ACTA UNIVERSITATIS PALACKIANAE OLOMUCENSIS

GYMNICA

Vol. 32
No. 1

PALACKÝ UNIVERSITY OLOMOUC
OLOMOUC 2002

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ISSN 1212-1185

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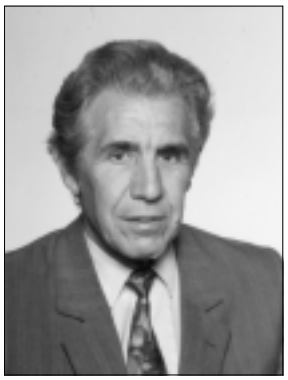

This year, Professor PhDr. Karel Měkota, CSc. reached the seventh decade of his life which has, in the main, been devoted to being a university teacher to the young. Thanks to his characteristic pedagogical manner (demanding as well as understanding) he has become an important personality in the life of the Faculty of Physical Culture of the Palacký University in Olomouc.

He was born on the 24th of March, 1932 in Brno, where he attended primary and secondary school, completing his final comprehensive school-leaving exams in 1950. He not only went through the school system in the Protectorate period, but also through the many changes of later years. He studied Physical Education at the Pedagogical Faculty of Masaryk University in Brno where he was awarded a "Graduate Pedagogue" degree in 1953.

In the same year he started teaching at the Department of Physical Education at the Mining College in Ostrava, where he worked until 1966. He concentrated on outdoor sports activities (winter skiing courses, summer training courses, mountain skiing etc.) and he founded the Climbing Group, part of the TJ Slávia physical education section of the Mining College. As early as this period he was inclined towards theoretical and research work; at the Mining College he presented an assortment of chapters on the theory of physical education. From the late fifties he also cooperated with Prague experts, namely with Professor Seliger, Čelikovský, Choutka and Štěpnička among others. He finished his external research work in Prague with his dissertation in 1964. As part of his research activities in the area of physical education, he used the factor analysis method, which was therewith being used for the first time in the history of the Czechoslovak Socialist Republic (CSSR). In the sixties, he became the only Moravian representative in the Academic Council of the Central Committee of the Czechoslovak Union of Physical Education.

In 1965 he organized, together with Associate Professor G. Šorm, the first national research into the motor performance of future college students. More than 19,000 respondents took part in this research, which was repeated at regular intervals until 1986.

In that year, more than 26,000 students were examined. The first research results were presented in 1966 at the *International Congress on Physical Performance* held in Prague. Further results were presented to the experts in 1974 during the world congress, *Sports in Modern Society,* held in Moscow and then during the *Olympic Congress* in Spain (Malaga 1992), where Prof. Měkota expounded upon long-term trends in the performance of college students.

In 1966, Prof. Karel Měkota accepted the offer of Associate Professor PaedDr. Mojmír Kocián, CSc., and commenced work at the Department of Expert Physical Education at the Faculty of Natural Science of Palacký University in Olomouc, which participated in the education of students for physical education teaching. During his work at the Faculty of Natural Science, he helped to introduce studies of anthropomotor activities and prepared the publication of Collection *Acta Universitatis Palackianae Olomucensis Gymnica*. He was its academic editor for another 26 years.

In 1968, Prof. K. Měkota espoused his higher doctorate work called *On the Physical Performance of College Youth* at the Faculty of Physical Education and Sport (FTVS) of Charles University in Prague and he acquired the degree of Associate Professor the following year.

The period after 1970 did not develop favourably for him. He was excluded from so-called expert reserves resulting in a particular limitation of his activities as a college teacher. Only later did he become the Chairman of the Rigorous Commission (1978–1980) having always been its member. During the eighties, he worked as a member of the commission for espousing under-graduate and dissertation works at the FTVS of Charles University in Prague. He prepared numerous opinions not only on rigorous activities and under-graduate as well as higher doctorate works, but also on final research reports.

In 1980, studies of physical education teaching within relevant departments were transferred to the Pedagogical Faculty of Palacký University in Olomouc. During this period, Prof. Měkota had still been teaching externally for three years, anthropomotor activities at the Pedagogical Faculty in Ostrava, as well as lecturing in Katowice and Warsaw where he helped to constitute this subject. He published many research works, being the author and co-author of several nationally-used teaching texts and three editions of the anthropomotor activities textbook. From 1973 to 1985 he organized five national seminars in Olomouc, concentrating on important themes from his field, with the participation, not only of experts, but also representatives of other scientific fields from the then Czechoslovakia as well as from abroad.

In 1990 he became a member of the team which prepared the establishment of an independent Faculty of Physical Education in Olomouc and he was elected Head of the Department of the Theory of Didactics of Physical Culture. This Department, after the establishment of the Faculty of Physical Culture (FTK) of Palacký University in Olomouc, was renamed the De-

partment of Kinanthropology. At FTK, he was nominated as the guarantor of doctorate studies, lecturer of participants in doctoral studies and a member of the Faculty Academic Council among other commissions. He was the Head of the Kinanthropology Department until 1995 when he had to give up some activities due to serious illness and several operations. In 1991, after the successful inauguration process at the Faculty of Physical Education and Sport of Charles University in Prague, he became a Professor in the field of anthropomotor activities – the theory of physical training. He became one of the first two professors at FTK UP in Olomouc. He has been working as the guarantor of this subject, lecturing in this discipline for all subjects at FTK UP. It needs to be said that he also introduced a new subject called *research methodology,* which he also lectured in.

The year 1990 was particularly important for Prof. K. Měkota. He became one of the nine founding members of the academic association *Internationale Gesellschaft für Sportmotorik* (IGS), presently the *International Association of Sports Kinetics* (IASK), in Gorzov in Poland. At the same time he was authorized to organize the II. International Conference of IGS in Olomouc in 1991 where he was elected to the position of Associate Vice-President. This act was in gratitude to Prof. Měkota for his activities but also in appreciation of his previous research and lifetime's work.

He worked in this position until 1999. During his work in the Association he participated in the preparation of another four international conferences held by the IASK Association in various countries as well as presenting invaluable speeches at all these conferences.

Many of his important works were conceived during this period, prominent among which were the development of the *UNIFITTEST* testing system (two monographs: Měkota, Kovář et al. 1995, 1996) and the international grant project, *Comparative Research on the Motor Performance of Physical Education Studies Candidates in Several European Countries.* The colleges of five European countries participated in the implementation of the research and the product was a monograph in English (Měkota, Zháněl et al. 1999), highly appreciated by the Rector of Palacký University Olomouc.

Prof. PhDr. Karel Měkota, CSc. co-operated with the founders of anthropomotor activities in CSSR, Prof. Čelikovský and Assist. prof. Štěpnička and their successors. He participated in the introduction of anthropomotor activites as a teaching subject in Czechoslovakia. He enriched the theoretical and methodological knowledge in this discipline extending the qualification of many college teachers in the field of physical culture.

Hopefully, Prof. Měkota shall continue his invaluable work. Congratulations on his jubilee.

K SEDMDESÁTINÁM PROFESORA KARLA MĚKOTY

Profesor PhDr. Karel Měkota, CSc., završil v letošním roce sedmou desítku let svého života, který z velké části zasvětil jako vysokoškolský učitel práci s mládeží. Svým charakteristickým pedagogickým pojetím (náročností i porozuměním) se stal významnou osobností života Fakulty tělesné kultury Univerzity Palackého v Olomouci.

Narodil se 24. března 1932 v Brně. V tomto městě navštěvoval základní i střední školu a v roce 1950 zakončil své studium na gymnáziu složením maturitní zkoušky. Zažil nejen protektorátní školství, ale i řadu změn, které probíhaly v pozdějších letech. Tělesnou výchovu vystudoval na Pedagogické fakultě Masarykovy univerzity v Brně a v roce 1953 získal titul promovaný pedagog.

Od téhož roku vyučoval na katedře tělesné výchovy Vysoké školy báňské v Ostravě, kde působil až do roku 1966. Zaměřoval se zvláště na sportovní činnost v přírodě (zimní lyžařské kurzy, letní výcvikové kurzy, vysokohorské lyžování aj.) a založil horolezecký oddíl v TJ Slávie VŠB. Již v tomto období inklinoval k teoretické a výzkumné práci; na Vysoké škole báňské v Ostravě přednášel vybrané kapitoly z teorie tělesné výchovy. Od konce padesátých let spolupracoval také s pražskými odborníky, a to zvláště s profesorem Seligerem, Čelikovským, Choutkou, Štěpničkou aj. Externí aspiranturu v Praze ukončil obhajobou disertační práce v roce 1964. V rámci své výzkumné činnosti v oblasti tělesné výchovy použil jako první v ČSSR metodu faktorové analýzy. V šedesátých letech se stal jediným zástupcem Moravy ve Vědecké radě Ústředního výboru Československého svazu tělesné výchovy.

V roce 1965 organizoval s docentem G. Šormem první celostátní výzkum motorické výkonnosti budoucích vysokoškolských studentů. Tohoto výzkumu se zúčastnilo více než 19 tisíc respondentů. Šetření se v pravidelných intervalech opakovalo až do roku 1986.

V tomto roce bylo již zkoumáno více než 26 000 studentů. První výsledky výzkumu byly prezentovány roku 1966 na *Mezinárodním kongresu o tělesné zdatnosti*, který se konal v Praze. S dalšími výsledky byla seznámena odborná veřejnost v roce 1974 na světovém kongresu *Sport v moderní společnosti,* který se uskutečnil v Moskvě, a posléze pak na *Olympijském kongresu* ve Španělsku (Malaga, 1992), kde prof. Měkota referoval o dlouhodobém trendu výkonnosti vysokoškolských studentů.

V roce 1966 přijal prof. Karel Měkota nabídku docenta PaedDr. Mojmíra Kociána, CSc., a nastoupil na katedru odborné tělesné výchovy Přírodovědecké fakulty Univerzity Palackého v Olomouci, která se podílela na výuce studujících učitelství tělesné výchovy. Při svém působení na Přírodovědecké fakultě se zejména zasloužil o zavedení výuky antropomotoriky

a v roce 1970 připravil vydávání sborníku *Acta Universitatis Palackianae Olomucensis – Gymnica*. Jeho vědeckým redaktorem byl dalších 26 let.

V roce 1968 obhájil prof. K. Měkota na Fakultě tělesné výchovy a sportu (FTVS) Univerzity Karlovy v Praze habilitační práci *K tělesné výkonnosti vysokoškolské mládeže* a v následujícím roce byl jmenován docentem.

