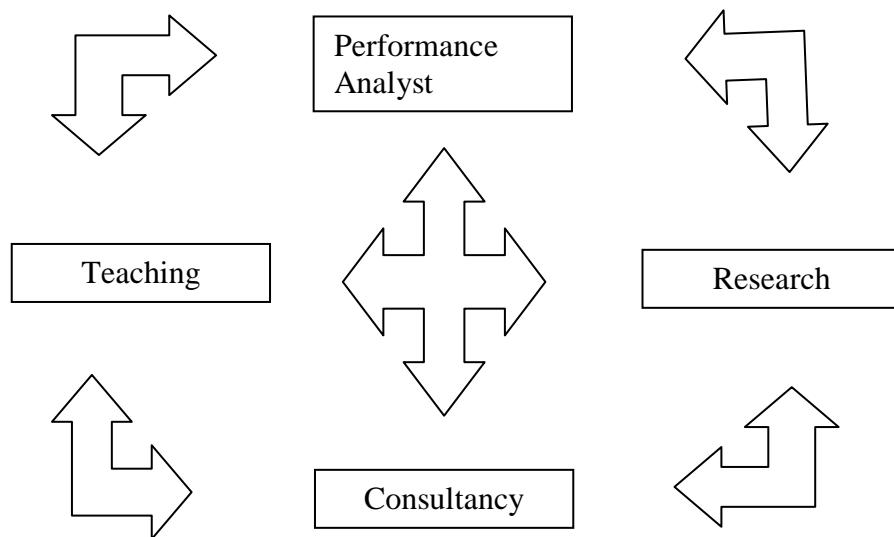


Figure 2. The roles and careers of a performance analyst.

The possible roles for a performance analyst are shown in Figure 2. The role of the consultant is driven by the demands of the coach, and the hardware and software available to the analyst. Current developments in hardware and software will be reviewed, but, as always, these reviews will be out of date before this paper is in press. The important message is that whatever the technology available, good analysis depends upon the skill and experience of the analyst and their communication skills in getting the messages across to the coaches and players.

Research informs the teaching process, and ultimately, drives the consultancy work. But not always, there are examples of analysts working in the field extending and developing techniques beyond those of the researchers. The latter are usually at the disadvantage of more limited resources.

Recent research has reformed our ideas on reliability, performance indicators and performance profiling in notational analysis – also statistical processes have come under close scrutiny, and have generally been found wanting. These are areas that will continue to develop to the good of the discipline and the confidence of the sports scientist, coach and

athlete. If we consider the role of a notational analyst (Fig. 1) in its general sense in relation to the data that the analyst is collecting, processing and analysing, then there a number of mathematical skills that will be required to facilitate the steps in the processes:-

1. defining performance indicators,
2. determining which are important,
3. establishing the reliability of the data collected,
4. ensuring that enough data have been collected to define stable performance profiles,
5. comparing sets of data,
6. modelling performances.

The recent advances made into the research and application of the mathematical and statistical techniques commonly used and required for these processes will be discussed and evaluated in this paper.

## 2 Academic and research



## Linear relationships in data gathering and feedback

Figure 3. Linear relationships in data gathering and feedback

When I first started working in sports science, the relationship between the scientist, the research data and the consultancy data was linear. Research data were often used to prescribe to the coach the training, tactical and technical strategies to be used with their athletes. As performance analysts became more experienced and more skilful, and often an integral part of the coaching and feedback processes with coaches and athletes, they tended to develop systems that were capable of providing in-event and post-event analyses of performance for the coach and the athlete. This also coincided with the introduction and development of computerised data gathering systems, the analogue nature of which inhibited, in some ways, the data analysis and presentation to the clients, it did aid the process in other ways.

Figure 4 presents a schematic of how analysts worked in the mid-80's through to the late 90's. Feedback loops from the coach/athlete teams to the separate analysts, when they existed, were separate – the sports science support teams of these times rarely talked to each other. The analysts in their separate disciplines collected the data, invariably they did all the videotaping themselves. The analogue VHS video cameras were unwieldy and bulky, so they were not generally used as leisure tools – so even operating video cameras was not a common

skill amongst coaches and athletes in the late eighties/early nineties. Analysing the video, with either commercial software (there was not a lot) or specifically designed systems, precluded the coach and athletes. Processing the data and presenting them in forms that the coach and athletes could understand was another problem area – it was only in the late eighties that PC's began to include colour screens and graphic capabilities. Commercial graphics packages arrived in the early 90's. The analyses of the data were yet another interface between the performers, the coaches and the analysis of performance. No matter how educated and enlightened the coach, the interpretation of these outputs (and the performance) was in the hands of the respective analysts. So, consciously or unconsciously, the analyst acted as a 'filter' on the interpretation of the data twice – many analysts attempted to involve the coaching teams in the design of these filter systems, but this was not always possible.

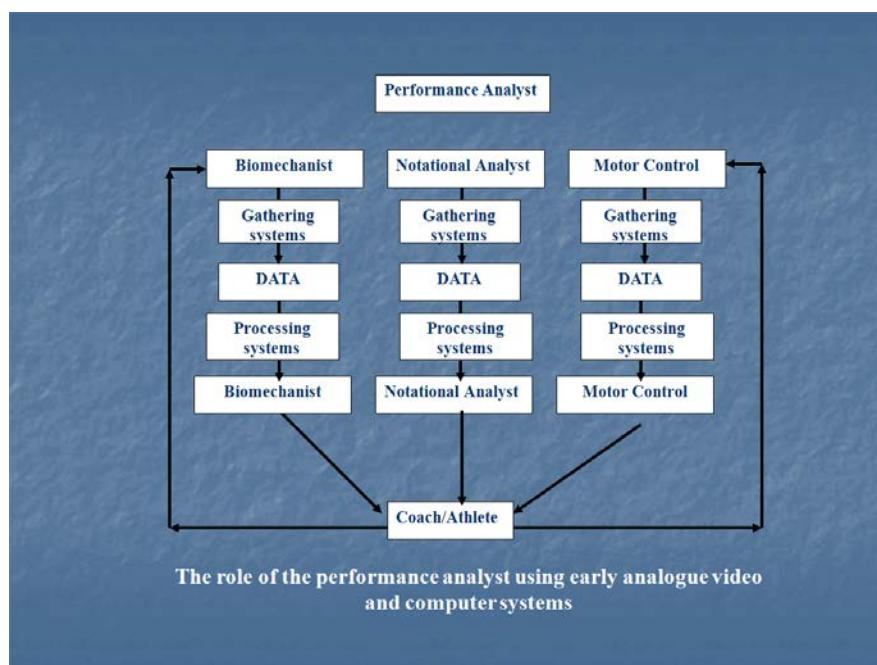


Figure 4. The role of the performance analyst using early analogue video and computer systems to gather and process performance data for the coach.

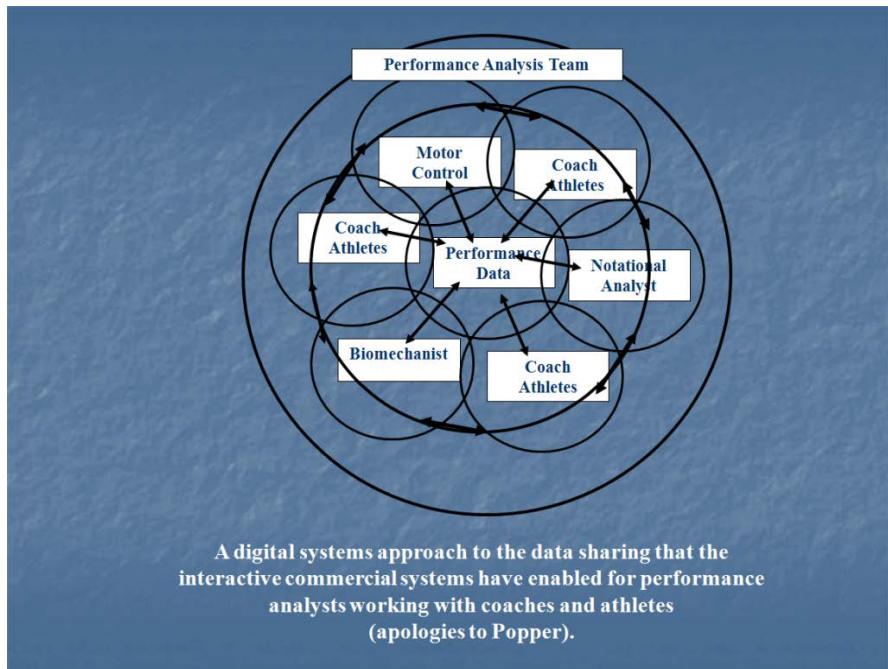


Figure 5. A digital systems approach to the data sharing that the interactive commercial systems have enabled for performance analysts working with coaches and athletes (from Hughes, 2004).

Notational analysis has changed radically with the introduction of digital technology. Coincidental with this new technology was the availability of the first commercial data gathering systems, and much more user-friendly computerised video-editing systems. The introduction of digital video cameras not only enhanced the quality of the recordings and the access to instant recall of any part of a performance (when accessed from digital storage not tape), but they immediately invaded the leisure market. In a couple of years everybody could operate video cameras. In recent years, computerised interactive analysis software, available commercially, improved step by step. These systems have become more and more easy to use and a lot of the mystery has been removed from producing edited videotapes of a performance. This means that coaches and athletes are now becoming more and more comfortable with handling the hardware and the software and can then take a more informed position in the partnership of the performance analysis team. This means the ‘data mining’ process can be one in which the whole team can be involved, it no longer means that the analyst is the only one understanding the process and the output. Inevitably the analyst will do the major part of the work, but performance data are best gathered and analysed as a product from a performance team – a combination of analysts from different disciplines, coaches and athletes, sharing as much information as they can (Fig. 5.). Digital technology makes this process so much easier now as the process becomes easier for all to assimilate.

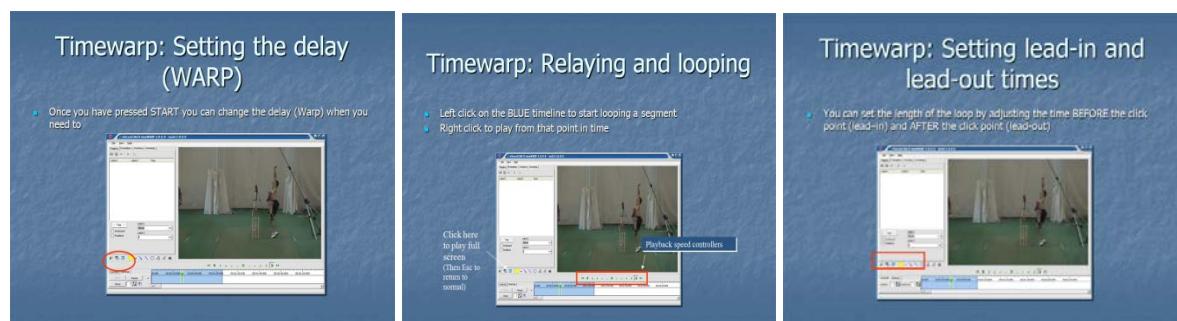
The software houses have not yet grasped the nettle of providing generic quantitative data analysis systems, in any depth or sophistication, integrated with their data gathering, but that cannot be far off. The data made available from these systems can then be easily interpreted. Therein lies a host of dangers for the coaches and athletes.

### 3 Consultancy

The working practise of notational analysts embraces most sports utilising a spectrum of software packages, together with the occasional application of a hand notation system. All systems of data collection, such as Focus or Sportscode, are carefully tested for reliability using clearly defined operational definitions, and statistical techniques applied to ensure that enough data has been collected to define stable profiles of performance. These will be used by coaches with their own players, to explore their strengths and weaknesses in technique, tactics and movement. Edited videotapes will then highlight the work that will need to be done to eradicate weaknesses and maintain their strengths. The same methods of analyses will be used on possible opponents, to examine best tactical strategies to employ against them. Movement analyses can explore fitness levels and/or movement technique, fundamental to success in many match play sports. Qualitative biomechanical analysis systems, such as Silicon Coach, Quintic and Dartfish, can be used in conjunction with the coach to explore technical problems, using still frame or slow motion analyses. Some analysts are finding high speed video cameras (400 fps) particularly rewarding, in this way, with racket sports coaches and players. Analysts spend half their time now editing videotapes for feedback, feed forward purposes for players and teams, motivation tapes, education tapes and coach analysis tapes. So in that way, their modus operandi has undergone a huge change over the last ten years. These new systems do aid that process immensely. There are now generic tracking and action analysing systems that can yield an immense amount of data of a whole team performance. Prozone is one commercial example of this (used by England RU, and a number of Premier Division Clubs in England). These are expensive in terms of capital outlay for the equipment and software, but they do yield huge databases of information, which in turn will demand expensive amounts of time to analyse them appropriately.