Období po roce 1970 se nevyvíjelo pro něho příznivě. Byl vyřazen z tzv. kádrových rezerv a to pro něho znamenalo značné omezení činnosti vysokoškolského učitele. Teprve v pozdějších letech se stal předsedou rigorózní komise (1978–1980) a je doposud jejím členem. V osmdesátých letech působil jako člen komise pro obhajobu kandidátských a disertačních prací na FTVS UK Praha. Vypracoval desítky posudků nejen rigorózních, kandidátských i habilitačních prací, ale i závěrečných výzkumných zpráv.

V roce 1980 přešlo studium učitelství tělesné výchovy s příslušnými katedrami na Pedagogickou fakultu Univerzity Palackého v Olomouci. V tomto období prof. K. Měkota ještě externě vyučoval po dobu tří let antropomotoriku na Pedagogické fakultě v Ostravě, přednášel v Katowicích a ve Varšavě, kde pomáhal tento předmět konstituovat. Publikoval řadu výzkumných prací, stal se autorem a spoluautorem několika celostátně používaných učebních textů a trojího vydání učebnice antropomotoriky. V letech 1973–1985 uspořádal v Olomouci pět celostátních seminářů zaměřených na závažná témata svého oboru, a to nejen za účasti odborníků, ale i zástupců dalších vědních oborů z tehdejšího Československa i ze zahraničí.

V roce 1990 se stal členem přípravného týmu pro vznik samostatné tělovýchovné fakulty v Olomouci a byl zvolen vedoucím katedry teorie didaktiky tělesné kultury. Tato katedra byla po ustavení Fakulty tělesné kultury (FTK) Univerzity Palackého v Olomouci přejmenována na katedru kinantropologie. Na FTK byl jmenován garantem doktorandského studia, školitelem doktorandů, členem vědecké rady fakulty a dalších komisí. Katedru kinantropologie vedl do roku 1995, kdy se po vážném onemocnění a několika operacích vzdal některých funkcí.

V roce 1991 po úspěšném inauguračním řízení na Fakultě tělesné výchovy a sportu Univerzity Karlovy v Praze byl jmenován profesorem pro obor antropomotorika – teorie tělesných cvičení. Stal se jedním z prvních dvou profesorů FTK UP v Olomouci. Stále působí jako garant tohoto oboru a přednáší tuto disciplínu pro všechny studijní obory FTK UP. Je třeba připomenout, že zavedl nový celofakultní předmět *metodologie výzkumu*, který také přednáší.

Rok 1990 byl pro prof. K. Měkotu zvláště důležitý. Stal se jedním z devíti zakládajících členů vědecké společnosti *Internationale Gesellschaft für Sportmotorik* (IGS), v současnosti *Internacional Association of Sport Kinetics* (IASK), a to v Gorzově v Polsku. Zároveň byl pověřen uspořádáním II. mezinárodní konference IGS v Olomouci v roce 1991, kde byl zvolen viceprezidentem společnosti. Tímto aktem bylo prof. Měkotovi vyjádřeno poděkování za jeho činnost, ale také ocenění předcházející výzkumné práce a celoživotního díla.

V uvedené funkci setrval až do roku 1999. Během svého působení ve společnosti se podílel na přípravě dalších čtyř mezinárodních konferencí pořádaných společností IASK v různých státech a na všech těchto konferencích vystoupil s podnětnými příspěvky.

V tomto období vnikla celá řada jeho významných prací. Je třeba uvést alespoň vývoj testovacího systému *UNIFITTEST* (dvě monografie: Měkota, Kovář et al., 1995, 1996) a mezinárodní grantový projekt *Komparativní výzkum motorické výkonnosti kandidátů studia tělesné výchovy v některých evropských zemích.* Do realizace výzkumu se zapojila učiliště pěti evropských států a výstupem se stala monografie v angličtině (Měkota, Zháněl et al., 1999), oceněná rektorem Univerzity Palackého v Olomouci.

Prof. PhDr. Karel Měkota, CSc., byl spolupracovníkem zakladatelů antropomotoriky v ČSSR, prof. Čelikovského a doc. Štěpničky, a posléze jejich pokračovatelem. Významně se podílel na konstituování antropomotoriky jako vyučovacího předmětu v Československu. Obohatil teoretické a metodologické poznatky v této disciplíně, a přispěl tak k vyšší kvalifikaci mnoha vysokoškolských učitelů v oblasti tělesné kultury.

Přejeme si, aby prof. Měkota v této záslužné práci pokračoval a k dosaženému jubileu mu ze srdce blahopřejeme.

PHYSICAL ACTIVITY AND SPORT PREFERENCES OF 10 TO 14-YEAR-OLD CHILDREN: A 5-YEAR PROSPECTIVE STUDY

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Submitted in February, 2002

Children's preferences for physical activity can be used to revise physical education curricula. A 5-year prospective study followed 118 girls and 127 boys from the ages of 10 to 14 years and assessed sport and physical activity preferences twice a year. Girls preferred swimming, dancing and skating, and boys' main interests were swimming, sport games and skating. High stability was evidenced by correlation of over .90 across time. There were sex differences in preference for activity categories, with girls preferring activities with an aesthetic orientation, and boys showing more preference for fitness activities. Gender-specific activity programs may be needed to respond to stated preferences of girls and boys.

Keywords: physical education, secondary school, longitudinal research, sports.

Acknowledgements

This study was supported by MSMT (Czech Republic) grant No. RS97073.

INTRODUCTION

Contemporary conceptions of physical education pedagogy stress the importance of considering students' physical, affective, and cognitive developmental states in developing curricula (Aschebrock, 1999; Crum, 1994; Grineski, 1996; Humel, 2000; Hummel & Balz, 1995; Jones & Ward, 1998; Kurz, 1995; Siedentop, 1996; Virgilio, 2000). Sport and physical activity preference is one variable that is likely to change with development. Including activities preferred by girls and boys in physical education curricula could produce several benefits, including greater involvement in lessons and increased enjoyment of physical education (Derner, 1994; Greenwood, Stillwell, & Byars, 2000; Knitt et al., 2000; Lee, Fredenburg, Belcher, & Cleveland, 1999; Sass H. & Sass I., 1986; Strand & Scatling, 1994; Volke, Poszony, & Stumpf, 1985). These are significant goals, because preference for physical activity and enjoyment of physical education are important predictors for overall physical activity participation (Sallis et al., 1999a, b). Although physical education curricula should be based on more than simply students' preferences, student preferences can inform the design of physical education, other school-based physical activity programs, and programs sponsored by other agencies.

Young people's physical activity and sport preferences are likely to vary by age, sex, socio-economic status and nationality. Although several studies have been conducted over many years (Greller & Cochran, 1995; Hoffman & Harris, 2000; Kotonski-Immig, 1994; Lamprecht, Ruschetti, & Stamm, 1991; Strand & Scatling, 1994; Taks, Renson, & Vanreusel, 1991; Telama, 1978; Walton et al., 1999), current understanding of children's preferences in specific sports and movement activities is limited. One of the main limitations is the cross-sectional nature of the data, so the stability of sport and physical activity preferences over time is not known.

The main aim of the present research is to describe the levels and trends in the development of sport and physical activity preferences in girls and boys over a period of five years, from the age of 10 to 14. Further, the study aims to establish the stability of preferences over time.

METHODS

The longitudinal survey of sport and physical activity preference in children was carried out from 1994 to 1999 at 10 elementary schools in the Czech Republic. Five typical schools throughout the country were chosen from municipalities up to 5,000 inhabitants and five schools from municipalities above 20,000 inhabitants.

The first measurement was conducted when children were 10 years old and attending the fifth grade. In case there were more than two 5th classes at one

school, only two of them were randomly chosen. Written permission was obtained from parents of all children and assent was obtained from children. The target sample for the first survey was 150 boys and 169 girls. By reason of address changes or transition to another school 23 boys and 51 girls did not finish the survey, so the final sample was 127 boys and 118 girls. For boys, the mean age was 14.5 (±1.1) years, weight was 57.8 (±11.9) kg, height was 168.8 (±11.4) cm, and BMI was 20.1 (±2.5) $kg \cdot m^{-2}$. For girls mean age was 14.2 (±1.1) years, weight was 61.9 (±9.8) kg, height was 174.1 (±8.6) cm, and BMI was 19.0 (±2.2) $kg \cdot m^{-2}$. In the course of the five-year study, the survey was administered twice a year (October and May).

Sport and physical activity preference was established by means of a standardised questionnaire (Frömel, 1994; Frömel, Novosad, & Svozil, 1999) covering the following spheres: sports branches, athletics, gymnastics, sports games, recreation, development of motor abilities and orientation of physical activity. A summary of items is shown in TABLE 1. In all these areas, the pupils gave the ranking for the first five favourite sports branches, orientation, or events. The sports preference was assessed by the sum of ranking. The highest sports preference had the lowest summed rank.

TABLE 1
Summary of sport branches and physical activity orientations for which preference rankings were obtained.

Sport Branches:
Athletics (includes all forms of running)
Technical sporting activities
Canoeing, rowing, rafting
Fitness exercise
Skiing – nordic
Skiing – down-hill, snowboarding
Rhythmic gymnastics
Orienteering
Swimming
Aerobics
Gymnastics
Sporting games
Dancing
Hiking and cycling
Self-defence (karate, judo)
Skating, skateboarding
Windsurfing
Others…

Physical Activity Orientations:
"Aesthetic" (dominance of aesthetic exercise performance, movement expression with music)
"Fitness" (stress on development of strength, endurance and speed, higher physical loading and good form)
"Sport" (dominance of development of sports capacity, sports competitions, typical sport branches and events)
"Recreational" (movement activities for leisure time, relaxation, enjoyment, recreation)
"Creative" (dominance of creative exercise performance, independence, liberty of decision-making, imagination, originality)
"Health" (stress on aerobic endurance, correct body posture, stretching, weight reduction)

The questionnaire had already been successfully used at all levels and types of school in the Czech Republic, Poland, the Slovak Republic, Germany and Sweden (Frömel, Novosad, & Svozil, 1999). The questionnaire had a high test-retest reliability (stability), based on a study of 13 year-old girls (n = 199; $r_s = .96$) and boys (n = 166; $r_s = .97$). The validity of the questionnaire is supported by the significant correlation between the ranking of sports preferences and students report of participation in those sports. In 11–14 year-old girls (n = 2217) $r_s = .69$ and in 11–14 year-old boys (n = 1978) $r_s = .70$.

The questionnaire was always applied during one 45-minute morning lesson. An investigator was present to assure that each student completed the survey independently and to answer questions. The investigator stressed the importance of repeated assessments of the same items.

Descriptive analyses of mean rankings were conducted. To find out the preference stability, rank order correlation was computed between initial and all following measurements. All analyses were carried out separately for girls and boys.

RESULTS

In girls, from ages 10 to 14, preference for swimming, dancing and skating (including inline-skating) predominated. Boys preferred swimming, sports games and skating (Fig. 1 and 2). Over time, girls' preference for aerobics improved from rank nine to the rank four. The second most substantial move was the improvement in girls' preference for tourism from eleventh place on the seventh place, due to cycle-tourism. In boys the only striking change in preference was for self-defence activities that declined from the sixth to tenth place.

Fig. 1
Girls' preferences for specific sports and physical activities, from age 10 to 14

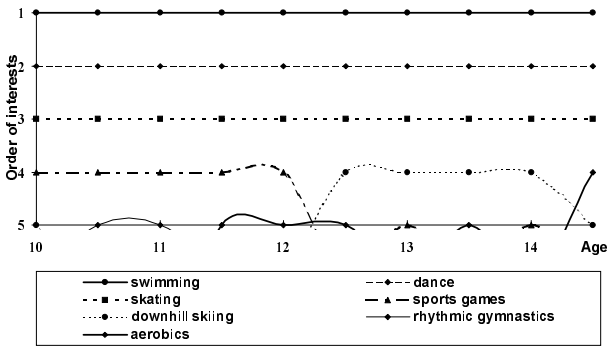
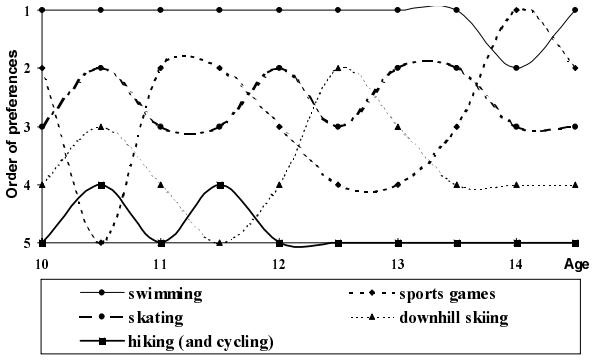
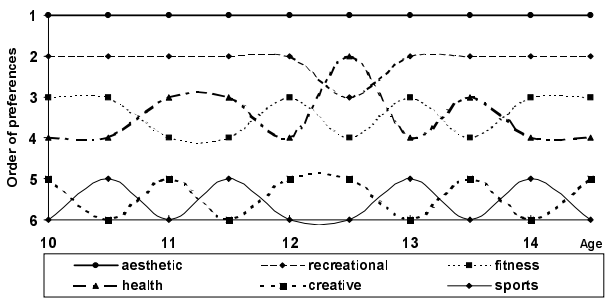


Fig. 2
Boys' preferences for specific sports and physical activities, from age 10 to 14



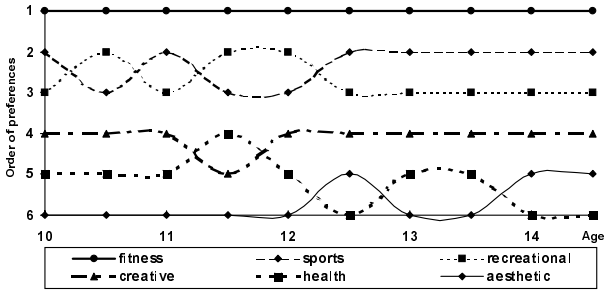
During the five-year period, the girls' preferences for aesthetically and recreationally orientated physical activity clearly prevailed (Fig. 3). This is an orientation in physical activity that puts emphasis on motor manifestation of one's personality, on exercises to music, and stress reduction. Girls showed less preference for sports and the performance orientation of physical activity, or in physical activity with higher demands on independence, thinking about the exercises, and creativity.

Fig. 3
Developmental trends in girls' preferences in orientation of physical activity, from age 10 to 14



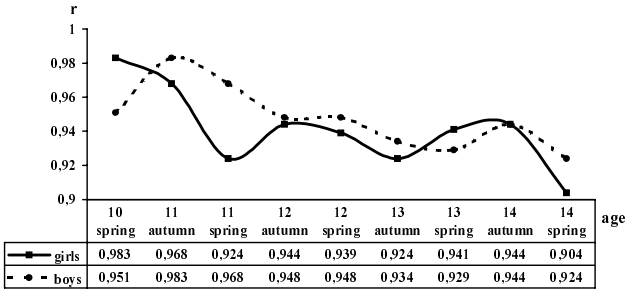
In boys, the preference in physical activity was dominated by a fitness orientation, followed by physical activity focused on sport performance (Fig. 4). Aesthetic and health oriented activities tended to be least preferred.

Fig. 4
Developmental trends in boys' preferences in orientation of physical activity, from age 10 to 14



The stability of specific sport and activity preferences was high for girls and boys across five years. Fig. 5 shows all correlations were above .90 but there was a gradual decline from a high of .98 to a low of .90. Similarly high levels of stability of physical activity orientations were observed for girls and boys. Figure 6 shows that correlations remained high for the entire five-year study period.

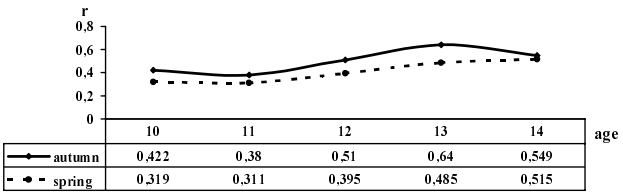
Fig. 5
Stability of sports preferences in girls (n = 270) and boys (n = 290) aged 10–14



	10 spring	11 autumn	11 spring	12 autumn	12 spring	13 autumn	13 spring	14 autumn	14 spring
girls	0,983	0,968	0,924	0,944	0,939	0,924	0,941	0,944	0,904
boys	0,951	0,983	0,968	0,948	0,948	0,934	0,929	0,944	0,924

Notes:
Spearman rank correlation coefficients express the relation between the structure of interests at the beginning and the structure of interests over five years.

Fig. 6
Differences in sports preferences of girls and boys in autumn and spring



	10	11	12	13	14
autumn	0,422	0,38	0,51	0,64	0,549
spring	0,319	0,311	0,395	0,485	0,515

Notes:
Spearman rank correlation coefficients express the relationship between the structure of physical activity preferences in boys and girls in the same period.

DISCUSSION

Both girls and boys preferred sports and activities that could be practised in their leisure time. Although girls and boys of all ages studied preferred swimming and skating, important gender differences in activity preferences were documented. Girls, in contrast to boys' preferences for sports games, hiking, and cycling also preferred dancing and aerobics.

More striking were the gender differences in physical activity orientation, which is related to motivation for physical activity. Girls clearly preferred activities with an aesthetic and recreational nature, while boys consistently preferred fitness and sports performance activities. The persistent differences in orientation argue against attempts to "erase the differences" between girls and boys in physical education. Coeducational classes are becoming more frequent in many countries, with the effect that neither the needs of boys nor girls are fully met. The gender differences in the orientation toward physical activity should be reflected in more gender-specific physical education curricula. For example, fitness development by means of aerobics in girls should emphasise aesthetic movement (Frömel, Vašendová, & Krapková, 2000). When involving boys in aerobics it is necessary to ensure corresponding physiological loading or to apply another variations like box-aerobics. In girls' volleyball, it may be desirable to place more emphasis on the relaxation and emotive aspects. On the contrary, in boys it may be more successful to strive for a higher physiological loading and a performance orientation. The acrobatic exercises in girls can be more oriented more aesthetically, whereas in boys the orientation could be more on performance and fitness (Bell, 1998). The effects of adapting gender-specific instructional methods for physical education on behavioral and affective outcomes should be assessed.

Out of the traditional content of physical education curricula the least preferred was gymnastics. Perhaps gymnastics is not presented in a sufficiently attractive and enjoyable form, and the movements are difficult to learn. A more effective approach may be to combine it with other sports branches like acrobatic rock'n'roll or combative sports. Another approach for enhancing preference may be to develop a simplified form of gymnastics exercises.

Girls' preferences for sports branches were generally much lower than boys' preferences. Studies are needed to determine how much the girls' lack of preference for sports branches and events account for their overall lower physical activity (Fromel, Novosad, & Svozil, 1999; Sallis & Patrick, 1994).

Sport and activity preferences of children showed a high stability throughout the five-year survey (Fig. 5). The same is true of physical activity orientation (Fig. 6), with virtually all correlations being above .90. There were no clear patterns of variation by season. Such stability suggests that activity preferences may be difficult to change, and offering girls and boys the specific activities they prefer may be an effective way to stimulate regular physical activity. However, the data contain some documentation that preferences can be changed by experience. Around the age of 13, most students attended a downhill skiing course. Fig. 3 and 4 reveal the influence of the skiing course on the rise of preference in downhill skiing. More studies are needed that document the effects of specific instructional techniques of young peoples' preferences for physical activity.

Strengths of the study include the 5-year prospective design, assessment of seasonal differences in preferences, exploration of sex differences in activity preferences, inclusion of students from schools in multiple regions in the Czech Republic, and use of the same preference measure throughout the study. However, it is unknown how the results will be generalised to other countries. An additional limitation is the assessment of preference by rank order only, so changes in the absolute levels of preference over time cannot be assessed.

CONCLUSIONS

- In girls aged 10–14, the dominant preferences were swimming, dancing, and skating (including inline-skating). In boys the main preferences were swimming, sport games, and skating.
- Children's sport and activity preferences showed high stability over the five years of this investigation.

- There were no substantial differences in the stability of sports preferences of girls and boys aged 10 to 14.
- During the entire five-year period, the girls' preferences for aesthetic and recreational physical activity prevailed. In boys, the prevailing preferences were for physical activity focused on fitness and sports performance.
- Knowledge of the structure of students' sport and physical activity preferences is important for developing school physical education curricula that in still positive attitudes in girls and boys towards physical education and physical activity

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STABILITA SPORTOVNÍCH PREFERENCÍ 10 AŽ 14LETÝCH DĚTÍ – PĚTILETÁ LONGITUDINÁLNÍ STUDIE

(Souhrn anglického textu)

Hlavním cílem longitudinálního výzkumu bylo analyzovat stav a vývojové trendy v sportovních preferencích 10 až 14letých dětí a zjistit stabilitu a rozdíly ve sportovních preferencích dívek a chlapců. Očekávali jsme, že nástup puberty ovlivní strukturu sportovních preferencí dětí, a že sportovní preference chlapců jsou stabilnější než u dívek ve stejném věku.