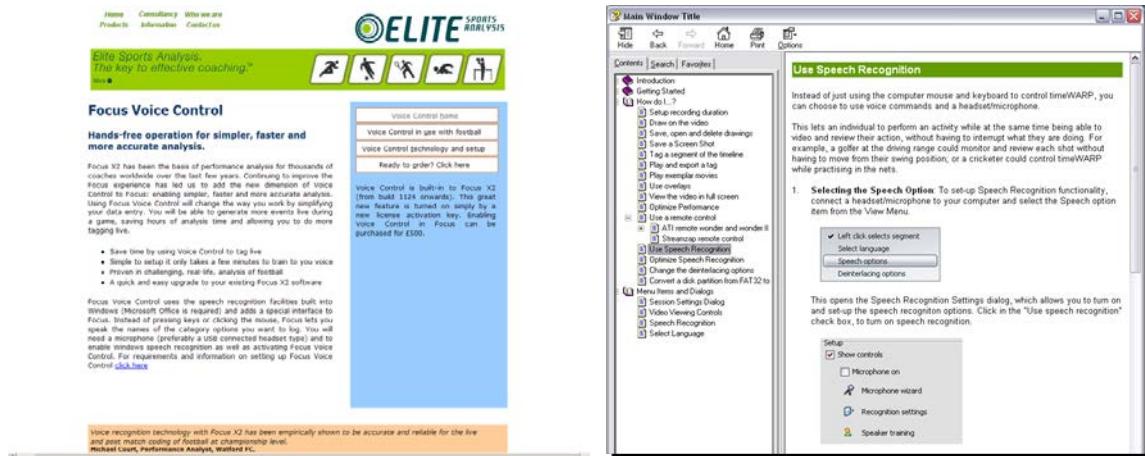


Figures 6a and 6b. Examples of recent developments in ‘Autotracking’ by Quintic.



Figures 7a, 7b and 7c. Examples of recent developments in ‘Timewarp’ by SiliconCoach.

Voice recognition technology with Focus X2 has been empirically shown to be accurate and reliable for the live and post match coding of football at championship level (Court, 2007). Taylor and Hughes (1988), in an early piece of research, suggested voice activated coding will be a natural extension for any current computing hardware system, and expected that the use of voice activated coding with sport analysis systems would be the next big step forward for the sport science community. Surprisingly the improvements in the hardware and software have been slow. Elite Sports Analysis have recently brought out Focus X2 (Figures 8a and 8b), with voice interactive software, the testing of which is presented in this volume (Hughes et al., 2011)



Figures 8a and 8b. Examples of recent developments in voice interactive software by Elite Sports Analysis.



Figure 9. Performance Analysis driving a video-based Knowledge Management with the Dartfish software packages.

Dartfish, as well as all the other software companies, has added different tools enabling the Performance Analyst to manage the knowledge of their organizations: online web platform directly linked to the traditional software applications; [very easy quantitative data integration on video](#), and '[easytag](#)' [PDA application](#).

ProZone are concentrating on

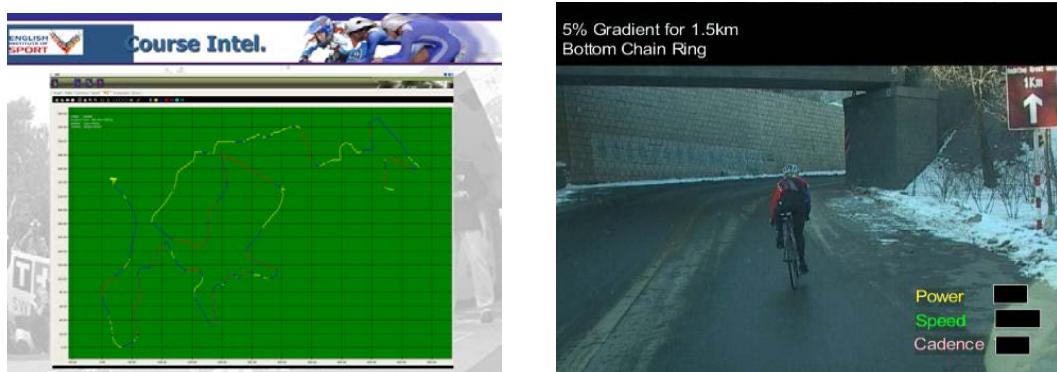
- **Real-time** - greater emphasis on instant access and objective intervention *during* matches, allowing coaches to make informed decisions immediately
- **Online access** – as coaches and managers become more familiar with web applications. E.g. ProZone Dashboard, which is ProZone's first online application giving users online access to performance information from anywhere in the world!
- **Increased usage** of performance analysis *in the media* and amongst the consumers (the fan); e.g. ‘real-time’ data access and gaming interactions. These opportunities also pose a threat to the performance analysis industry in terms of the accuracy, reliability and depth of information being broadcast via these portals.

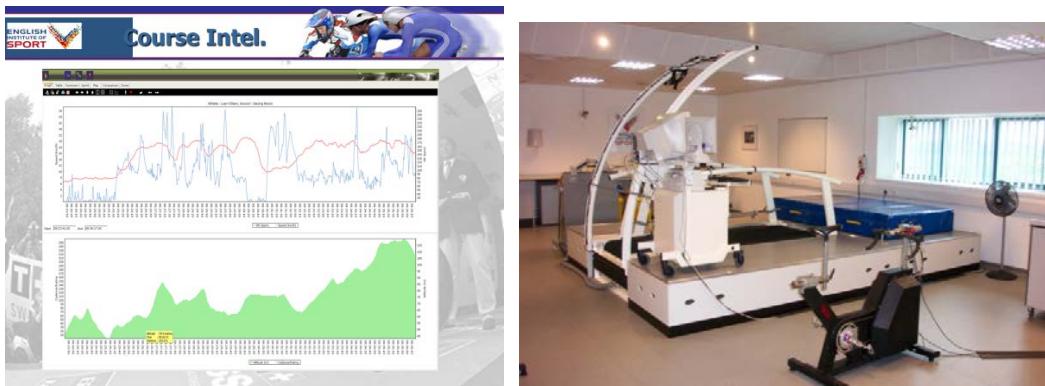
### **Various GPS Units**

Movement analysis, particularly in-event, has progressed rapidly in individual and team sports through the use of GPS units. Hughes (PGIR) has been very innovative in pioneering their application with the GB Cycling team in their build-up to, and during, the Beijing Olympics, when working with the EIS. He is now using these with England Rugby, and they are in use throughout the soccer Premiership.

1. GPS Sports                        5Hz (Claims 15Hz on the way)  
(Team Sports, cycling)
2. Catapult                        5Hz  
(Team Sports, including Everton!)
2. Garmin                        5Hz  
(Cycling, outdoor recreation)

The 1st two are the main 2 competitors for team sports and have the lions share of the market and are used extensively in Aussie rules and Rugby League for the last 5 years in matches as well as training (in Rugby Union this year). Garmin produces more for individual sports and for cars, has some very nice online facilities for tracking your rides and runs and producing reports.





Figures 10a, 10b, 10c and 10d. Exemplifying the application of GPS units in tracking cyclists in race (10a); videoing the road race course (10b) while monitoring the altitude and heart rates (10c) and replicating these conditions back in the training laboratories in Manchester (10d).

From a team sports perspective GPS Sports and Catapult offer very little differences. Both provide 5Hz monitoring, a similar level of accuracy, coverage of satellites and size and weight. Both suffer from the same problems though, fairly lengthy download times for multiple units. But, very badly designed software for producing reports of training sessions, no database management facility to build up profiles of athletes over time, faulty synchronizing of the data with video and poor support due to their offices being based in Australia, are all disadvantages of these units.



Figure 11. The Apple ‘iPad’.

Another technological innovation that is proving very popular is the ‘iPad’, particularly with players and athletes as a way of sending and watching edited videos. The iPad has an excellent mix between portability and an easily viewed screen, and with great resolution and clarity, it means it is ideally suited for video feedback during training or matches. In addition it has wireless facilities to receive video and data and can be connected directly to a projector for presentations. On the other hand it has no USB ports for transferring information, so you have to use ‘iTunes’ software or other applications, and it has limited memory size of 64Gb means it soon fills up if using a lot of video. It is thought that the second or third generation of these appliances will be far better.

## 4 Research

It has been suggested that the processes necessary for a Notational Analyst working either as a consultant or an academic researcher are as follows (Hughes, 2004) :-

1. defining performance indicators,
2. determining which are important,
3. establishing the reliability of the data collected,
4. ensuring that enough data have been collected to define stable performance profiles (performance profiling),
5. comparing sets of data,
6. modelling performances.

It was concluded that recent research has demonstrated:-

- ✓ clear methods for determining which performance indicators are relevant and which are more important,
- ✓ simple absolute measures of reliability need to be used together with accepted non-parametric measures of variance,
- ✓ that if performance profiles of teams or individual athletes are being applied, then some measures of confidence in the stability of these profiles need to be expressed,
- ✓ the comparison of sets of data in notational analysis needs to be considered carefully, as the data are usually non-parametric and conform most likely to Poisson and Binomial distributions. The use of  $\chi^2$  seems to be a simple answer, however, as soon as more complex models and higher-order comparisons are required, the approach based on log-linear models is shown to be more effective,
- ✓ the sensitivity of these  $\chi^2$  and log-linear models to the small differences in performance, that differentiate between winning and losing at the elite level, is open to question,
- ✓ that there are many techniques used to model sport, some of these are providing the greatest challenges to notational analysts and mathematicians alike.

It is clear that the working notational analyst must have a broad set of mathematical and statistical skills and be prepared to maintain and extend those skills just as the research in this area develops the knowledge base. Further research is urgently needed in some of these areas:-

- ❖ How do we define performance indicators in a general and generic sense? At the moment they are arbitrarily defined for each sport depending upon the subjective opinions of the analyst and/or coach.
- ❖ The statistical methods that we use are improving, but more work needs to be done on making the more sophisticated systems more transparent, in terms of how they relate to the experimental aims of the comparisons, and also the basic practical demand of them being easier to apply.

- ❖ The sensitivity of the tests needs to be examined – how can we determine the significant differences in performance when the increments of comparison are very small?
- ❖ More research in modelling in performance analysis is vital as we extend our knowledge and databases into those exciting areas of prediction.

Using the word prediction in the same phrase as sport almost certainly creates a form of an oxymoron, because of the inherent nature of sport. Nevertheless, working towards the extended aims of modelling, and therefore forecasting, must be the most exciting of the ways to further develop performance analysis.

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# **Analysis of physical demands of ballroom dancers in tango and quickstep using the tracking system SAGIT.**

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## **Abstract**

*The tracking system SAGIT was used to study the physical demands placed on a sample of six qualitatively different ballroom (BR) dance couples (3 higher (PRO) and 3 lower (JUN)-quality) in the tango and quickstep.*

*All the couples danced two BR dances at the same time (tango and quickstep). Dancers were recorded directly to DVD with one camera at a frequency of 25 frames per second. Recordings were analyzed using the SAGIT tracking system to determine the distance covered and the average speed of movement of the dancers.*

*Comparison of PRO and JUN couple's trajectories showed that the younger and less experienced dancers were still using the basic choreographic form through the circle while the top dance couples were looking for a way in the inner space of the dance floor, not just on the outside edge of a dance circle.*

*The results show that the dynamics of movement decreases as the quality of the dancing couple decreases PRO couples covered longer distances on average (about 30m) and their average movement speed was also approximately 0.3 m/s higher. This increase in speed was not at the cost of the movement characteristics. Consequently this finding confirms the commonly held belief that softness and speed are key for success in BR dance choreography and technique.*

## **1 Introduction**

Sport dancing in Slovenia has a long-standing tradition, as well as many great international successes in sport dancing competitions. Bigger national and international competitions demand more precision, systematic and professional work from young dancers and a more holistic, interdisciplinary approach to improve performance in this sport. Kinesiological science thus intertwines with other sciences and theirs methods that research the possibilities of improving sport results.

Sport dance is still a »young« sport discipline, which started to develop around 1920. It is a monostructure, complex, conventional sport discipline which emphasises energy and information components on the one hand and aesthetics of movement on the other. Sport dancers are very expressive in their dance, often undertaking aesthetic movements (Zaletel, Tušak, Tušak, & Zagorc, 2005). Of course, dancers have to be physically well prepared to achieve the status of a top dancer and to execute moves beautifully, achieve harmony in movement, precision, synchronisation with music etc. Artistic or, even better, aesthetic preparation is one step above physical preparation yet all three are merging together.

Dance in its superb form combines virtuosic mastery of the body in a certain rhythm and the simultaneous compliance with her/his partner (Zagorc, 2000).

Dance is an art that has developed in space and in time (Da Silva in Bonorino, 2008), expressing sensibility through the physical movement, in a harmonious way or not, according to the interpretation and the aesthetics of expression (Dantas, 1999). It is a sequence of gestures, steps and physical movements with musical rhythm that expresses affectionate states (Catarino, 2002) and, as closer to the perfection the dance becomes, less we distinguish its elements (effort, gravity, body, muscular strength, objects, sound) (Zucolloto in Freire, 2003).

Sports dance consists of five ballroom (BR) and five Latin American dances (LA). Dance couples can compete in a combination of ten dances or in each group separately. Choreography for competitors take place over a relatively long time of 1min 40sec.

BR dances (English waltz, tango, Viennese waltz, slow foxtrot and quickstep) have been developed in Europe, where the English created a distinctive natural and easy style. BR dances have more subdued character and they use closed dance position. The dance partners are in constant contact with each other while dancing around a virtual circle around the room, in an anti-clockwise direction. Movement in BR dances is current, still fast, emphatic periods in music (at the beginning of each cycle) are followed by extended and emphasized steps, which seems to be the ability of dancers for a correct interpretation of the characteristics of movement in a particular dance.

Time and space are two essential parameters of a dancer's expressiveness (Minvielle-Moncla, Audiffren, Macar and Vallet, 2008). Accuracy in timing motor activities is a major asset in choreographic production both with and without a partner. Dancers often adapt their movement timing to the accompanying music and to their partner's motion and displacements. Speed of executed steps, movement structures and dance figures is extremely important for success in dance.