Do výzkumu byli vybráni žáci základních škol různých regionů s rovnoměrným zastoupením městských a vesnických škol. Celkem se longitudinálního výzkumu zúčastnilo po celou pětiletou dobu výzkumu 127 chlapců a 118 dívek. Struktura sportovních preferencí byla zjišťována standardizovaným dotazníkem.

Dívky ve věku 10 až 14 let preferují plavání, tanec a bruslení (i kolečkové) a chlapci plavání, sportovní hry a bruslení. Celkově převažuje zájem o sportovní odvětví, která je snazší provozovat ve volném čase. Při značných rozdílech ve sportovních zájmech dívek a chlapců dochází mezi 10. až 14. rokem k mírnému snižování rozdílů neboli k postupné zájmové konvergenci.

Sportovní preference dětí vykazují v průběhu pětiletého výzkumu vysokou stabilitu. V preferenci oblíbených sportovních odvětví v pětiletém období byla zjištěna větší stabilita u dívek, zatímco celkově byla zjištěna menší variabilita sportovních preferencí u chlapců. Vliv puberty není možné vzhledem k průměrným výsledkům a rozdílnému biologickému věku respondentů stanovit. Je ale zřejmé, že puberta se výrazně ve struktuře sportovních preferencí neprojevuje. Závažnou sociální otázkou je, do jaké míry může stabilita sportovních preferencí a jejich účinné uspokojování příznivě ovlivňovat sociálně žádoucí hodnotovou orientaci dětí v prepubertálním a pubertálním věku.

U dívek po celé pětileté období jednoznačně převažuje zájem o esteticky a rekreačně zaměřenou pohybovou aktivitu. Tedy o takové zaměření pohybové aktivity, při které je kladen důraz na pohybový projev, cvičení s hudbou, odreagování, regeneraci apod. Méně jeví dívky zájem o typické sportovní a výkonnostní zaměření pohybové aktivity, a také o pohybovou aktivitu s vyššími nároky na samostatnost, promýšlení cvičení a tvořivost.

U chlapců dominuje zájem o kondičně zaměřenou pohybovou aktivitu a dále sportovně výkonnostní charakter pohybové aktivity. Odlišnosti v zaměření pohybové aktivity je žádoucí účinněji prosazovat jak ve vlastním vyučování, tak i v kurikulech a v další pedagogické dokumentaci. Diagnostika sportovních preferencí dívek a chlapců je důležitá pro úspěšnou realizaci školních kurikul a zejména pro vytváření pozitivních postojů dívek a chlapců k tělesné výchově, k pohybové aktivitě i celé tělesné kultuře.

Klíčová slova: tělesná výchova, střední škola, longitudinální výzkum, sport.

INACTIVITY IN THE LIFE STYLE OF ADOLESCENT GIRLS CLASSIFIED ACCORDING TO THE LEVEL OF THEIR BODY WEIGHT

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Submitted in February, 2002

The technological development of society has got, in addition to positive economic, social and other consequences, also some negative impacts. One of them is the extension of time spent in inactivity – sitting in front of the TV or PC monitor, in school, while studying or when entertaining oneself. This insufficiency of physical activity together with improper nutrition starting in childhood and continuing through the adolescent period manifests itself adversely in the area of physical fitness and health. The main aim of this study is to discover the structure and representation of inactivity in adolescent girls as related to carried out physical activity by analysing their normal school week routine and visualising some determinants important for positive changes in their life style and healthy habits. From our analysis we conclude:

- The total volume of inactivity in girls who were classified according to the level of their body weight was stable and ranged from 4.86 to 5.21 hours per day.
- Watching TV is the second longest type of inactivity, after sitting in school, including the normal school week routine in all groups of girls classified according to the level of their body weight.
- The "absence" of sitting in school during weekend days is "substituted for" by the longer duration of the watching of TV as compared to weekdays (most evidently in obese girls and girls with a higher level of body weight).
- Modified individual record monitoring including the structure of inactivity markedly improves the quality of analysis of the life style of children and youth.
- Feedback service information about carried out physical activity and inactivity contributes to the motivation of participating students to perform physical activity optimally and allows schools to expertly intervene in the structure, content as well as duration of the learning process in physical education related to after-school activities of children and youth.

Keywords: inactivity, obesity, energy expenditure, school physical education.

INTRODUCTION

"Physical inactivity appears to be a behavior distinct from physical activity, and may be an important health promotion target. TV watching is a major contributor to sedentary activity, especially among children, and may be a useful marker for overall levels of sedentary behavior" (Pratt, Macera, & Blanton, 1999, S531). We characterize inactivity as human behavior which doesn't extensively increase total energy expenditure above the rest level of metabolism (max. 2 METs – sitting at TV, PC, in school, sitting and lying while studying, playing, in restaurants, parks and in the cinema, etc). Inactivity, in addition to the factors of overall health, hobbies and nutrition, distinctly determines the quality of children's and youth's lifestyle (Armstrong, 1998; Kann, 2000; Sallis & Owen, 1999). In the current lifestyle of Czech as well as foreign youth, a high level of inactivity is evident which, together with improper nutrition (Cavadini, Siega-Riz, & Popkin, 2000), adversely influence their health and fitness (Armstrong, 1998; Crespo, 2001; Kann, 2000; Tomori, Zalar, & Plesnicar, 2000). Analysis of data gathered in the years 1988–1994 in 4063 American children aged 8–16, according to Andersen, Crespo, and Bartlett (1998), implies that children watching TV longer than 4 hours a day (26 %) have got a significantly higher percentage of fat than those watching TV less than two hours a day (67 %). "Students who watched television or played video games for three or more hours in the after-school period were significantly more likely to be low-active than students who watched less than this amount" (Pate et al., 1997, 244). This multivariate analysis was based on questionnaires designed to measure beliefs and social influences regarding physical activity, self-efficacy therein, the perceived physical activity habits of family members and friends, and access to exercise and fitness equipment at home. It was completed by 361 American children aged 10.7 ± 0.6 years (Pate et al., 1997). Lowering

inactivity by increasing the level of physical activity markedly contributes to enhancement of health and improvement of life quality (Crespo, 2001; Owens et al. 1999; Strauss, Rodzilsky, Burack, & Colin, 2001). Strauss et al. (2001) have found the following results in their study exploring relationships between health beliefs, self-efficacy, social support, sedentary activities and physical activity in 92 healthy children (44 boys and 48 girls) aged 10–16 years:

1. Time spent in sedentary behaviours (viewing television, sitting at the computer, and doing homework) was inversely correlated with the amount of moderate-level (walking, playing) activity ($p < .001$) but not high-level activity (fast walk, jogging, slow run).
2. Time spent in high-level activity correlated with self-efficacy scores ($p < .001$) and social influences scores ($p < .005$).
3. Behaviour, happiness, intellectual, and popularity self-esteem subscores were significantly ($p < .05$) decreased in children with low-levels of high-level activity.
4. High-level physical activity was associated with improved self-esteem ($p < .05$).

Active exploitation of leisure time in youth is, at the present time, Problem Number One everywhere in the world. Sport clubs, organisations and associations, schools, fitness, wellness and other centres create favourable conditions for solving this problem by offering a wide range of movement programmes (Frömel, Novosad, & Svozil, 1999; Sallis et al. 1999).

The main aim of our research was to discover the volume and structure of inactivity in adolescent girls during their normal school week in relation to performed physical activity, and to visualise some determinants that are important for positive changes in their lifestyle and health.

Partial aim: To verify the possibility of using a modified individual record of physical activity that, in addition to FITT characteristics of practised physical activity and energy expenditure from Caltrac, monitors also the duration of inactivity (see Appendix 1).

METHODOLOGY

In the research conducted in natural and comparable conditions at four grammar schools (two in Olomouc during autumn 2000 and two in Katowice in spring 2001) a total of 145 girls took part (mean ± standard deviation – age 15.99 ± 2.22 years, body height 164.60 ± 6.66 cm and body weight 53.75 ± 7.87 kg). The quantity and level of weekly physical activity were monitored by standardised methodology based on assessment of energy expenditure with the Caltrac accelerometer and steps and skips with the Omron pedometer (Frömel, Novosad, & Svozil, 1999; Sigmund, 2000).

Monitoring was supplemented by the keeping of a modified individual record (see Appendix 1) in which participants wrote down, in addition to data from Caltrac and FITT characteristics of practised physical activity, newly also the structure of daily inactivity. Besides an analysis of obtained data about physical activity and inactivity we offered a feedback didactic service for students and their parents, teachers and headmasters at involved secondary grammar schools, thanks to special software (Chytil, 2000). Immediately after data evaluation, each of the participating students obtained a graphic output about the level and structure of realised physical activity and inactivity with the opportunity to be anonymously compared with schoolmates. Teachers and headmasters obtained average, summary and comparative results.

The level of body weight was classified according to the percentile graph of body mass index (thereinafter BMI), (Bláha & Vignerová, 1997). Individuals with BMI values ranging between 25^{th}–75^{th} percentile are regarded by Bláha and Vignerová (1997) as normal with respect to body weight. BMI values between the 75^{th}–90^{th} percentile signal a higher level of body weight. Individuals with BMI values higher than 90^{th} percentile are obese, respectively those categorized lower than the 25^{th} percentile respectively have got a lower level of body weight.

RESULTS AND DISCUSSION

a) Inactivity

The total volume of inactivity in girls who are classified according to the level of their body weight was constant during the normal school week and ranged from 4.86 to 5.21 hours per day. Differences were found in the structure of the inactivity (Fig. 1). In a comparative study, Strauss et al. (2001) discovered that 92 children aged 10–16 years spent 5.2 ± 1.8 hours per day doing homework, sitting at the computer, or watching television (75.5 % of the "out-of-school" day), while the remaining 4.5 ± 0.7 hours per day of sedentary time primarily were spent at school. In contrast, only 1.4 % of the day (12.6 ± 12.2 minutes) was spent in vigorous activity.

Obese girls and girls with a higher level of body weight spent more time watching TV than girls with a normal or lower level of weight. On the other hand, girls with a normal or lower level of body weight spent more time sitting in a restaurant, park or cinema, respectively sitting during sports or other cultural events, than did their obese schoolmates and schoolmates with a higher level of body weight (Fig. 1). Independently of the level of body weight, girls worked one hour a week with a computer that corresponded to their actual school timetable during monitoring.

An unsurprising fact is the finding that the obese girls (according to their body weight) spent the most time of all the groups (of girls) sitting in school. Because the school timetable is the same for all included girls we understand that this reality is caused by a different way of spending breaks and "free" lessons.