In order to achieve excellence in sport dance there are various tests, which give some relevant information to dancers, trainers and researchers, so that further improvements can be made in future training. So far, we have carried out several studies of connection and dependence of different dimensions of psychosomatic status of dancers and the environmental impact on their success: a study of morphological and motor skills of sport dancers, the study of the psychological dimensions of sport dancers in comparison with other top athletes (personality, motivation, values, self-concept, interpersonal skills) (Zagorc and Zaletel, 1996; Zaletel, Zagorc and Tušak, 2004; Zaletel, Tušak and Zagorc, 2007).

In addition to the aesthetic movement and morphological characteristics (Da Silva and Bonorino, 2008, Claessens, Nuyts, Lefevre and Wellens, 1987), for sport dancers there are many other important skills and characteristics (Brown, Martinez, and Parsons, 2006; Zagorc, 2000). For example, studies show a high physiological load for sport dancers (Jaray and Wanner, 1984, Hollmann and Hettinger, 1990; Zagorc, Karpljuk and Friedl, 1999; Zagorc and Kanduč, 2009).

The study of physical demands in complex sports is important in terms of appropriate physical, technical and tactical preparation. Therefore, the scientific literature is offering many studies whose primary purpose was to examine the physical effort of athletes in soccer (Bangsbo, Mohr and Krustrup, 2006), basketball (Ben Abdelkrim, El phase and El Ata, 2007), rugby (Deutch, Kearney and Rehrer, 2007), handball (Sibila, Vuleta and Pori, 2005), volleyball (Mauthner, Koch, Tilp and Bischof, 2007) and squash (Hughes, Franks and Nagelkerke, 1989). Despite the remarkable popularity of dance, the research literature is deficient in the area of investigation of the dancer's movement through the space and the range and speed of movement in two-dimensional space. In the present study we examined the workloads of qualitatively different dance couples in selected BR dances. We also wanted to determine the possible differences in distance covered and speed of movement between dancers of different quality.

## **2 Methods**

### **2.1 Subjects**

The group sample consisted of 6 BR dance couples (6 females, 6 males), who differed in quality of their dance. There were 3 competitive dance couples, who dance professionally and are training every day (PRO), and 3 junior couples, who have potential to be very successful, but their quality is lower (JUN).

Participants were 16 to 24 years old (PRO couples:  $M=23.8$ ;  $SD=2.2$ ; JUN couples  $M=16.5$ ;  $SD=3.4$ ). In 2010 all the top-level athletes were members of respective (junior and/or senior) national teams; some of them are also World Champions.

All the couples danced tango and quickstep at the same time.

### **2.2 Equipment**

The study took place in the sports hall in Ljubljana. Dancers were recorded directly to DVD with one camera (Ultrak KC CCD Color CP 7501, Japan) at a frequency of 25 frames per second. The camera was secured on the ceiling of the hall which enabled the recording of a rectangular projection on the dance area. By using a wide-angle lens (Ultrak KL2814IS, Japan) the entire dance area was in view.

### **2.3 Processing the data**

The footage was later transferred to a PC and analyzed with the SAGIT tracking system, which is a human tracking measurement system based on computer vision technology (Perš, Bon, Kovačič, Šibila and Dežman, 2002). This software provides the methods and algorithms that serve to obtain useful information from the digital images. The system was successfully used on several occasions to study the physical demands of athletes in handball (Bon, 2001), basketball (Erčulj, Vučković, Perš, Perše and Kristan, 2007), squash (Vučković, Perš, James and Hughes, 2010) and tennis (Filipčič, 2008).

The aim of present study was to analyze distance covered and the average speed of a dancer's movement in the selected BR dances.

## **3 Results**

Motion trajectory of JUN couples in quickstep showed a wide movement around the space in the direction of the circle, this was not found for PRO couples. Their path, in addition to dancing on the outer edge of the circle, involved continuing within the interior of the dance floor (Figure 1).

Tango is a specialty of BR dances and contains quite a few differences: posture is more firm, there are no rises and descents like in other BR dances, foot technique is more pronounced and complex. Trajectory of movement in tango shows that the tango is typically characterized by a circular movement, but more rhythmically sharp, cut off. Figure 3 and 4 also show the sharp corners when changing directions, which are also characteristic of the tango.

Table 1. Details of the distance covered and speed of movement of PRO and JUN couples in quickstep and tango.

	<i>JUN1</i>	<i>JUN2</i>	<i>JUN3</i>	<i>AVERAGE JUN</i>	<i>PRO1</i>	<i>PRO2</i>	<i>PRO3</i>	<i>AVERAGE PRO</i>
quickstep speed (m/s)	1.3	1.45	1.31	1.35	1.53	1.62	1.64	1.60
quickstep distance (m)	112	124	112	116	139	148	149	145.33
tango speed (m/s)	0.82	0.84	0.8	0.82	1.18	1.07	1.11	1.12
tango distance (m)	76	78	75	76.33	115	104	109	109.33

Legend: JUN - junior dance couples of lower quality and PRO - top level dancers, the highest quality dance couples

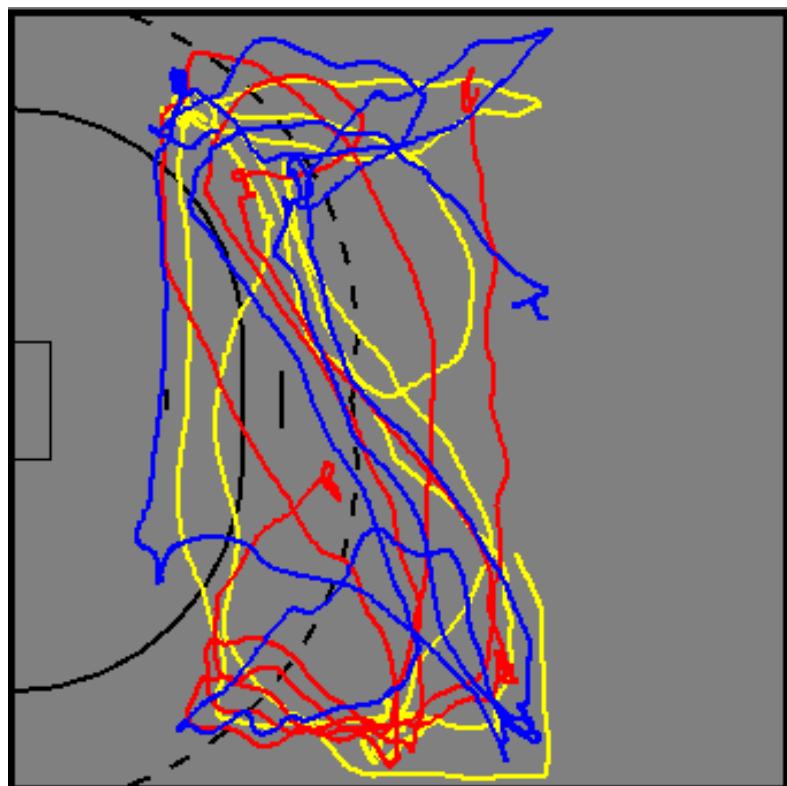


Figure 1. Paths of three PRO dance couples in quickstep.

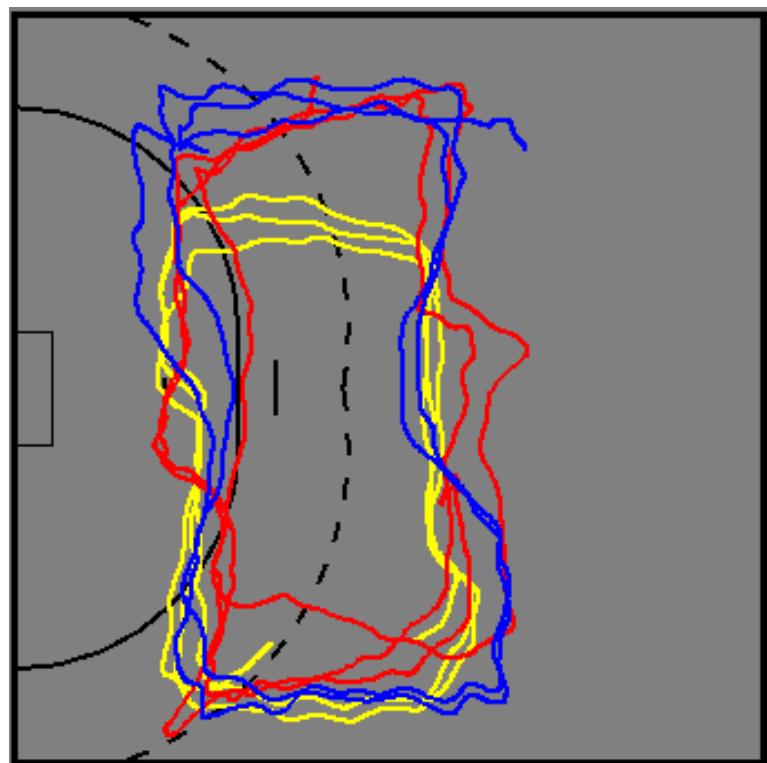


Figure 2. Paths of three JUN dance couples in quickstep.

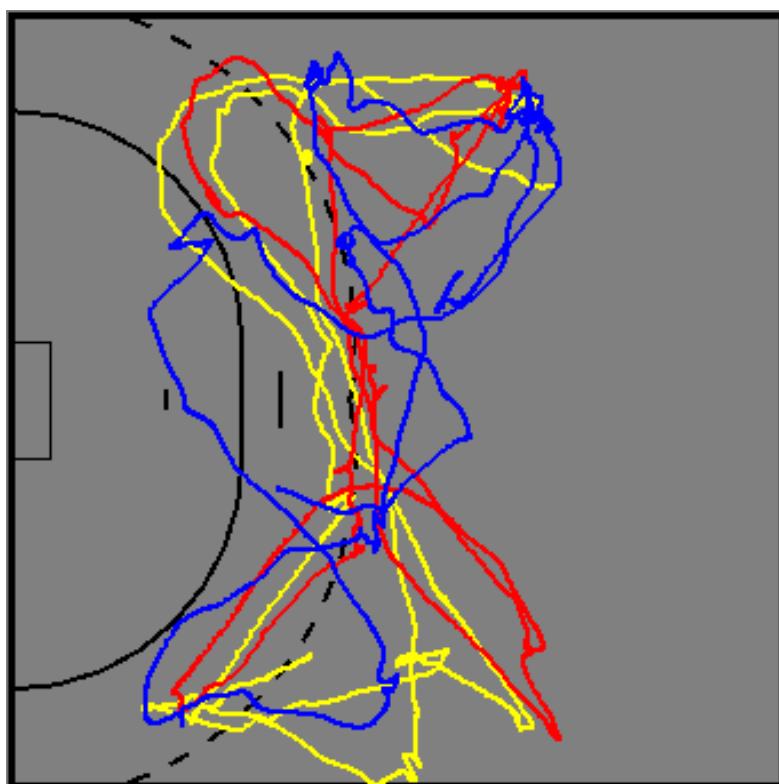


Figure 3. Paths of three PRO dance couples in tango.

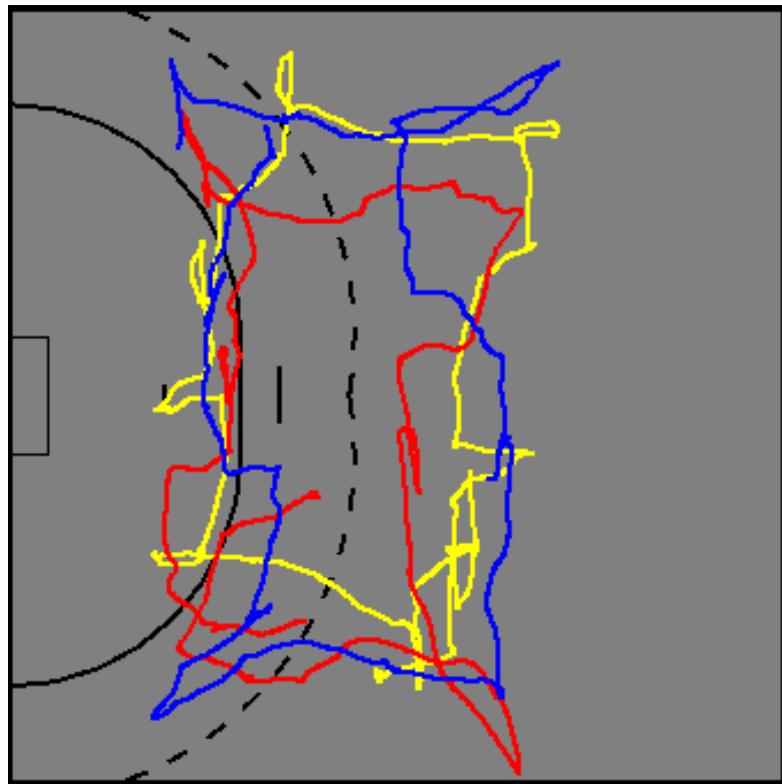


Figure 4. Paths of three JUN dance couples in tango.

Comparison of PRO and JUN couple's trajectories showed that the younger and less experienced categories were still using the basic choreographic form through the circle, while the top dance couples were looking for a way inside the dance floor.

The results show that the dynamics of movement decreases by the quality of the dancing couple. PRO couples covered on average about 30m longer distance and also their average movement speed was 0.3 m/s higher.

#### 4 Discussion

The movement of BR dance couples has its meaning in the space - to create an image of softness, rhythm, travel, power, passion, game. By changing the speed of movement dancers are trying to create the illusion of lightness, aesthetic perfection, both for the viewer as well as for an empire.

A pilot study analysing the workloads of dance couples during selected BR and Latin-American dances using the SAGIT tracking system (Zaletel, Vučković, Rebula and Zagorc, 2010) discovered that both female and male dancer had almost identical movement trajectories and also speed trends were very similar. BR dancers dance in a closed position so dance partners are traveling together on the same path and can be considered as one object. Also, their speeds are the same as they must operate as one, move through the space easily, giving the impression of controlled movement. Technical requirements dictate holding the correct body positions in various motor actions, which in BR dances include the proper foot technique, lifts, drops, swings, body rotations in all directions, performed at the rhythmic musical accompaniment.

In quickstep, path of PRO dance couple is focused on every corner of dance space, where the couple does not delay too long, but continues in a diagonal across the dance floor. This way the dancers can string together a series of typical quickstep figures and show precise control of their foot technique. PRO dancers, so much more so than JUN colleges, present effortless movement actions and rhythmic contrast, sudden stops, sudden changes of direction and fast movements in complex structures that are specific to the quickstep.

Because of the speed of dance there is a danger that the dance couples collide with each other so it is wise to choose space in the interior dance floor as found for the PRO dancers (see Figure 1). They thus have a better view of the dance floor and have enough time to avoid unpleasant situations. A similar situation was found for the tango (Figure 3).

The emphasis in tango is on speed and sharpness on the one hand and the softness and reticence on the other side. Circular movement in tango is rhythmically sharp and cut off so that the dancer can achieve a certain edge when moving through the dance floor.

PRO couples are looking for a way inside the dance floor, therefore they're using more space to perform the complex dance figures and avoid the crowd on the outskirts of the dance circle since in competitions more than one dance couple is on the floor at the same time. Collisions of dance couples especially in high speed quickstep are therefore inevitable.

Dance is multi-directional and involves the use and coordination of different muscle groups at varying times. Increased movement dynamics call for greater control and coordination of the torso muscles of dance partners, which have been shown in previous studies (Zaletel, Tušak and Zagorc, 2006).

Dance of JUN couples therefore appears to be more monotonous compared to PRO couples as they do not explore the dance floor as a whole. This might be described as less choreographed in terms of use of space and thus explains the less distance being covered by JUN dancers. Qualitatively better couples also move faster than their younger colleagues, but increase in speed was not at the cost of the movement characteristics.

## 5 Conclusions

Excellence of BR dance couple is that they seem to be one - as a whole, and move through the dance floor in accordance with character of specific dance. In the last decade, BR dances promoted to the complexity of choreography and performance of individual elements. Each dance bears different content, wants to communicate to viewers, empires, not least to dance partner. The choreography combines character of each dance with music, dancer's expression only amplifies the story. However, the top control of the body in various dance figures is the key of the best dancers, what is certainly visually (by dancing judges) influenced by speed of the movement.

It turns out that a tracking system SAGIT shows satisfactory path and speed of the dancers and gives us numerous parameters about their workload during the dance. However, in future research it would be beneficial to analyze individual dance elements and fine movements with hands, head, etc. Consequently a notational module of the SAGIT tracking system should be applied (Vučković, Dežman and Pers, 2006). Thus, it will be possible to determine not only the frequency of occurrence of these elements, but also their sequence. It would also be interesting to find out what is the dynamics of the female and male dancer whilst implementing aesthetically perfect figures of each dance. Although some dance actions are often occurring on the site, they still represent a significant portion of the final assessment of the dancer's performance.

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# **The performance development by the flow in the Canoe sport.**

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## **Abstract**

*In our study we compared the psychology immune-competence values of two groups. The participants are former kayak-canoe sportsmen, and teachers who don't do any sports. 50 former sportsmen and 50 teachers participated in our study. The participants filled four questionnaires.*

**Keywords:** Flow, health education, Increasing of performance,

## **1 Introduction**

It is very important in the life of a top competitor and his trainer to make a good decision at the right time. It can be determinant in the later career and can influence private life too. It concerns of course every field however it is even more important in our profession. Work of a trainer is about that we are who consider alternatives and determine the right way instead of the competitor as well. I am sure in one thing that is we can only achieve our aims if we have enormous humility towards the trainer profession and the sport itself. It is necessary to indoctrinate our competitors with this ethical attitude in order to they become world class competitors. Among the several circumstances the most important is maybe the creation of the training system based on performance, in which the competitor can belong in and endure the load fitting for his age. I build this system from the tradition of this sport, experience and the specific training methods. One of the problems concerns how we can build the talented young competitors in the world famous adult team. Present-day successful trainers often get into a situation like this and in these matters we absolutely shirk for ourselves. Of course, class competitors are provided with everything by the Kayak Canoe Association which is necessary for their preparation but this is not the case with the second line. It is a thankless task to decide who should be promoted for the future Olympic athletes and this decision is made by trainers. It does not always pleasure for older aged world class competitors and that is why conflict can arise against a less experienced but talented young person. Unfortunately the young coming from the nature of their age does not endure the everyday duplicate trainings based on performance and the stressful situations coming from the determinant personality of the class competitor. The outcome: they give up competition!

In sport competitive like feature is a very important and attractive motive. Sport can be one of the most effective activities of the improvement of physical abilities and addresses and it sets all-absorbing problems from the point of view of Pedagogy, Psychology and Sociology as well. Competitive feature in exponent sport involves more and more problems because achievements and results are continuously rising, which put to the trainers to start the regular trainings in younger and younger age. According to my survey children at the age of 12

kayak 2-3 hours a day. These exaggerated training quantum involve the possibility of the psychic and physical overburden and the impairment of health. This is one big dilemma of our days and then we haven't mentioned the appearance of dopes and the more and more wide-ranging spread of them, which are dangerous for certain sports. These arguments put to the outstanding representatives of sport science to try to analyse those possibilities in a more and more complex way (Pedagogy, Biology and Psychology) and with the help of these the effect of the negative factors can be removable or at least reducible.

We started our analysis because of the above-mentioned recognitions and in it we analyse the effect of the competition sport on personality from pedagogical aspect. The training courses can be such stages of the educational process where the personality development and together with it the attitude- and the activity framing can come true measurably. This is important because in kayak sport schooling already starts at the age of 10 and the sportsman spends 2 later 3-6 hours a day in close work contact with its trainer. According to Bábosik: "we can consider only such operations as functional parts of the educational process, therefore concrete educational operation, which provide the framing of the attitude and activity<sup>3</sup>. It's important that the sport activity in this case the attendance of the kayak training be determined by inner motivation impetus.

These arguments put me to analyse the educational effect of kayak sport and at the same time my personal inspiration was that I belonged to the crack of this sport for 15 years. This survey can bring out such hot and promising results, which can give valuable information to the trainers and competitors of kayak-canoe sport for the development of the effectiveness of their educational work and besides it in the initiation of a more successful competitor and trainer career.

The latest trend of coaching is to enhance productivity as well as mental capacity. Therefore this study is based on two models, that is, the Flow theory of Mihály Csíkszentmihályi and that of Antonowsky's.

During trainings the body should be strengthened so as to be able to tolerate and bear strains and stress. A special tailor made training plan will enable competitors to cope with this flow while preparing sportmen/women for competitions. It is evident that this stress and hard work bring about other personal/individual problems.

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<sup>3</sup> Bábosik: Egy optimális nevelési modell körfonalai M. A modern nevelés elmélet. Szerk: Bábosik I. Telosz Kiadó Bp. 255p.

## 2 Methods

### **Subjects:**

- 50 kayak-canoe professional competitors
- Control group with: 50 non professionals ?

To gain data in relation to psychological immune competence the Questionnaire of Psychological Immune- system ( PIK Oláh 1996) was used. The 16 scales attempt to identify the interviewees' stress-resistance. Each scale has 5 items and the participants can indicate to what extant they think.

### **Aims**

- To map up the protective factors developed by doing sports
- To change trainers' attitudes on the basis of the outcomes
- To work out methods supporting sportsmen/women to be able to adapt themselves into civil life.

### **The questions may be relevant for them:-**

- Valid outcome can be gained only in the state of flow
- Each successful professional has already experienced flow
- This psychological immune system strengthened by trainings and competitions will support the individuals' life and career.

## 3 Results and d iscussion

skála	sportolók	tanárok	szign.
Positive thinking	15,36	14,84	-
feeling of growth	14,91	15,41	-
emotional control	13,14	13,41	-
feeling of control	16,05038	13,9304919	0,000001
feeling of coherence	14,18148	15,4133708	0,035813
Self-esteem	15,59645	14,9512208	-
challenge, flexibility	15,56575	15,1545048	-
ability of social monitoring	14,05276	13,6325841	-
Inventiveness	14,69425	14,0734705	-
feeling of self efficiency	15,1595	15,0455628	-
ability of social mobility	14,20229	14,2191835	-
social creativity	14,85873	13,2407515	0,004537
the skill of synchron	14,20444	14,2046364	-
Stamina	13,76274	14,0519058	-
Impulse control	14,73597	13,5181567	0,014494
quicktemper,inhibition	12,5463	13,1694178	-

Figure 1. Outcomes of PIK scale.

On this diagram, we can see the 4 dimensions where there is significant differences between the professional sportsmen and the control group. In the case of feeling of control, social creativity and impulse control the professional sportsmen achieved better result and in the case of feeling of coherence the teachers had higher scores.

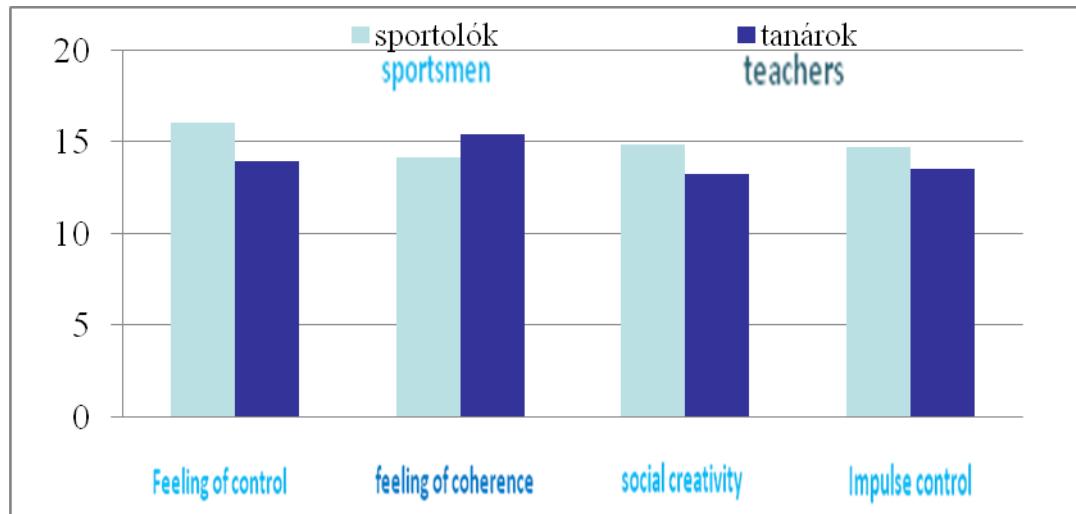


Figure 2. Significant outcomes of the 4 factors .

On the 2nd diagram we can see the differences between the sportsmen and non active teachers. As not expected, sportsmen achieved worse results in feeling of coherence. To me it highlights that with a special treatment I can expect an improvement of the performance.

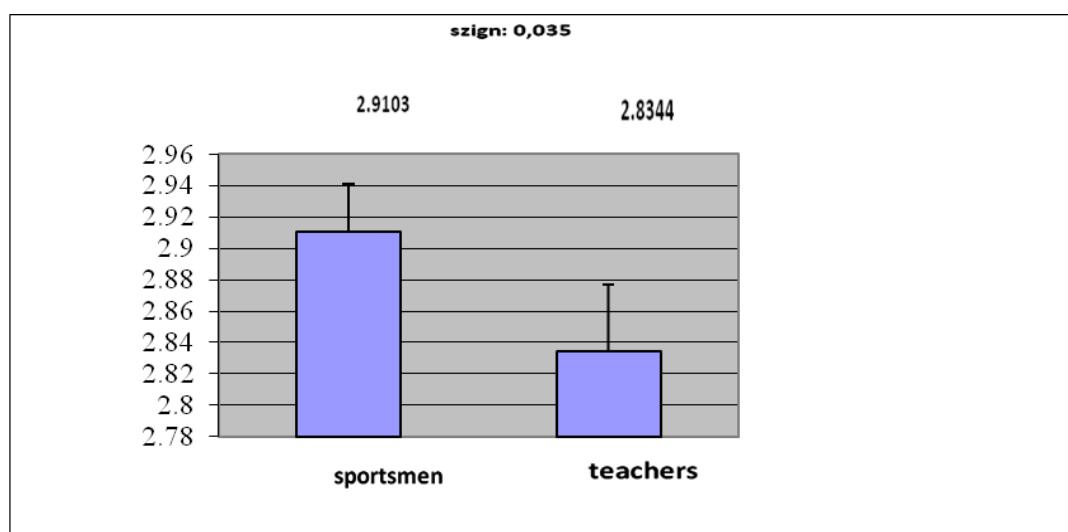


Figure 3. The avarage of the survey .