Fig. 1
Structure of inactivity in girls who are classified according to the level of their body weight in the course of the normal school week routine (min)

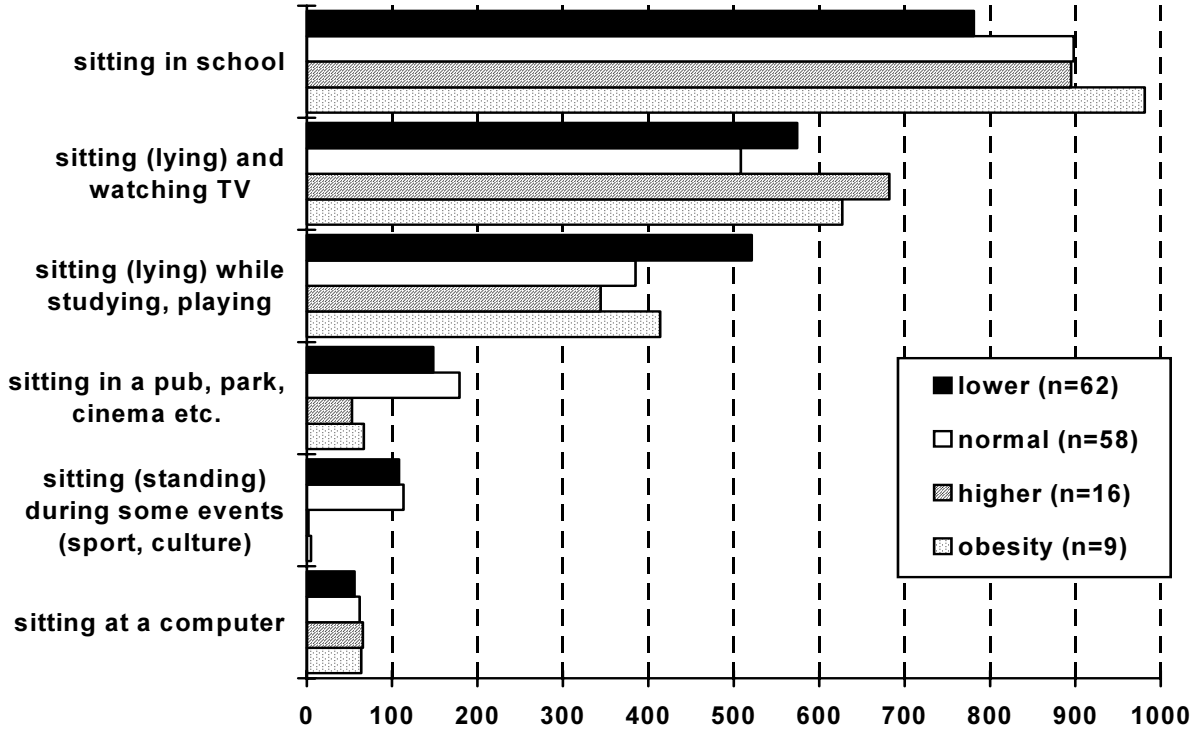
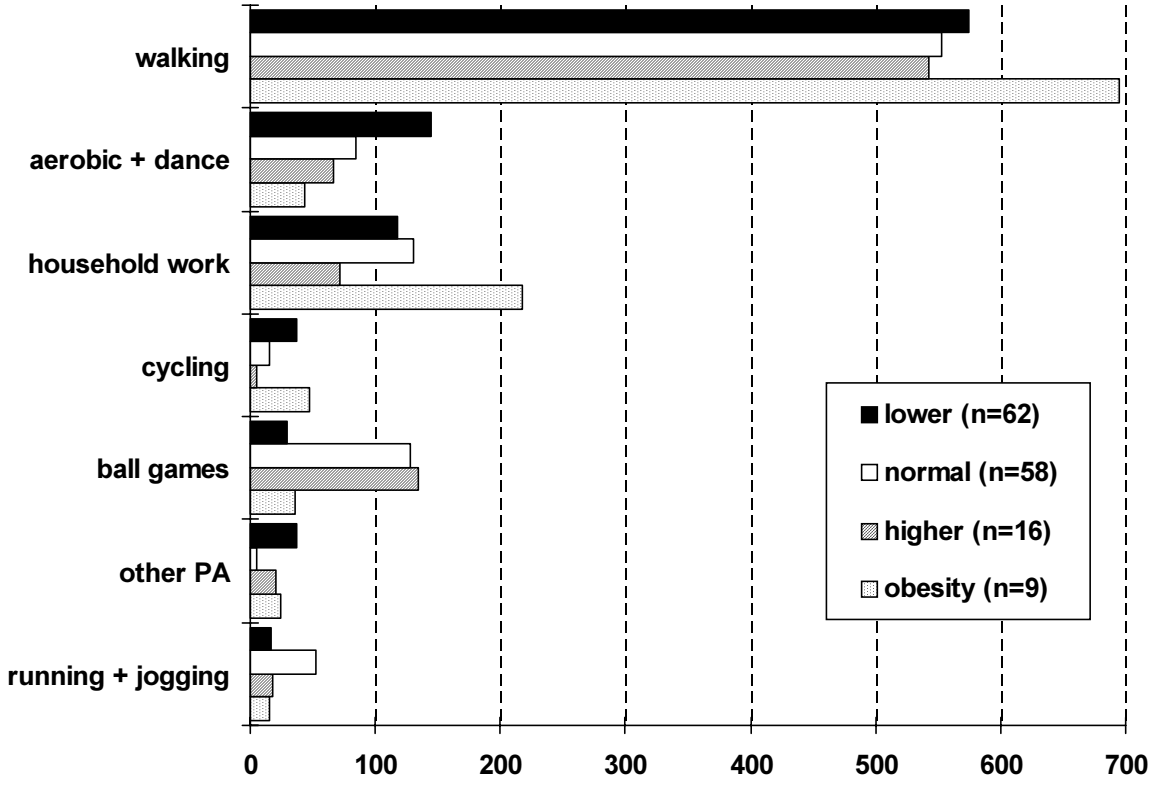


Fig. 2
Structure of the most frequent kinds of physical activity carried out by girls who are classified according to the level of their body weight in the course of the normal school week routine (min)



Note: PA – physical activity

While non-obese girls spend breaks, in addition to sitting, also devoted to other activities, obese girls just sit.

In obese girls and girls with a higher level of body weight we found a constant ratio of inactivity and physical activity 1.9:1 when comparing weekdays and weekend days. By means of a deeper analysis we found that the "absence" of sitting in school on weekend days is "made up for" in all groups of girls by watching TV for longer than they do on weekdays when they have school, most markedly in obese girls and girls with a higher level of body weight.

Tomori, Zalar, and Plesnicar (2000) refer to the fact that a group of Slovenian adolescents who watch TV for longer than 3 hours a day (29 % of girls and 40 % of boys) is mostly represented by girls and boys who are overweight or obese. This discovery was made based on a representative sample of Slovenian adolescents (2459 girls and 2131 boys) that were 14–19 years of age.

b) Physical activity

Besides the comparison of inactivity structure we present also the structure of the most frequently realised types of physical activity of observed girls during a normal school week (Fig. 2). Walking is an unambiguously dominant type of physical activity in all groups of girls. It is followed by not very demanding household work and very popular aerobics and dance in girls, not depending on their age, level of body weight, regional nationality or school orientation (Frömel, Novosad, & Svozil, 1999). In the category of ball games we put together volleyball, basketball and football/soccer in Fig. 2.

During monitoring, the obese girls spent an evidently longer time walking (more than 2 hours per week) and household work (about 1.5 hours per week) than their non-obese schoolmates. But during the carrying out of sport-oriented physical activity – aerobics and dance (respectively ball games) they were far behind the girls with normal or higher levels of weight, approximately about 60 (resp. 25–45) minutes per week (Fig. 2).

Walker, Ross and Gray (1999) analysed physical activity and inactivity in 1769 New Zealand children and youth aged 5–17. They found the highest representation of girls and boys (47 %) who practise physical activity (walking not included) less than 2.5 hours per week in a given period, of 16–17 years of age, while the duration 2.5 hours of physical activity per week is regarded to be a minimum for health enhancement.

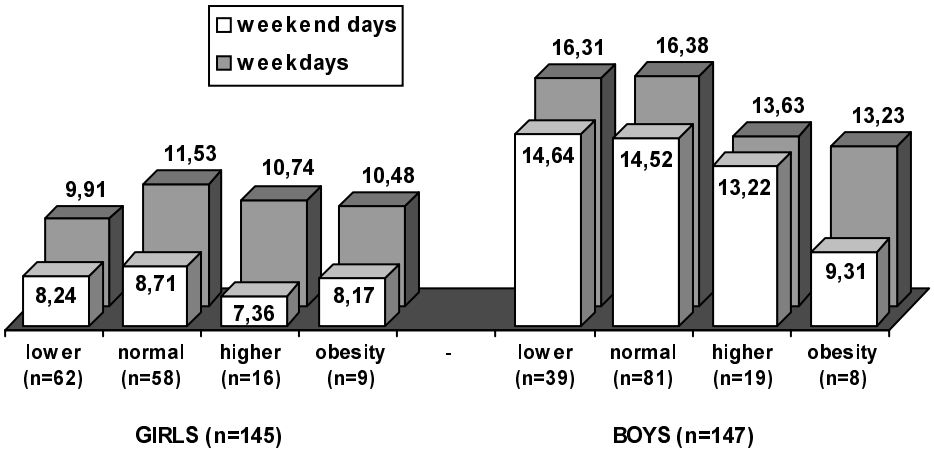
From Fig. 3 illustrating average values of daily energy expenditure during physical activity (active energy expenditure – thereinafter AEE) as measured by the Caltrac accelerometer, it follows that obese girls and girls with normal and higher body weight levels carried out a markedly lower level of physical activity on weekend days as compared with weekdays (school days). A difference of 2.3–3.3 kcal·kg^{-1}·day^{-1} in AEE when comparing school days and weekend days matches approximately to one vigorous lesson of aerobics about 60 min long in this group of adolescent girls defined by age and BMI. So that we consider this difference to be practically significant from the aspect of the average quantity of daily physical activity.

For reasons of comparison, we also present AEE in boys – schoolmates of the observed girls – similarly classified according to their level of body weight (Bláha & Vignerová, 1997) in Fig. 3.

The relative formulation of AEE, related to a kilogram of body weight moreover allows putting together the following comparisons:

- There is a lower level of physical activity in girls than in boys of the same age.
- There is a lower level of physical activity in groups of obese girls and boys and girls and boys with a higher level of body weight than in the group of girls and boys with a normal or lower level of body weight of the same age.

Fig. 3
Active energy expenditure (kcal·kg^{-1}·day^{-1}) on weekdays and weekend days in girls and boys classified according to the level of their body weight



With respect to the level and structure of physical activity explored in girls with a lower level of body weight (Figure 2 and 3), it would be desirable to concentrate on their lifestyle in future studies.