On the 3<sup>rd</sup> diagram we can see the assessment of the answers for all the questions. We can see the positive effect of the sport to the mental health.

## **4 Conclusions**

In case of educators there is a significant difference within the feeling of coherence due to the strict rules of sports. Sports do not support sportsmen/women in the third dimension of education, namely to acquire skills enabling them to act autonomously . Actually rules will control their life (Gombócz, 2007). Bearing this fact in our mind indicate that we should develop the educative and pedagogic strategy of trainings. It is also crucial to make a plan that focuses on enhancing the awareness of the importance of experiencing FLOW as well positive thinking.

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## **Bodily communication in volleyball.**

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Keywords bodily communication, tactical, function, diagnostic.

### **Abstract**

*The actual coaching formation of volleyball training theory, tactics of game play, knowledge of biomechanics, automatism of sport gesture techniques, and the functional mechanisms to recruit energy. The formative itineraries give rise to the acquisition of the psychological bases of competence that regulate the dynamics of a group in the diverse phases of a game, but there was not a thorough study of the function of signs and gesticulation. So, the aim of this research was to define the first inventory of signs (gestures) most frequently used in volleyball.*

*The study method is complex and integrated. Complex because it consists of the basic research methodology of the humanities, its Philosophy, Pedagogy and Psychology and the testing of descriptive research. Integrated because it combines several theoretical aspects of pure study, deductive arguments related to different knowledge: epistemology, education, psychology, physiology. Thus it explains and justifies the phenomenon with the results of descriptive research in the field to evaluate the body communication performance.*

*Integrated because it utilizes empirical approach, both related to the field approach for the human science by ecological vision. An observers' group analyzes three fast volleyball skills to evaluate the type of phenomenon by the following four steps:*

- 1) study of specialized literature
- 2) observation
- 3) investigation
- 4) focus group

*The subjects, that made the specialized group, are three coaches of major level of the observed team. The group is integrated by six athletes of the observed volleyball team that participate to focus group.*

*It was concluded that during the last years at the professional level, many trainers have dedicated time to these aspects of nonverbal communication, to their codes, and to their technical-tactical uses of gesture, but often undervaluing the scientific aspects that subtend body language. Therefore, it is necessary to provide an educated course for technicians and coaches that teaches and speaks about the subjects. Education in the field of corporeal and body language requires interactive methodologies like cooperative learning, role playing, and the experimentation of multiple types of simulations. It needs to make an appropriate framework inside university studies that includes the basis of the functions of gestures, signs and mimicking in order to construct the competence of gestures required to become expert coach of volleyball or specialist performance analyst.*

## **1 Introduction**

The actual coaching formation of volleyball training theory, tactics of game play, knowledge of biomechanics, automatism of sport gesture techniques, and the functional mechanisms to recruit energy. The formative itineraries give rise to the acquisition of the psychological bases of competence that regulate the dynamics of a group in the diverse phases of a game, but there was not a thorough study of the function of signs and gesticulation. A more detailed analysis of the diverse actions connected to the phases of a game (sport) can provide evidence for the strategic role of body language and its conditioning ability on performance and results. The cause of this conditioning probably draws on two interdependent traditions of research: the first on the form of nonverbal communication in team sports, and the second one, on the neurobiological mechanisms that connect action and cognition. Contest description: Volleyball is a very fast sports game in a very narrow and little court (81 square meters per team) whose technical characteristics, tactics and logistics constantly favour nonverbal communication between the players on the court. Furthermore the motor control system theories has got a significant influence to deep the phenomenon.

Bodily communication has got its own epistemological frame and into which the message follows a process of coding, transmission and decoding. It establishes relations and contacts that become real thanks to the elaboration of data and to the evaluation of the content of the message. It is also the relationship in sociality (Shannon and Weaver, 1949) where people collaborate in a common target, it exchanges inside of itself the roles to make effective the function, it shares the meaning using facial expressions (Ekman, 2001), signs, symbols (Argyle, 1988) and spaces (Hall, 1966) also with the paradoxes of body as regards to the meaning of word (Watzlawick, 1967). Bodily communication in social context also allows the building of the phenomenon through the process of subjectivity among people (Husserl, 1935) and perception also contributes to this process (Merleau Ponty, 1945). It is the spaces and the relations body and bodies in the spaces according to proxemics theory (Hall, 1966). It is also a dynamic flow formed by five basic elements: context, sender, receiver, channel, code (Jakobson, 1956) and it is enriched by some other elements of ethnic and social knowledge as in the case of relationships among individuals belonging to different cultures (Mehrabian, 1972) where coding and decoding are different but the process is the same. The identifying of the source and the destination of the message are fundamental phases to intercept the code in the channel of communication and to proceed to the decoding. By "code" we mean a shared system for the organization and the use of specific signs both linguistic and physical. The relation between mind theories such as Behaviourism (Skinner, B. F., 1969; Mackenzie, B. D., 1977), Gestalt psychology (Kohler, 1947), Cognitivism and Phenomenology and bodily communication help to enlarge the horizons around the body to a best understanding of the phenomenon in an educational psychology vision. The neuropsychological aspects contribute to widen the knowledge of the mechanisms of bodily communication according to the laws of movement (Latash, 2004) of motor control (Adams, 1975; Schmidt, 1985) and to the abstract processes of particular nervous structures and they describe the wide complexity of them.

There is new scientific evidence on the brain on some nerve cells that are activated when it

sees, hears or perceives through touch but does not produce a movement or act. These nerve cells are defined by the properties to reflect movements of the others or imagine it remaining in stop position. They do not contribute to the practical execution of the movement but they will receive only information (Rizzolatti, Iacoboni, Welsh, Fogassi, Fadiga et al., 1996). They can be seen by sophisticated brain-imaging equipment such as trans-cranial magnetic stimulation and functional magnetic resonance imaging.

The focus of this study is the application of bodily communication theories and to construct an interactive process to aim a new scientific paradigm on bodily communication by integrative vision. So the aim of the study is to collate the distinct interfaces of the same knowledge and even to study together and with details the qualitative aspect into the environment. Furthermore the objective is to identify the types of bodily communication in volleyball. So, the research wants to define the first inventory of signs (gestures) most frequently used in volleyball, according to:

- The scientific principles of corporeal communication based on the theoretical model of Dr. Michael Argyle, Professor of Social Psychology at Oxford University and Fellow of the Wolfson College for his work published in the book “Bodily Communication” (1988) pp. 5-12,22-25,48-68,118-131,150-153,165-181,199-209. This way study is integrated by other authors on nonverbal language such as Shannon, Weaver, 1949, Watzlawick, 1967, Ekman 2001, Jakobson, 1956, Mehrabian, 1972, Hall, 1966.
- The aspects of perceptive senses according to the research of Alain Berthoz, published in the book “Le Sens du Mouvement” (1997) pp. 1-41, 103-122. This way study is integrated by other authors on motor control theories system such as Jack Adams, 1975 and Richard Scmidth, 1985.
- The neurobiological implications based on the findings of the research of mirror neurons by Giacomo Rizzolatti published in the book “So Quel Che Fai” (2006) pp. 113-135 and by Marco Iacoboni M. Mirroring People. The new science of how we connect with others (2008) pp. 134-180.

## 2 Method

The study method is complex and integrated. Complex because it consists of the basic research methodology of the humanities, its Philosophy, Pedagogy and Psychology and the testing of descriptive research. Integrated because it combines several theoretical aspects of pure study, deductive arguments related to different knowledge: epistemology, education, psychology, physiology. Thus it explains and justifies the phenomenon with the results of descriptive research in the field to evaluate the body communication performance.

Integrated because it utilizes empirical approach, both related to the field approach for the human science by ecological vision. An observers' group analyzes three fast volleyball skills to evaluate the type of phenomenon by the following four steps:

- 5) study of specialized literature
- 6) observation
- 7) investigation
- 8) focus group

The subjects, that made the specialized group, are three coaches of major level of the observed team. The group is integrated by six athletes of the observed volleyball team that participate to focus group.

### **3 Results**

#### **3.1 Theoretical Results**

Bodily communication, according to the authors Argyle, Mehrabian, Watzlawick and Ekman Hall has its own epistemological framework where the non-verbal message is empirically investigated in the process of decoding and encoding. Communicating means to establish a relationship, a contact among people and implies the transfer of a message from one individual to another, communication is not just transmission of information through a channel where the beginning is the source of the bodily signs or issuer and the arrival or receiving the same in the form of Shannon and Weaver which addresses to logical-mathematical aspects. In the relational approach, communication is the foundation of sociability and socialization where it planned cooperation, exchanges of roles (issuer / receiver), sharing among multiple actors in a same context surrounding the provision for the existence of common symbols that replace or accompany the use of language.

Communication is social because it is composed of behaviors that help the socialization through the construction of subjectivity meanings among people. The individual, through the natural development and evolution in the interaction with the socio and cultural context, acquires a set of norms, values and behavior characteristic patterns of that particular cultural reality. They are learned and, therefore, are evaluated and varied from context to context and only from the context, because the decoding of messages from outside the body is difficult due to the lack of specific knowledge elements of the signs, symbols, signals, movements and spaces of that context. Another context has other items, for example the sport is different from the other context for dynamics, rules, elements.

The communication process takes into account these variables, a dynamic flow where there are several elements: the context, sender, recipient, channel, code (Jakobson). Knowledge of the factors of communication does not guarantee the success of the communication. In the case of relations among individuals belonging to different contexts is necessary to remove the obstacles against which the communication would not be effective. If you are able to identify immediately the issuer the message, the one who produces it, and the recipient, who must decode the message or the recipient to whom the message is directed, the context, the channel and the code may be incomprehensible. Code means a shared system for the organization of signs that refers to a linguistic code, due to a different language the message is decoded by the absence or difference in code where code is the same as spoken language; if channel means the physical medium through which the communicative act takes place, a non-verbal channel for example can cause misunderstandings in relation to cultural beliefs and customs, the environment, understood as physical or psychological scenario in which communication events occur, may interfere with the communication process when the code of an issuer is understood by the recipient but the meaning is distorted for ideological reasons.

It is quite obvious that, for those who do not speak a language code, physical contact or rather non-verbal language represents the first real form of communication between the two subjects. It is not often given appropriate emphasis to this approach that can generate some real misunderstandings if you do not know the habits of the interlocutor.

Some aspects of nonverbal communication are universal, others are adopted by different cultures and contexts and these differences in the area of non verbal communication represents the cause of "a major source of antagonism, misunderstanding and conflict between cultural and ethnic groups" (Argyle, 1988 ). The smile, facial expression and a symbol according to different contexts, cultures and places, is widely interpreted as a sign of

contentment considered the studies of eleven different cultures. In Japan, the smile is used as a mask that can hide embarrassment or reserve . The face, facial expression, is the first element to be analyzed in a first approach followed by the postures, movements and bodily attitudes. The facial expressions that communicate emotions are very similar in different cultures and in different contexts. If Ekman and Friesen's studies reveal that the facial expressions reveal emotions, feelings and moods, no less importance must be given to gesture, "is the aspect that seems to change more in the context of different cultures" (Argyle, 1988). He defines nonverbal emblems acts that have a direct verbal translation, as do the nod, the beckon and the pointing at. The origin of these movements is derived from basic human experiences or symbols that describe actions or natural persons. If this final gesture is considered universal and then the same in all cultures, it is not the gesture of the head that in many cultures as in northern Europe is shaken to indicate "no", while in Greece the rapid movement of the head is a sign of denial. The same sign with thumb and forefinger to form a closed ring is a sign of approval in the United States and northern Europe to mean "OK" but in southern France indicates something worthless recalling zero. It should not be neglected the contribution of sign language in its purest form were developed by groups of people who cannot make use of words such as deaf.

The visual interaction varies considerably within different cultures. The Arabs, South Americans and southern Europeans in a survey conducted by Watson in 1970 on a sample of 110 foreign students of the University of Colorado, looking more than students from other cultures where physical contact is limited. Just as American blacks look less white, giving the impression of a lack of attention or understanding, if combined with a slight head movements during listening. While African-Americans would look directly at a higher index of equal status, so they are reluctant to do so because their action would be interpreted as a lack of respect (Hanna., 1984).

The spatial behavior must be duly considered in the relationship between individuals and groups. The proxemics theory (Hall, 1966) gives the answer on the relation among object and people and between persons within the past relation. It defines the current definition of distance space and its effect of verbal language .Anthropologists often distinguish between cultures with frequent physical contacts and cultures with no or very limited physical contacts. Individuals from cultures with frequent physical contact (Arabs, Latin Americans, southern Europeans) are closest, are often opposite each other, touch each other and they look more at each other, they also speak louder than people from cultures of non-contact as Asians, Indians, Pakistanis and northern Europeans. The Arabs, for example, when greeting you take your hands for a certain period of time or they can embrace and kiss the hands, face or beard in formal occasions; Arab men, in conversation, touch each other on the upper arm with their right hand and playfully slapped their right hand, against the Arab females are not touched at all in public. Most likely the differences in spatial behavior may result from differences in the structure of the physical environment, such as the size of the houses and the degree of crowding. Instead, we are likely to interpret the spatial behavior in a very simplistic way: who gets too close is considered invasive in contrast to those who approach too little that are considered cold and aloof. There are significant cultural differences concerning the number and type of contact. The Arabs also have a forward leaning posture, an angle of the body most directly aimed at the contact, while the Japanese bow (even up to 45 °) are only a sign of respect. Another characterization of ethnic groups is the use of voice tone and vocal intensity as not to associate with the verbal communication that is the absolute transmission through the contents of the word. The inhabitants of the West Indies do not mark the end of sentences with a rising tone of voice appearing rude to the English culture, in addition they utilize high tones to emphasize what they say, wrongly interpreted as sudden outbursts of anger. The Arabs use a very high tone of voice compared to most cultures that could be seen

as assertive and speak up is synonymous with sincerity. The Japanese instead change their vocal style to sex gender and social status of their partner, Morsbach has distinguished eight separate tones of voice.