A medium correlation between selected characteristics of physical activity and inactivity found during monitoring of the normal school week of secondary grammar school girls (TABLE 1) entitles us to present the group-comparative analysis above.

The keeping of a modified individual record enables us, (when combined with FITT characteristics of carried out physical activity and data from accelerometer Caltrac), to make detailed registration of the main types of inactivity (see Appendix 1) without making additional demands on the recording of participants. The supplementation of monitoring physical activity with the structure of daily inactivity markedly improves the quality of analysis of children and youth's lifestyle.

c) School physical education

75–90 % of the total time spent in physical activity by children is displayed in their leisure time after school and the missing 10–25 % of physical activity is organised by schools, sport clubs and other concerned organisations (Bouchard, Shephard, Stephens, 1994; McGinnis, 1985). In spite of this fact we regard, as is consistent with Coleman (1999), Lambert (1996) and Rychtecký (1997), the main and long lasting aim of school physical education to be to create positive attitudes towards lifetime regular physical and sport activity. Comparing the results of monitoring weekly physical activity (based on Caltrac accelerometer use) of Moravian and East Bohemian adolescents from standard classes (69 girls with a mean age of 16.3 years and 37 boys with a mean age of 17.1 years) and sports classes(53 girls with a mean age of 13.4 years and 122 boys with a mean age of 13.6 years), we discover:

- As we assumed, girls and boys from standard classes spent the same amount of time (30 % of the day) in school. Nevertheless, counting the all-day AEE, boys exceed girls with a difference of 7 % (girls 25 % and boys 32 %), comparing AEE in school.
- Girls and boys from sports classes spent also the same amount of time (39 % of the day) in school. School physical education and training lessons represent 47 % (53 %) of the all-day AEE in girls (boys), as assessed by Caltrac accelerometer.

Standard classes' weekly physical activity routine included 2 physical education (thereinafter P. E.) lessons per week. While sports classes per week included, in addition to 2 P. E. lessons, 2–4 extra training lessons per week carried out also within the school framework.

In research carried out in a randomised sample of 1504 Northern American girls and boys equally represented according to race, gender and age, Sallis et al. (1999) searched for relationships between performed physical activity in school and free time and socio-economic (nationality, education and occupation of parents, complete and incomplete families), ethnographic (living location, number of inhabitants), and other individual variables affecting children and youth. By analysis of data obtained from participating children and youth aged 10–18 years (n = 247, age 10–12 years; n = 250, age 13–15 years and n = 200, aged 16–18) they discovered the following unsurprising, however important findings:

Children and youth, without any difference between gender, age and nationality, and different socio-economical and ethnographical conditions preferred, in school physical education:

- To have a feeling of satisfaction, enjoyment from physical activity and a friendly atmosphere in the lessons.
- To use presented and performed physical activity also in their leisure time.
- To be offered, preferably, the type of physical activity that can be practised together with their parents.

Gibbons and Thomas (1998) evaluated the opinions and attitudes of pupils (n = 8828) from basic schools towards physical education. They found that 76 % of pupils in school physical education gain skills and knowledge that they consequently use in their leisure time and 66 % of pupils are motivated to making other developments of their physical fitness in

TABLE 1
Relations between selected characteristics of physical activity and inactivity determined from accelerometers Caltrac, pedometers Omron and modified individual record sheets during field monitoring of normal school week routine in secondary grammar school girls (n = 145)

r_s (n = 145)	Steps, skips during PA Omron	Duration of PA modified individual record	Duration of inactivity modified individual record
• Active energy output – Caltrac	0.63*	0.50*	–0.41*
• Steps, skips during PA		0.43*	–0.44*
• Duration of PA			0.30

Note: PA – physical activity, r_s – Spearman's coefficient of order correlation
Statistically significant values marked on the level: $p < 0.0001$

their leisure time in addition to school physical education.

Trying to describe the main factors interacting in the sphere of attitudes, values and relationships to sport and school physical education in 11–19-year-old girls (n = 890) and boys (n = 668) from all the regions of the Czech Republic, Slepička et al. (2000) highlighted the following facts:

- The observed children and youth have a good relationship to school physical education. 49 % of girls and 68 % of boys consider school physical education to be their favourite school subject.
- Almost 50 % of the observed individuals participate in voluntary or elective school physical education programs ranging from 1–4 hours a week. 80 % of girls and 77 % of boys practise sport activity on a recreational or competitive level, most frequently swimming and athletics.
- The popularity and necessity of physical activity are the most important motives for children and youth for the performance of school physical education and sport. 94 % of girls and 98 % boys state that physical activity is healthy.

Trudeau et al. (1999) assessed the influence of the more frequent carrying out of physical activity in childhood, within the framework of school physical education, on active lifestyle and health in adulthood. His experimental group contained 272 girls and boys who experienced, during six years of basic school in 1970–1975, five lessons of school physical education per week. This group was compared to a control group (n = 304) that in compliance with existing curricula went through, in the same period, only one forty-minute lesson of school physical education per week. When analysing answers from questionnaires after twenty five years Trudeau et al. (1999) found that individuals from the experimental groups are nowadays more frequently physically active, women even significantly more active ($p < .05$) than their peers from the control group. Moreover in experimental groups there are significantly less smoking people (statistically significant number $p < .05$) than in the control group.

CONCLUSIONS

- The total volume of inactivity (sitting in front of TV, PC, in school, while studying, playing, in a restaurant, in the cinema etc.) in girls who are classified according to the level of their body weight was stable during the normal school week and ranged from 4.86 to 5.21 hour per day.
- Watching TV is the second longest lasting type of inactivity, after sitting in school, including the normal school week routine in all groups of girls classified according to the level of their body weight.
- The "absence" of sitting in school during weekend days is "substituted for" by the longer duration of watching TV than on weekdays (most distinctly in obese girls and girls with a higher level of body weight).
- Modified individual record monitoring including the structure of inactivity markedly improves the quality of analysis of children and youth's life style.
- Feedback service information about carried out physical activity and inactivity contributes to the motivation, of participating students, to practice physical activity optimally and allows schools to expertly intervene into the structure, content as well as duration of the learning process in physical education as related to the after-school activities of children and youth.
- Although most of the physical activity of children and youth is carried out in their leisure time, school physical education creates favourable conditions for health enhancement and decreasing inactivity.

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INAKTIVITA V ŽIVOTNÍM ZPŮSOBU ADOLESCENTNÍCH DÍVEK KLASIFIKOVANÝCH PODLE ÚROVNĚ TĚLESNÉ HMOTNOSTI

(Souhrn anglického textu)

S technickým rozvojem společnosti vedle pozitivních ekonomických, sociálních a jiných důsledků podstatně vzrůstá i doba trávená inaktivitou – vsedě před televizní obrazovkou, před monitorem počítače, ve škole, při učení i zábavě. Nedostatek pohybové aktivity spolu s nevhodnou výživou se již u dětí a mládeže nepříznivě projevuje v úrovni jejich zdravotního stavu a tělesné zdatnosti. Záměrem této studie je analýzou běžného školního týdenního režimu adolescentních dívek zjistit skladbu a zastoupení inaktivity ve vztahu k jimi realizované pohybové aktivitě a zviditelnit některé determinanty, které jsou důležité pro pozitivní změny v jejich životním způsobu a zdravotním stavu. Z analýzy vyplývá:

- Celkový objem inaktivity dívek klasifikovaných podle úrovně jejich tělesné hmotnosti byl neměnný a pohyboval se od 4.86 do 5.21 hodin denně.
- Sledování televize je za sezením ve škole druhou nejdelší inaktivitou v běžném školním týdenním režimu u všech skupin dívek klasifikovaných podle úrovně tělesné hmotnosti.
- „Absenci" sezení ve škole o víkendových dnech „dohánějí" sledované dívky (nejvýrazněji pak obézní a se zvýšenou hmotností) delším sledováním televize než ve dnech pracovních.
- Modifikovaný individuální záznam, monitorující i skladbu inaktivity, výrazně zkvalitňuje analýzu životního způsobu dětí a mládeže.
- Servisní zpětnovazební informace o prováděné pohybové aktivitě a inaktivitě přispívá k motivaci zúčastněných studentů k optimálnější realizaci pohybové aktivity a umožňuje školám kvalifikovaněji zasahovat do skladby, obsahu i průběhu vyučovacího procesu v tělesné výchově ve vztahu k mimoškolním aktivitám studentů.

Klíčová slova: inaktivita, obezita, energetický výdej, školní tělesná výchova.

Appendix 1

Department of Kinanthropology **Faculty of Physical Culture, Palacký University**

Record sheet for weekly physical activity (Caltrac)

Name and surname, school, form:.....
Date of the beginning of the registering: ..... Date of the end of the registering: .....

A. Value of energy expenditure "CALS MET USED" and "CALS MET USED ACTM"
Registered values are put down every morning and every evening when the apparatus is fixed and removed.

Is, in your opinion, the level of your efficiency: **BELOW AVERAGE – ABOVE AVERAGE**

Day of measurement	1	2	3	4	5	6	7	8	Note
Morning – time									
CALS MET USED									
CALS MET USED ACTM									
School – start time									
CALS MET USED									
CALS MET USED ACTM									
P.E. lesson – start time									
CALS MET USED									
CALS MET USED ACTM									
P. E. lesson – end of time									
CALS MET USED									
CALS MET USED ACTM									
School – end of time									
CALS MET USED									
CALS MET USED ACTM									
Training lesson – start time									
CALS MET USED									
CALS MET USED ACTM									
Training lesson – end of time									
CALS MET USED									
CALS MET USED ACTM									
Evening – time									
CALS MET USED									
CALS MET USED ACTM									

B. Type and intensity of all performed physical activities, including the organised ones

Registered is the time (rounded off to five minutes) of all physical activities performed in the course of the day for longer than 15 minutes (identical activities are added together). Physically demanding physical activity with higher intensity (getting very tired, out of breath, perspiring, having a high heartbeat frequency) is to be marked in the column minutes by letter H (Hard).

Physical activity	1	2	3	4	5	6	7	8
Walking (and hiking)								
Running (jogging)								
Exercise to music (aerobics)								
Dance								
Basic and sports gymnastics								
Fitness exercise, bodybuilding								
Healthy exercise (inc. Morning)								
Swimming								
Downhill skiing								
Cross Country Skiing								
Skating (incl. in-line skating)								
Cycling (incl. Mountain biking)								
Football, floorball								
Basketball								
Volleyball								
Tennis, soft tennis								
Table tennis								
Other game								
Martial arts								
Gardening								
Occupational activity								
Household work								
Other								

C. Structure of inactivity

We recorded all time spent in inactivity (rounded off to five minutes) in which we were engaged for longer than 15 minutes in the course of a day (we count together identical forms of inactivity participated in several times a day).