This analysis opens the scene of bodily communication in physical education and sport and its specific aspects related to the individual situation of sports both individual and group, with common roots and different endings, with general characterizations and specific details. The confrontation between adversaries is also with the help of bodily communication and the effects in the context at that particular time and place. Particular arguments revolve around the feint, manifest intention of achieving a goal through the initial implementation of a plan with specific motor signs, postures, attitudes, etc., which then are carried out in completely different versions of those originally deduced. In this case, the psychological foundations of the movement related to the perception and motor control on the theoretical framework, according to the authors Adams (1975) and Schmidt (1985), affect the performance. In addition, the motor system according to the theory of mirror neurons (Rizzolatti et al, 1996) is a new ecological vision more and more associated with the current Phenomenology of Perception, Merleau Ponty (1945), with the current ecological visual perception of the mind (Gibson, 1978) and with the current movement sense (Berthoz, 1998). So, explaining how the brain works only from the biological point of view may be limited, the same may apply if it deals with the matter only from the philosophical point of view. The new scientific findings bring into the question of body communication and the theories of motor control are the principal field of research. It distinguishes the temporal phase of the afferent perception and efferent movement enforce the reflection according to two scientific paradigms. The first scientific evidence that the perception occurs first and then occurs the movement and so constantly in a continuous pathway, where the feedback helps continuously the movement by adjustments and corrections of motor execution. The adjustments and corrections are compared by the scheme already in motor memory. It is called in motor system theory "closed-loop" (Adams, 1975). The second one is when the movements are in the motor memory in a wide repertory of motor scheme and they are executed without the help of feedback for the adjustments and the corrections of errors. It cannot be adjustment and corrected because the feedback comes up to the 200 milliseconds and the brain do not process the data. It is called in motor system theory (Schmidt, 1985). There is new scientific evidence on the brain on some nerve cells that are activated when it sees, hears or perceives through touch but does not produce a movement or act. These nerve cells are defined by the properties to reflect movements of the others or imagine it remaining in stop position. They do not contribute to the practical execution of the movement but they will receive only information (Rizzolatti, Iacoboni, Welsh, Fogassi, Fadiga et al, 1996 et al) They can be seen by sophisticated brain-imaging equipment such as trans-cranial magnetic stimulation and functional magnetic resonance imaging.

The phenomenon of activation occurs continuously, in processes of the mind related to the movement of its own or that of others, thus opening a new scenario on learning related to the movement by imitation and teaching based on simulation. New discoveries about the brain suggests that some sort of order mixing action perception in a single process where perception and execution are together without sequential order. It is described in motor imagery. Which means that action and perception carries out in a single moment without the phases of afferent sensory or perception, motor development of the idea, motion planning and execution of actions

In conclusion it would open a new way to concern the body and its movement in accordance to a complex approach and an ecological vision. The partial study nowadays do not help the total phenomena of the body language. There are no studies in physical education and sport literature on body language, although there is an interest in the field of investigation

and the consequences that the appropriate use of the findings and mechanisms of encoding and decoding of the message body may have some proficiency in fundamental gestures of the sport in variable contexts. It might be useful for the analysis and evaluation of performance of the athlete. It checks the inference on the behavior, to observe the associations among the observed variables and possibly identify pathways that helps to regulate the educational training to enhance the performance. To identify the components of bodily communication relating the epistemological, psycho-pedagogical and technical evaluation could be useful to collect the all aspects around the question.

### 3.2 Empirical Results

They are three types: Tactical, Functional, Diagnostic.

The decoding of the signs or of the gesticulation may be: Tactical when the gesture or the action simulates a game intention to solicit a reaction of the adversary who helps their own team. Bodily and nonverbal communication of the athletes is expressed through 4 different typology:

- dominate → when an athlete dominates the area of game thanks to his high athletic and/or technical ability works.
- hostile or adverse → when in the adverse phases, the technical-athletic ability works in conjunction with the facial signs and the body pantomime which communicate aggressiveness).
- friendly → (during training when the actions of the game are finalized to improve on the plans of attack and defence. In this case, the players of the same team split into 2 separate (rival) teams).
- subjected or mastered → (when the offensive abilities of a team are obviously higher)

The decoding of the signs or of the gesticulation may be: Functional when it refers to the same team and it is involved the communication between the game companions or that between trainer and athletes on the tactical intentions, the strategies and the problems of game.

In volleyball, for example, the setter uses conventional prearranged signs to communicate to the other players the plans of the game (hand gesture):

1. index finger → meaning the ball will be set (tossed) in front of the player (setter) for a very rapid spike centred on the net by the attacking player;
2. middle and index finger → meaning the ball will be set (tossed) behind the player (setter) for a very rapid spike on the right side of the net by the attacking player;
3. thumb and index finger → meaning the ball will be set (tossed) away and in front of the player (setter) between the left side and the centre of the net for a very rapid spike by the attacking player;
4. thumb and little finger → meaning the ball will be set away and behind the player (setter) between the right side and the centre of the net for a very rapid spike by the attacking player.

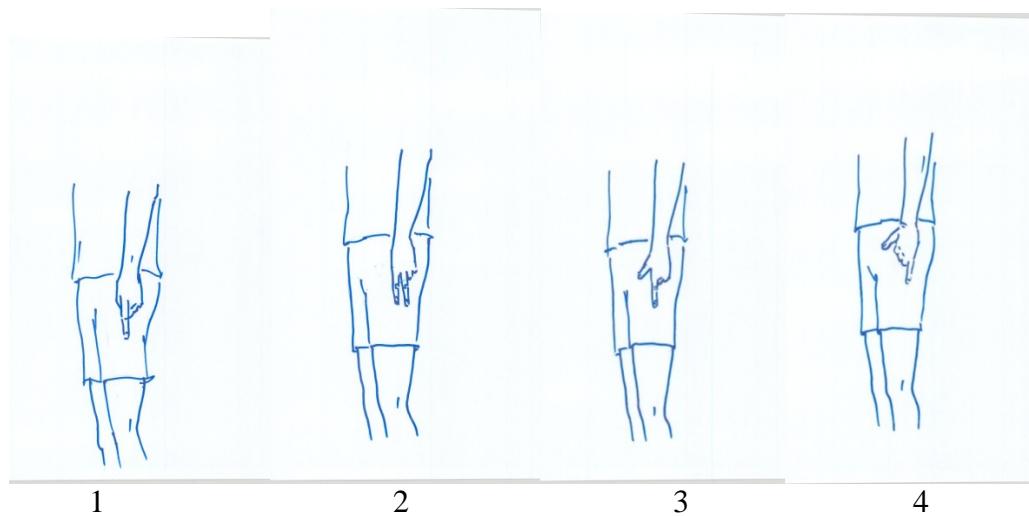


Figure 1. The setter uses conventional prearranged signs to communicate to the other players the plans of the game (hand gesture).

The decoding of the signs or of the gesticulation may be: Diagnostic when it is possible to analyze the diverse forms of nonverbal communication of the opposing team, the signs of the athletes and of the trainer, who anticipate or solicit actions of the game. This sign language between players is based on (M. Argyle, 1986 - E.T. Hall, 1966):

- close contact and a glance → (distance between the players of two teams, visual contact through the net);
- expressive ability → (facial expressions and corporeal (bodily) gestures that precede, continue, and follow the actions of play);
- significant difference between signs → (difference between corporeal signals, conventionally coded, prearranged, or personal);
- rituals → (gestures, facial expressions, or attitudes that mark the behaviour of the athlete);
- symbolic presentation of oneself → (utilization of the body and of gestures to express one's own needs or demands).

#### 4 Conclusions

During the last years at the professional level, many trainers have dedicated time to these aspects of nonverbal communication, to their codes, and to their technical-tactical uses of gesture, but often undervaluing the scientific aspects that subtend body language. Therefore, it is necessary to provide an educated course for technicians and coaches that teaches and speaks about the following subjects:

- Neurobiological knowledge on the mechanisms of regulation of the various types and ways of imitation, learning, and gestural communication according to the research on mirror neurons;
- Knowledge of the mechanisms of perception and on the sense of movement or kinaesthesia which studies the types of simulations and anticipations of motor

actions;

- Knowledge of the mechanisms of imitation in the different phases of training; i.e., the phenomenon called “covert” or “implicit imitation” or the chameleon effect;
- Knowledge of the rule of the emotion in the sports effect described as an emotional contact;
- Acquaintance and meaning of non-verbal communication, of the interpersonal motor attitudes, of spaces and body in the spaces, of posture, of facial expressions, of contact, of proceeding, and of the glance.

Education in the field of corporeal and body language requires interactive methodologies like cooperative learning, role playing, and the experimentation of multiple types of simulations.

It needs to make an appropriate framework inside university studies that includes the basis of the functions of gestures, signs and mimicking in order to construct the competence of gestures required to become expert coach of volleyball or specialist performance analyst.

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**Teaching , coaching methodology**

## **The importance of being earnest – with your data.**

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### **Abstract**

*Reliability, in terms of performance analysis, pertains to the extent to which the event codes (data) reflect what happened in the game (James, Taylor and Stanley, 2007). In many other areas of research the value used to represent the quantity being measured is slightly different to the actual value, if direct measurement was possible, this is known as measurement error. However, having ensured, by suitable reliability testing, that data collection methods were satisfactory, this does not signal the start of inference or correlation testing.*

*This paper discusses the extremely important intermediate stage of analysing the data prior to applying any statistical procedures. Hence graphical procedures (histogram, stem and leaf plot, scatterplot, box plot, probability plots) to identify any unusual values and trends in the data will be presented along with guidance on what to do when the unexpected happens. The types of data collected (nominal, ordinal, interval, ratio) as well as the shape of the distribution (normal, skewed) are important determinants of how the data should be subsequently described and analysed. Hence appropriate measures (mean, median, standard deviation, interquartile range, skewness, kurtosis) and techniques for different data types will be presented along with statistical procedures to determine the type of distribution (e.g. Kolmogorov-Smirnov). The procedures presented in this paper will enable researchers to analyse their data correctly and identify any interesting features that need to be discussed.*

### **1 Introduction**

Having collected reliable data, ascertained by suitable reliability testing (James, Taylor and Stanley, 2007) this does not signal the start of inference or correlation testing. Rather the data needs to be analysed prior to applying any statistical procedures. This is achieved by carrying out a visual inspection of the data i.e. by using graphical procedures such as a stem and leaf plot, as well as obtaining statistical measures to ascertain the type of distribution, appropriate measures of central tendency and dispersion and the presence of outliers. The decisions necessary for selecting the most appropriate methods for achieving these goals are determined by the type of data collected as well as the type of research being carried out. This paper will present solutions for common research paradigms in sports science.

For the purposes of this paper research will be categorised as either experimental, where the researcher manipulates things to assess the effect of an intervention (independent variable) on some performance (dependent variable) or correlation research, where the researcher simply measures things and assesses whether there is a relationship between these measures.

## 2 Correlation research

An experimenter measured counter movement and squat jumps performed by young soccer players belonging to age category squads (U10, U12, U14, U16 and U18). These vertical jumps are typically used to assess leg power. The countermovement jump (with arm swing) starts from an upright standing position; a preliminary downward movement is instigated by flexing the knees and hips, immediately followed by an extension of the knees and hips to jump vertically off the ground. The squat jump starts in a stationary semi-squatted position and does not employ a preliminary downward phase (the countermovement). Skilled performers of these jumps usually jump about 4 cm higher when using the countermovement although the opposite may be true when unfamiliar with the countermovement jump.

Since the jumps were measured in centimetres the data was classified as ratio (Field, 2009) implying that parametric statistical methods may be appropriate. Parametric methods refer to the methods of calculation used when determining averages, dispersion etc. In this instance the actual values for each item of data can be used as they are real numbers and consequently any numerical differences apparent accurately reflect true differences.

When assessing the relationship between two variables it is necessary to view the data to determine whether there are any unusual values (these could be due to input errors or exceptionally poor or good performances). When these values are found a decision needs to be made whether to remove or amend the data or to simply leave the data alone. Whilst this sounds rather unhelpful in that all possible scenarios are presented as applicable in reality the decision is determined by the explanation for the unusual value. For example if an input error was detected (e.g. typing 99 instead of 9) then it is obvious that the error would be corrected. On the other hand if the unusual value was as a result of an exceptionally poor or good performance then the decision is not so straight forward. Suppose a participant slipped during a running test resulting in a very slow time, should the data be included or removed, or the running test re-taken? The answer is down to the experimenter who needs to be able to justify the decision. Suppose the running test was not able to be re-taken then the argument for removal or otherwise of the data might be determined by the degree to which the test result had been affected, e.g. a very minor slip may be included on the basis that small slips are common on this type of test, other researchers tend to include this data and therefore times which include small slips are valid data. Equally the research may determine that the slip was sufficient to make the time totally unrepresentative of performance for this type of participant and remove the data altogether. Both decisions can be justified logically and are therefore acceptable.

To visually see the relationship between two variables it is common to produce a scatterplot. In PASW (formerly known as SPSS) this can be achieved using the chart builder (in the graphs pull down menu). In the chart builder dialogue box the Scatter Dot chart type needs to be selected and if the individual group membership needs to be identified, as in this example, the coloured selection selected and dragged into the chart area (Figure 1).

The resultant scatterplot (Figure 2) shows the general relationship between the countermovement and squat jumps with performance on both tending to increase with age although some overlap between age groups is evident. Critically the relationship between the two variables can be assessed visually by drawing an imaginary line around the data points. In Figure 2 this imaginary line has been drawn to exemplify. The strength of the relationship is determined by the width of the shape, in this case it is quite thin suggesting a good relationship. However the main purpose of visually looking at the data is to determine if there are any unusual values (points that are a distance from the other points) and to see if a different relationship other than a linear one exists e.g. a curved shape of points suggests an exponential relationship. In this example a linear relationship exists and one participant

appears to have performed better on the squat jump than his countermovement jump performance would predict (highlighted by red circle on Figure 2).

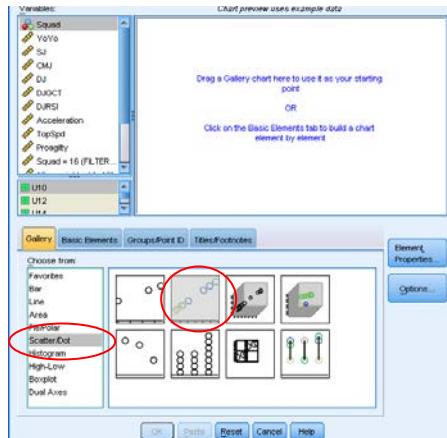


Figure 1: Chart builder dialogue box

The actual strength of the relationship is given by the correlation coefficient. In PASW this is calculated using the Analyze, Correlate, Bivariate pull down menu. This enables the Pearson (parametric) and Spearman (non-parametric) correlations to be calculated. In this case the Pearson coefficient was 0.938 and based on 79 pairs of data was shown to be significant ( $p < .001$ ). It is important to recognise that the significance value does not suggest the strength of the relationship (this is determined using the correlation coefficient) but rather the certainty that the correlation coefficient is an accurate measure, as such is more related to the sample size.

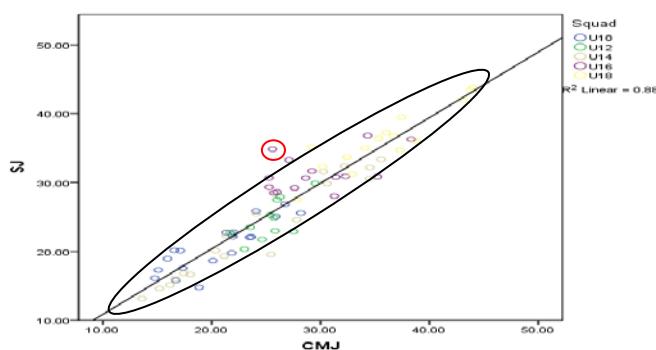


Figure 2: Scatterplot of counter movement and squat jump performances by age group soccer players

In this example the correlation coefficient of 0.938 is strong as this value ranges from -1 to 1 where 0 signifies no relationship and 1 a perfect relationship. The sign simply designates the direction of the relationship where a positive value indicates that high values of one variable are associated with high values of the other. Conversely a negative value simply indicates that high values of one variable are associated with low values of the other. To ascertain the extent to which the two variables are related to each other the correlation coefficient should be squared, this can be done in the chart editor (double click on chart) and inserting a linear fit line which also adds the  $R^2$  value as shown in Figure 2. In this case (0.88) suggests that 88% of the motor skills recruited by the countermovement and squat jumps are the same and 12% are different.

### 3 Experimental research

Experimental research is where the researcher manipulates independent variable(s) to assess whether there is any effect on some performance (the thing you measure – the dependent variable). In this situation it is usual to have more than one group of data between which comparisons are made to assess the impact of the independent variable(s). When comparing groups of data there are some requirements that need to be considered to enable you to select the correct statistical procedure for the comparison test.

The first consideration is whether the distribution of values in each group are broadly speaking similar. This is assessed as an equality of variances test and the appropriate methods for each test are built into the options for the test in PASW.

A second consideration is the type of data (this is relevant for dependent variables) that has been collected. This question refers to how powerful the data is and thus how the data can be used. There are four types of data scale:-

- **Nominal.** Categorical data i.e. no implied relationship between categories e.g. male, female (you will notice that data i.e. dependant variables, generally are not in this form, it is more likely that the independent variables are of this type).
- **Ordinal.** When there is an implied order to the named categories. Here a ranking is typically applied to the categories such as 1=strongly agree, 2=agree etc. Whilst there is an order in these ranking you cannot say that the difference in magnitude between “strongly agree” and “agree” is the same as “agree” and “disagree” since different subjects may subjectively assign appropriate ranks but you cannot be certain that different subjects use the same process for assigning ranks. This implies non parametric techniques although many researchers conveniently ignore this fact! It is worth reading an editorial devoted to this topic (Nevill and Lane, 2007).
- **Interval.** Here the difference between categories is relative. The most common interval scale in psychology is the intelligence scale. This is only interval data (and not ordinal) because of the great deal of effort taken to standardise these tests. However the point is that the difference between 90 and 100 is the same as between 110 and 120. There is more justification for using parametric approaches with this type of data but it is rare to have this sort of data in sports science research.
- **Ratio.** This is the most powerful scale which extends from the interval scale to include a true zero. This allows the assignment of ratios to the data. For example if two times were recorded for a cross country run where one runner’s time was 104% of the winner’s time compared to another of 108% you could say that the first runner did twice as well as the second in terms of relative performance to the winner. This type of data suggests a parametric approach.

If parametric tests are to be used then some assessment of the distribution of the data is also necessary to determine if the data is normally distributed (if data is normal then most values tend to cluster around the average value for the distribution and a frequency plots look like an inverted U). Performance analysis data of frequency counts of events tend to be skewed distributions with large frequencies of low values and increasingly less frequent occurrences of higher values (often Poisson or binomial distributions; Nevill *et al.*, 2002).

Another consideration of the data is whether there are outliers (unusually large or small values) present. This is more important for parametric tests as these tests use the numerical value of the data to determine differences. Hence very large or very small values have a disproportionate influence on the statistical test.

In order to demonstrate appropriate techniques a series of examples will be used to show both the output and an explanation of why the procedure was necessary and what is showed.

### 3a Two groups of data

The first example research design involved collecting shot to shot times for elite squash players (time taken from a starting point when the opposing player hit the ball to the point in time when the return shot was played). Since the data is time taken (contains a real zero) the dependent variable is on the ratio scale implying parametric techniques. Parametric techniques use the actual values of the data and compare each data point with the average (arithmetic mean) for the group. The sum of all of the differences between each data point and the average is used in the assessment of difference between groups. Consequently this sort of test requires that each group is normally distributed and of similar variance. So before carrying out a parametric significance test these two data features need to be checked.

An ideal method for this is to use the Explore command in PASW (analyse, descriptive statistics, explore). Within this command there are some useful options to select. Select the plots button (Figure 3) and select stem-and-leaf, histogram and normality plots with tests.

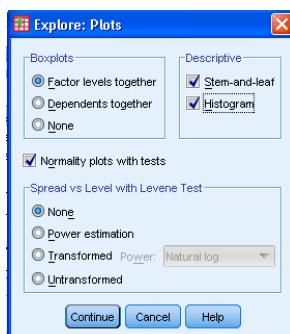


Figure 3: Plots option with the Explore command

The output from the Explore command with these settings is extensive but very informative although depending on the data some will be more informative than others. Each output will be discussed in terms of what can be good indicators.

The first output is the descriptive statistics (Table 1). Some general principles can be considered although these are not always informative, particularly if the values are small or similar in value. In a normal distribution the mean and median are the same so for player 1 the values are 1.44 and 1.36 and for player 2 1.49 and 1.40. The decision whether the scores are different or not is not particularly obvious but maybe made simpler by considering the difference as a proportion of the magnitude of the mean 5.746% for player 1 and 6.099% for player 2. Since normality is never clear cut this is perhaps not too informative!

More informatively the skewness and kurtosis values are measures of the tendency for the data to have more low values than high (skewness values greater than 0) or for there to be more data around a central point (kurtosis values greater than 0). For a normal distribution, both skewness and kurtosis statistics are zero. A skewness value more than twice its standard error is taken to indicate a departure from symmetry, as is the case for both players here.

Fortunately much of the guesswork is removed by the ability to perform normality tests (as we selected earlier). When we selected the normality plots option we also gained the Kolmogorov-Smirnov statistic, with a Lilliefors significance level for testing normality, in

this example (Table 2) the times for both player 1 and player 2 departed from normal as the significance level was less than 0.05 (.000 should be reported as p<.001).

*Table 1: Descriptive statistics for time taken between shots (PASW output).*

Descriptives			
Hitter		Statistic	Std. Error
Player 1	Mean	1.4429	.01728
	95% Confidence Interval for Mean	Lower Bound	1.4090
		Upper Bound	1.4769
	5% Trimmed Mean		1.4277
	Median		1.3600
	Variance		.181
	Std. Deviation		.42513
	Minimum		.52
	Maximum		2.76
	Range		2.24
	Interquartile Range		.68
	Skewness		.497
	Kurtosis		.099
Player 2	Mean	1.4909	.01688
	95% Confidence Interval for Mean	Lower Bound	1.4578
		Upper Bound	1.5241
	5% Trimmed Mean		1.4779
	Median		1.4000
	Variance		.175
	Std. Deviation		.41864
	Minimum		.56
	Maximum		2.72
	Range		2.16
	Interquartile Range		.64
	Skewness		.469
	Kurtosis		.099

*Table 2: Tests of Normality (PASW output)*

hitter	Kolmogorov-Smirnov <sup>a</sup>			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	Df	Sig.
time taken to travel from start point to finish area	Player 1	.098	605	.000	.967	605
	Player 2	.088	615	.000	.974	615

a. Lilliefors Significance Correction

The normality plots (Figure 4) confirm the above finding since for a normal distribution the points on the graph would fall on the straight line.

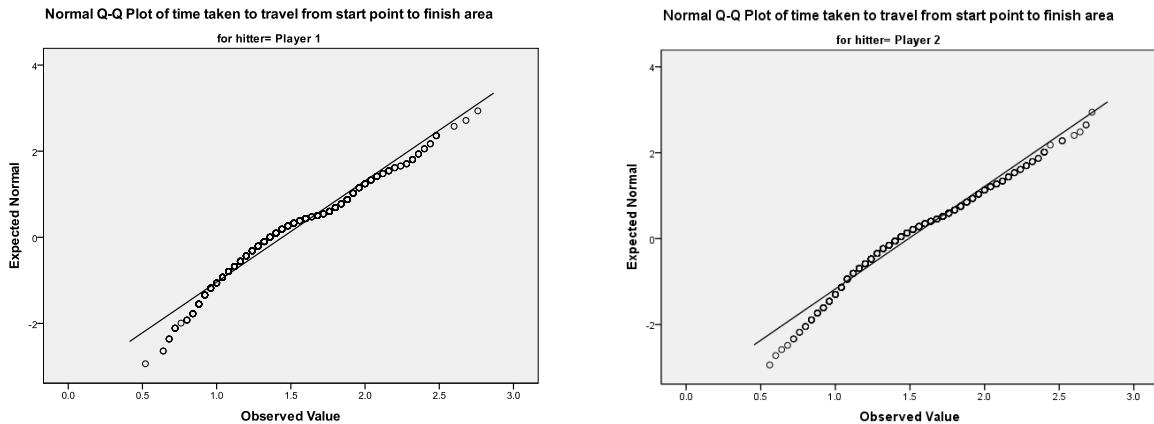


Figure 4: Normality Plots for player 1 and 2

In a similar manner the detrended plots (Figure 5) should exhibit no discernable pattern for a normal distribution, whereas in this example they do.

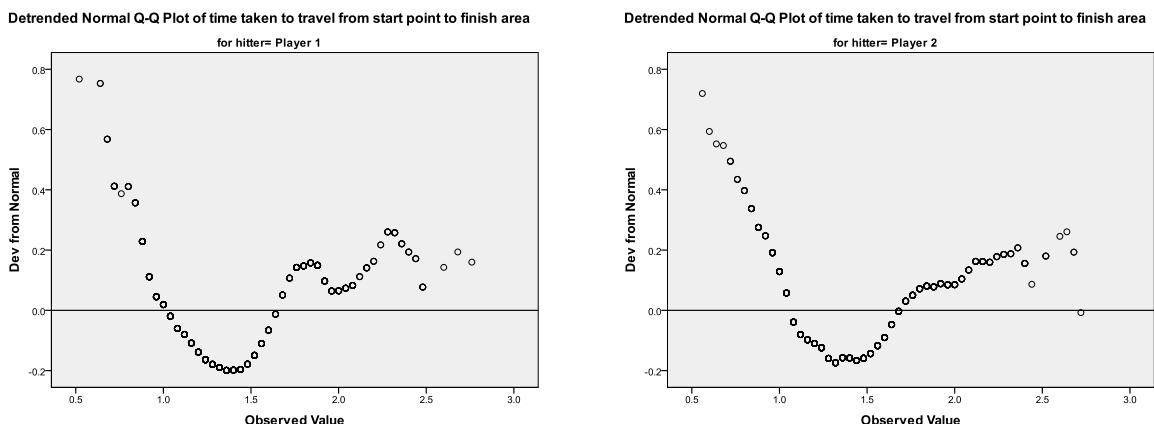


Figure 5: Detrended Normality Plots for player 1 and 2

The conclusions drawn from this examination of the data, which was ratio and therefore suitable for parametric statistics, was that the non normal distributions suggest non parametric approaches or a transformation of the data to normalise.