Physical inactivity	1	2	3	4	5	6	7	8
Sitting (lying) and watching TV								
Sitting (lying) at a computer								
Sitting (lying) while studying, Playing								
Sitting in school								
Sitting in the park, pub etc.								
Sitting (standing) during some events (sport matches, etc.)								
Other								

INDIVIDUALISATION IN THE PROFESSIONAL PREPARATION OF THE PHYSICAL EDUCATION TEACHER

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We worked together on "individualised didactic materials" for the improvement of the quality of the professional preparation of physical education teachers and provided them, within the framework of pedagogical training in 2001, to practising students (from the Faculty of Physical Culture) who had started their first pedagogical training. These students were instructed on how to carry out "individualised physical education lessons" (IPE). In addition, 62 practising students and 802 pupils at basic and secondary schools took part in a survey that was both quantitatively and qualitatively oriented.
Results showed positive acceptance of IPE by practising students as well as their pupils. Students appraised preferably an increase in motivation, autonomous work and creativity in classes, a free atmosphere, a "good feeling", as well as interest and enthusiasm in the pupils. Therefore they are willing to accept impulses for increasing individualisation during instruction. The pedagogical training curriculum as well as the subject of physical education didactics were innovated according to findings based on evaluation of the effectiveness of pedagogical training.

Keywords: professional preparation, individualisation, pedagogical training, teacher, pupil.

INTRODUCTION

The present concept of the education process demands a greater orientation to each pupil. Demands are focused on the greater involvement of pupils in diagnostics, autodiagnostics, evaluation, self-evaluation and mutual evaluation, on new forms of co-operation, creativity and individualisation, on newly framed inductive learning procedures and integrative instruction including co-educational instruction etc. (Hummel, 1995; Balz, 1992; Crum, 1992). In the face of a positive shift towards school physical education we call attention to some noticed deficiencies, to the necessity of a more thorough analysis of the causes of these deficiencies and to the importance of anticipating the future development of school physical education. Registered deficiencies are immediately concerned also with problems of individualisation in the didactic process. Substantial differences between our concept of school physical education and approaches abroad (preferably in Western European states) we see in understanding the merit of physical activity and in the conception of the didactic process (Frömel, Novosad, & Svozil, 1999, 11).

By using a systematic approach we want to ensure that all main factors playing a role in pedagogical training (the practising students themselves, faculty teachers, pupils at schools, conditions at the Faculty and relevant schools) and their interaction will support a new concept of pedagogical training. Urbánek (2000), Švec (2000), Svozil and Frömel (2002) focused on monitoring the professional activities of practising students during their training and that is what makes this topic current. Efforts over the long haul to improve the pedagogical training of physical education students and formation quality research "background" enables us start making revolutionary changes in our conception of pedagogical training. Preferably it includes fundamental change in "role of practising student" on pedagogical training.

One possibility as to how to create better conditions for enforcing new concepts of school physical education we see in the effective enforcement of individualisation in the didactic process in continuity with other contemporary conceptions (Haselbach, 1990; Hirmke, 1996). The individualisation of the education process cannot be understood to be in conflict with co-operation, "enjoyment", "creativity" and similar didactic demands. Similarly non-controversially we understand the role of individualised instruction within the field of didactic forms. Skalková (1999, 214) mentions that "the development of trials to carry out individualised instruction in the 20th century brought us valuable didactic findings about its advantages and limits. It was confirmed that there is no use in considering individualised and collective forms of instruction to be at odds, but it is effective to think about their mutual support".

It is mainly the tendency to connect school with practical life that leads physical education teachers, in

the didactic process, to ensure the higher activity and independence of pupils, to develop the talent and ability of each pupil, to use the ability of each individual for the benefit of the collective, while not doing so at the expense of other important educational demands.

Individualised instruction is considered as: "A specific way of controlling the teaching process, during which each pupil is optimally and effectively respected within the framework of all main factors and relations and is seen as a unique personality and the collective is understood as a group of unique and special individuals" (Frömel et al., 2000, 6).

OBJECTIVES

This paper aims at a systematic improvement of quality during the professional preparation of physical education teachers and an innovation of the present conception of pedagogical training in compliance with modern trends.

Partial objectives

1. To observe a characteristic example of controlling physical education lessons led by practising students during pedagogical training.
2. To analyse the activity of practising students in terms of didactic skills and reveal the main current deficiencies in their teaching activity.
3. To design didactic materials (teaching and learning procedures, models of different types of lessons) suitable for the didactic activity of each practising student during pedagogical training.
4. To verify designed didactic materials in a natural school environment.
5. To involve students actively in the design and verification of new didactic materials.
6. To verify the possibility of using individualisation in physical education lessons with various content.
7. To find out the attitude of pupils and practising students toward individualised physical education lessons taught by practising students during pedagogical training.
8. To propose innovative changes in the professional preparation of physical education teachers.

METHODOLOGY

Practising physical education students were reminded of the theoretical principles of the individualisation of the didactic process before the beginning of the first and second pedagogical training sessions (students knew theory, as it was a content of the school subject, didactics of physical education). Further, practising students were instructed in the practical carrying out of individualised physical education lessons with the possible use of a given methodological guide, individualised didactic materials etc.). Each practising student prepared and taught one habitual and one individualised physical education lesson. To teach a habitual lesson (HPEL) means, for the practising student and the appropriate class, the most suitable, usual and, from the practising student's individual point of view, lessons proved by practise. In a second physical education lesson with similar content and structure, practising students were to conduct an individualised lesson (IPEL) in the same class. Carrying out IPEL means to apply individualised episodes, to involve pupils in controlling the lesson, offer the selection of various options during exercising and to provide pupils with more freedom during the decision-making process. Altogether, 62 practising students and 802 pupils participated in the first pedagogical training session and 54 practising students and 726 pupils in the second pedagogical training session.

The evaluation of physical education lessons was detected by a standardised questionnaire for the diagnosis of the pupils' and practising students' attitude toward physical education lessons. This questionnaire is based on an immediate reaction and expression of feelings at the end of carried out lessons. The questionnaire includes 24 dichotomous questions divided into six dimensions (cognitive, emotive, health, social, attitudinal, and creative) and one supplementary dimension, the so-called "pupil's role". This last dimension is made up of eight selected questions.

Special software was used to process the results. A testing criterion of two relative difference values as well as basic statistical parameters were used for the statistical processing of variables for the further analysis of observed sets.

After finishing the first pedagogical training, practising students handed over the questionnaires and then they underwent a structural interview with open questions regarding the opinions, feelings or perceptions of the atmosphere in carried out individualised lessons, for example: "During what activity were IPEL (individualised lessons) carried out?" "How did you and your pupils react to IPEL?" etc. Answers were written down and categorised. Categorisation, according to Strauss and Corbin (1990/1999) is understood as gathering terms that belong to similar phenomena, into a higher frame.

After the second pedagogical training session, practising students (n = 27) evaluated the individualisation of the didactic process in enclosed anonymous questionnaires. The evaluation of individualisation relates to five categories:

- Assess professional preparation history according to your readiness for creativity, individualisation and the co-operation process within the didactic process in physical education.
- Assess your fruitfulness during the individualisation of the didactic process.
- Assess the pupil's approach to individualisation.
- Assess the faculty teacher's approach to individualisation.

– Mention other impulses and suggestions that may contribute to an improvement in the carrying out of our intentions (increasing the "pupil's role" in the didactic process) during the second practical training session.

Statements in these categories were summarised and qualitatively analysed.

FINDINGS

Evaluation of pupils' and practising students' attitudes towards physical education lessons during the first practical training session in 2001

During analysis of results from the questionnaire survey in habitual and individualised physical education lessons we found the lowest values in pupil's attitudes towards lessons in the social dimension. The difference between groups was not significant (t = 1.18), see TABLE 1. During detailed analysis the only difference in this dimension was found in the question: "Was the teacher, during the lesson, more of a mentor (one of you and an older friend)?" This question was answered in individualised lessons by 82 % of pupils as opposed to 74 % in habitual (question no. 4, Fig. 1; t = 3.63**).

The less positive evaluation of the social dimension in both the types of PE lessons was found in question no. 22 (t = 0.78; Fig. 1). Not even the change in teaching PE lessons had got the influence on the significant shift in the elimination of insufficiencies in pupils (IPEL 32 % of positive answers; HPEL 30 %). This fact was recorded also by practising students who answered this question even as the worst of all the questions in both the types of physical education lessons (Fig. 2). Feeling the discipline in a class is interesting. Practising students in their lessons perceived the same lessons more critically than their pupils did (question 10, Fig. 1, Fig. 2). In IPEL, 72 % of pupils did not register, in classes, the deterioration of discipline as compared to 66 % of practising students. A similar situation appeared to be also in HPEL (73 % of pupils; 59 % of practising students, Fig. 1, Fig. 2).

A similar discrepancy between the evaluation of practising students and their pupils was recorded also in separate questions of health dimension as for example in question 3 concerning evaluation of relaxing and regenerating effect of physical education classes. In answering the question in the health dimension, practising students were again more critical than their pupils (IPEL pupils 66 %, HPEL pupils 60 % t = 2.64** Fig. 1; IPEL practising students 55 %; HPEL practi-

TABLE 1
Pupils and practising students' attitudes towards habitual and individualised physical education lessons during the first practical training session in 2001

Dimensions		PEL (type)	Pupils (n_{HPEL} = 794, n_{IPEL} = 802)			Practising students (N_{HPEL} = 59, N_{IPEL} = 62)		
			Points	%	T	Points	%	t
I.	**cognitive**	HPEL	1904	60	**2.37***	200	85	0.38
		IPEL	2016	63		207	83	
II.	**emotive**	HPEL	2494	79	**1.97***	223	94	0.62
		IPEL	2583	81		231	93	
III.	**health (fitness)**	HPEL	2044	64	**2.64****	156	66	0.48
		IPEL	2165	67		169	68	
IV.	**social**	HPEL	1826	57	1.18	148	63	**2.92****
		IPEL	1891	59		186	75	
V.	**attitudinal**	HPEL	2358	74	**2.32***	201	85	0.27
		IPEL	2462	77		209	84	
VI.	**creative**	HPEL	2019	64	**10.33****	112	47	**7.93****
		IPEL	2421	75		201	81	
VII.	**pupil's role**	HPEL	3615	57	**9.55****	287	61	**6.87****
		IPEL	4180	65		400	81	
I–VI	**total**	HPEL	12645	66	**8.37****	1040	73	**4.76****
		IPEL	13538	70		1203	81	

Notes:
HPEL – habitual physical education lessons
IPEL – individualised physical education lessons
Points – positive points reached
% – percentage of positive points reached
n_{HPEL} – number of pupils in habitual physical education lessons
n_{IPEL} – number of pupils in individualised physical education lessons
N_{HPEL} – number of practising students teaching habitual physical education lessons
N_{IPEL} – number of practising students teaching individualised physical education lessons
t – testing criteria of two relative values
Statistically significant values *p < .05; **p < .01.

sing students 42 % t = 1.37; Fig. 2). Positive about this important dimension is the fact that the individualisation of controlling PE lessons did not have any negative influence on subjective evaluation of fitness development (question 15, IPEL pupils 72 % of positive points; HPEL pupils 69 % of positive points; t = 1.23; Fig. 1). The dimensions that were assessed to be best for pupils as well as practising students were emotive and also attitudinal. In both these dimensions, practising students assessed lessons better than their pupils (see TABLE 1). In both types of lessons pupils (question 8, IPEL 91 %, HPEL 89 %; Fig. 1) highly assessed a good learning atmosphere, pleasant feelings, but also strain (IPEL and HPEL practising students 95 % of positive points; Fig. 2). Pupils had a feeling of satisfaction from physical activity during the lessons (question 2, IPEL pupils 82 %, HPEL pupils 81 %; Fig. 1).