Although we have determined that in this case the data was not normal this would not always be the case. In the case of finding normal distributions in the data we also need to identify whether there are any extreme values (outliers). These, as discussed earlier, require consideration as to whether anything needs to be done. In any case the other plots produced in the explore command are very useful for this purpose and will be presented using different data.

### 3b A single data set

The data presented next is the proportion of time 21 basketball players walked at speeds of up to 1.4 m/s (velocity class 1 (VC1) in Vučković *et al.*, 2010) during 3 matches between two

teams during the final stages of the Slovenian National Championship (2004/05). The same explore command (with previously selected options) was used.

Table 3 suggests a relatively normal distribution as the mean (69.12) is similar to the median (69.43), the difference being 0.45% (as a proportion of the magnitude of the mean). Furthermore the skewness value (-0.314) is not twice its standard error (0.18). The kurtosis is near to 0 (0.655) also suggesting normality.

*Table 3: Descriptive statistics for proportion of time spent walking (PASW output)*

Descriptives			Statistic	Std. Error
VC1	Mean		69.120	.4545
	95% Confidence Interval for Mean	Lower Bound	68.223	
		Upper Bound	70.017	
	5% Trimmed Mean		69.187	
	Median		69.428	
	Variance		37.589	
	Std. Deviation		6.1310	
	Minimum		46.9	
	Maximum		85.1	
	Range		38.2	
	Interquartile Range		7.6	
	Skewness		-.314	.180
	Kurtosis		.655	.358

The opinion that the data was normally distributed was reinforced by the significance level of the Kolmogorov-Smirnov statistic ( $p=0.20$ ; Table 4).

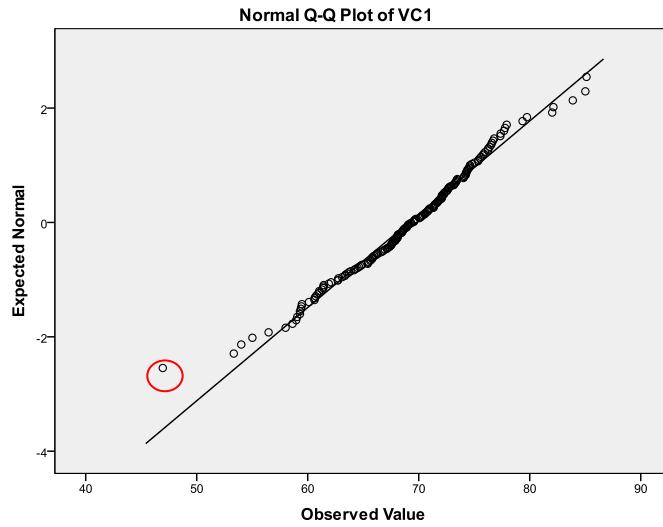
*Table 4: Tests of Normality (PASW output)*

	Kolmogorov-Smirnov <sup>a</sup>			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
VC1	.056	182	.200*	.987	182	.104

a. Lilliefors Significance Correction

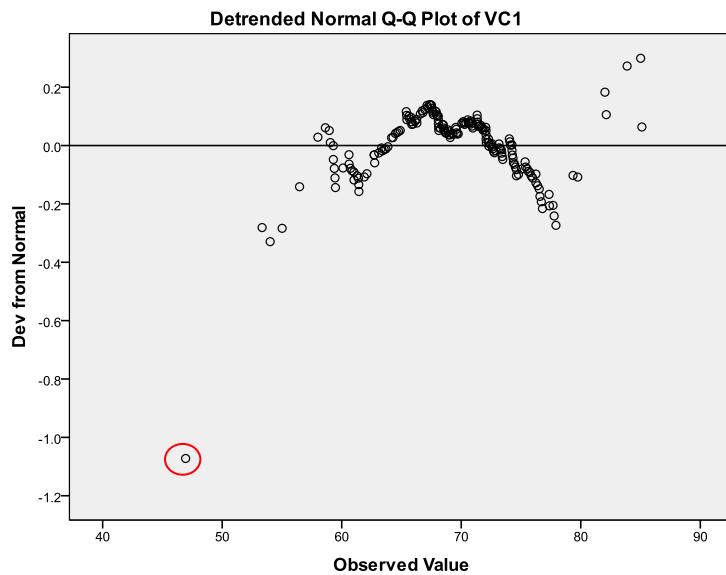
\*. This is a lower bound of the true significance.

The normality plot (Figure 6) is less clear as for a normal distribution the points on the graph should fall on the straight line. However extreme values (outliers) tend to affect these plots with the dot highlighted indicative of an extreme value.



*Figure 6: Normality Plot for proportion of time spent walking*

In a similar manner the detrended plot (Figure 7) should exhibit no discernable pattern for a normal distribution, which in this example is not the case. At this point it should be noted that the issue of normality is not as straight forward as to say a distribution is or is not normal. There are few examples of perfectly normal distributions and many distributions are relatively normal i.e. they display normal characteristics but contain more or less data in one or more areas of the distribution. Hence the assessment of normality is to determine if the data is “normal” enough to allow parametric analyses. Up to this point the evidence has suggested the data is normal but the presence of extreme values (one is clear on this plot and highlighted) also determines the validity of using parametric testing.



*Figure 7: Detrended Normality Plot for proportion of time spent walking*

The final three plots (histogram, scatterplot and boxplot) are useful for determining outliers and the shape of the distribution although each can be more useful than the others on occasion. Hence it is recommended that all are viewed to collect the necessary information. The first plot (histogram) in this example has the advantage that a normal curve can be drawn

on it. As with all charts in PASW the chart needs to be double clicked to open the chart editor. The button highlighted in Figure 8 allows this to be achieved.

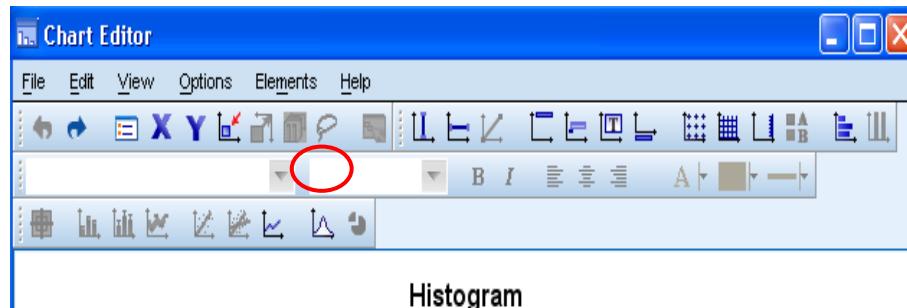


Figure 8: Chart editor for Histogram highlighting button for drawing normal curve

Whilst PASW offers alternative curves to fit to the data the default selection is the normal curve (Figure 9) and in this instance the curve drawn looks normal in that it is pretty close to symmetrical to the data.

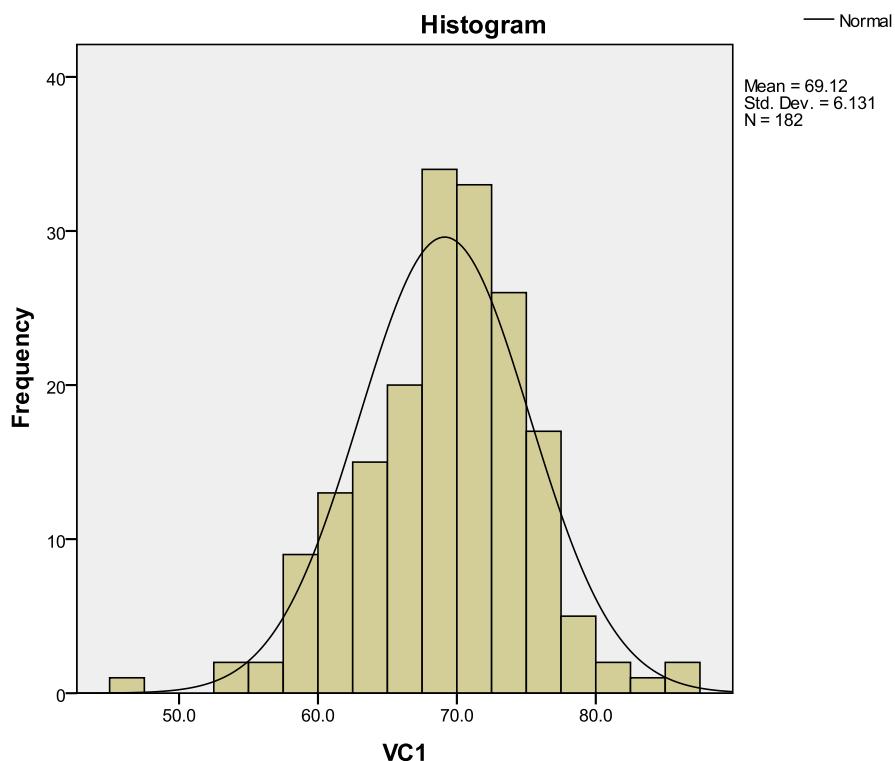


Figure 9: Histogram of proportion of time spent walking

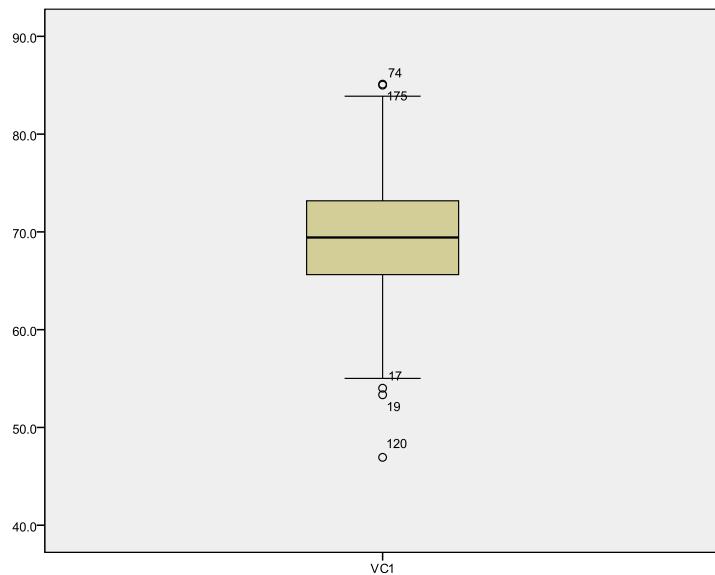
The stem-and-leaf plot (Figure 10) is constructed by splitting each score into a stem (the leading digit(s)) and a leaf (the trailing digit). The plot then represents a normal distribution laid on its side. A big advantage of this plot is that the number of extreme values are clearly identified (in this case 3 very low values of less than or equals 54 and 2 very high values of greater than or equals 85).

### VC1 Stem-and-Leaf Plot

Frequency	Stem & Leaf
3.00 Extremes	(=<54)
1.00	5 . 5
1.00	5 . 6
9.00	5 . 888999999
12.00	6 . 000001111111
10.00	6 . 222233333
15.00	6 . 4444455555555
19.00	6 . 66666677777777777
26.00	6 . 888888888888888999999999
24.00	7 . 00000000000001111111111
22.00	7 . 2222222222222333333
21.00	7 . 44444444444445555555
12.00	7 . 66666677777
2.00	7 . 99
.00	8 .
3.00	8 . 223
2.00 Extremes	(>=85)
Stem width: 10.0	
Each leaf: 1 case(s)	

*Figure 10: Stem-and-leaf plot of proportion of time spent walking*

The last plot is the boxplot (Figure 11) which has the added advantage of summarising the distribution. The box is determined by the median (the black line through the middle), the 25th percentile (lower boundary line) and the 75th percentile (upper boundary line). This means that 50% of cases will fall inside the box with the length of the box telling you about the spread of the data.



*Figure 11: Boxplot of proportion of time spent walking*

If the median is closer to the bottom of the box (not in this case) it means that the data is positively skewed. Lines are drawn from the box to values which are the highest and lowest values that aren't outliers. You will also notice outlying values are plotted. The

numbers represent case numbers (in the PASW data sheet) and when preceded by an o are outliers (between 1.5 and 3 box-lengths from the upper or lower box edges) whilst values preceded by an \* are extreme values (over 3 box-lengths from the upper or lower box edges).

The 5 outliers identified in this distribution may make you consider a non-parametric approach with this data although this is not necessarily the case. If using a parametric approach it would be wise to consider the effect these outliers might have on the subsequent results (outliers have more effect than non-outliers). If a more conservative non-parametric approach was used then the box plot is a very useful method of presenting the data (see a side by side boxplot example in James and Rees, 2008).

#### 4 Conclusion

The techniques presented here have demonstrated the important intermediate stage of analysing the data prior to applying any statistical procedures. Each procedure offers advantages over the other techniques and so a comprehensive approach to viewing your data should be adopted. The key decision to be made concerns whether you adopt a parametric or non-parametric approach to your data analysis. Convention determines that if you adopt a parametric approach then mean and standard deviation values should be used to describe your data. If a non-parametric approach is used then the median and interquartile range are more suitable although some researchers are resistant to this presumably thinking that the mean and standard deviation are generally better understood measures.

#### 5 References

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