Perception of praise from a teacher or a classmate (question 20, emotive dimension) is recorded very unequally in practising students (IPEL practising students 95 %, HPEL practising students 98 %; t = 1.00; Fig. 2) and in pupils (IPEL pupils 56%, HPEL pupils 51 %; t = 2.04; Fig. 1). It seems that pupils did not register the demonstrable effort of the practising students to assess their activity positively. Praise is only accepted if it is addressed directly to a pupil and if it is repeated. Collective evaluation of this kind: "It was good because each of you strived" or "Almost all of you improved and in the next lesson we can improve the exercise", pupils did not perceive as praise.

In the overall positive evaluation of individualised lessons by pupils (t = 8.37**) as well as practising students (t = 4.76**), the creative dimension had the greatest share. There appeared to be the most significant differences both in pupils (IPEL pupils 75 %, HPEL pupils 64 %; t = 10.33**) and practising students (IPEL practising students 81 %, HPEL practising students 47 %; t = 6.87**) (TABLE 1). This positive state is influenced by providing greater possibilities for using independent and creative solutions of movement tasks (question 6, IPEL pupils 71 %, HPEL pupils 44 %; t = 10.92**; Fig. 1) and further providing the chance to at least once decide individually (question 12, IPEL pupils 83 %; HPEL pupils 65 %; t = 8.41**; Fig. 1). Differences between the evaluation of individualised and habitual lessons are apprehended to be the same also for practising students. The pupil's role increased significantly thanks to the creative dimension, namely in pupils as well as practising students' assessments (TABLE 1).

Assessment of pupils and practising students' attitude toward physical education lessons during the second pedagogical training session in 2001

The assessment of pupils and practising students during the second pedagogical training session in 2001 within the context of the total evaluation, in the supplementary dimension of the "pupil's role" and the creative dimension do not differ from the first practise session. We also recorded many significant differences to the credit of individualised lessons. During evaluation of differences between the first and the second practical training session we found statistically significant differences in pupils who expressed themselves more positively in the first training session, namely in habitual lessons (t = 2.54*) as well as in individualised lessons (t = 2.02*). The factual significance of this difference (in IPEL 1 %, HPEL 2 %) is not high and we consider the expression of pupils in both the types of physical education lessons as equivalent. On the other hand, practising students assessed their lessons as being better in the second training session. Neither factual nor statistical significance was found.

Pupils assess as significantly better, in IPEL, the feeling of satisfaction from physical activity (t = 3.10**; question 2; Fig. 3) and highly evaluate the relaxing and regenerating effects of the lesson (t = 3.94**; question 3; Fig. 3). 89 % of pupils in IPEL (82 % in HPEL; t = 3.89**) did not have the feeling that they were "directed" by a teacher (question 18, Fig. 3). In regard to the creative dimension we recorded a high statistical difference to the credit of individualised lessons in these questions: "Did you have the chance to solve some task independently and creatively?" (IPEL 75 %; HPEL 36 %; t = 14.66**; question 6, Fig. 3) and "Could you decide freely at least once during the lesson as to what you will do or how you will do it?" (IPEL 85 %, HPEL 62 %; t = 9.95**; question 12, Fig. 3).

Practising students also had the feeling that in these questions they offered pupils a lot of room in IPEL. The big differences in the assessment of pupils and practising students were recorded during perceiving "…whether pupils asked the teacher or a classmate during learning about something" (social dimension TABLE 2). Practising students had the impression that in IPEL (94 %) as well as in HPEL (81 %; question 16; Fig. 4) they communicated with pupils (and pupils with each other) sufficiently. Only 54 % of pupils perceived this fact in HPEL and even fewer, 48 % in IPEL (t = 2.08*; question 16; Fig. 3). In contrast to the first pedagogical training session, pupils and practising students concurred in their evaluation of disci-

TABLE 2
Attitude of pupils and practising students towards habitual and individualised physical education lessons during the second pedagogical training session in 2001

Dimensions		PEL (type)	Pupils (n_{HPEL} = 726, n_{IPEL} = 695)			Practising students (N_{HPEL} = 54, N_{IPEL} = 54)		
			Points	%	t	Body	%	t
I.	**cognitive**	HPEL	1741	60	1.06	177	82	1.47
		IPEL	1705	61		188	87	
II.	**emotive**	HPEL	2210	76	**3.89****	199	92	**2.42***
		IPEL	2234	80		210	97	
III.	**health (fitness)**	HPEL	1819	63	0.72	141	65	0.72
		IPEL	1767	64		148	69	
IV.	**social**	HPEL	1653	57	0.29	139	64	**3.42****
		IPEL	1593	57		171	79	
V.	**attitudinal**	HPEL	2056	71	**5.39****	171	79	1.51
		IPEL	2143	77		183	85	
VI.	**creative**	HPEL	1693	58	**14.59****	90	42	**9.72****
		IPEL	2126	76		183	85	
VII.	**pupil's role**	HPEL	3153	54	**11.63****	247	57	**9.94****
		IPEL	3614	65		374	87	
I–VI	**total**	HPEL	11172	64	**10.25****	917	71	**7.84****
		IPEL	11568	69		1083	84	

Notes:
HPEL – habitual physical education lessons
IPEL – individualised physical education lessons
Points – positive points reached
% – percentage of positive points reached
n_{HPEL} – number of pupils in habitual physical education lessons
n_{IPEL} – number of pupils in individualised physical education lessons
N_{HPEL} – number of practising students teaching habitual lessons
N_{IPEL} – number of practising students teaching individualised lessons
t – testing criterion of two relative values
Statistically significant values: *p < .05; **p < .01.

Fig. 1
Attitude of pupils toward habitual and individualised physical education lessons
First practical training session 2001

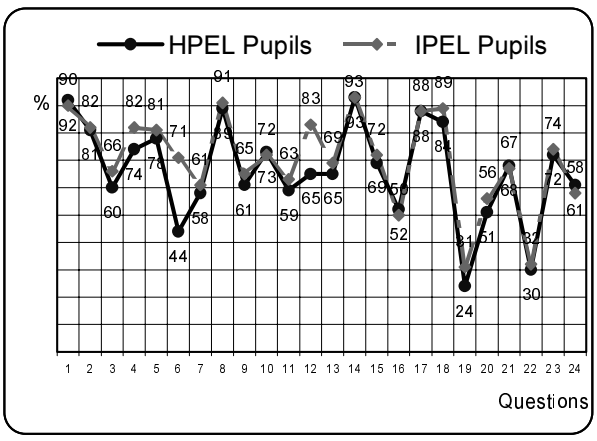
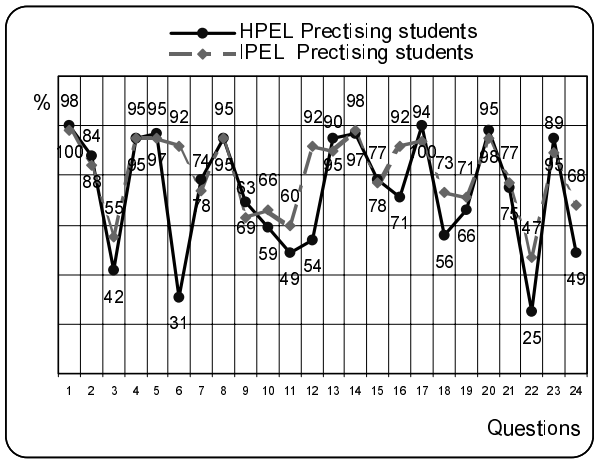


Fig. 2
Attitude of practising students toward habitual and individualised physical education lessons
First practical training session 2001



pline. 70 % of pupils in IPEL as well as HPEL and 69 % of practising students in IPEL as well as in HPEL assessed that there was good discipline in the classes (question 10, Fig. 3, Fig. 4).

The fact that practising students provided room for individualisation and allowed students to decide freely, etc. was manifested in organisational difficulties by the fact that students did not always have time for the closing (relaxing) part of the lesson. Also, pupils in HPEL (65 %) had significantly more "stretched or shortened muscles or had to at least once correct their body posture" than in IPEL (IPEL 58 %; t = 2.89**; question 21, Fig. 3).

Fig. 3
Attitude of pupils toward habitual and individualised physical education lessons
Second practical training session 2001

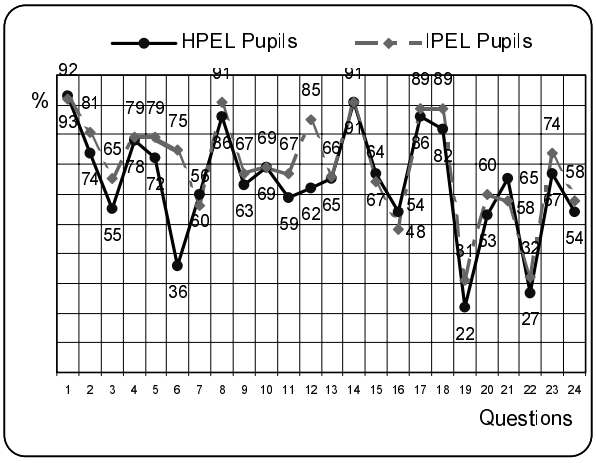
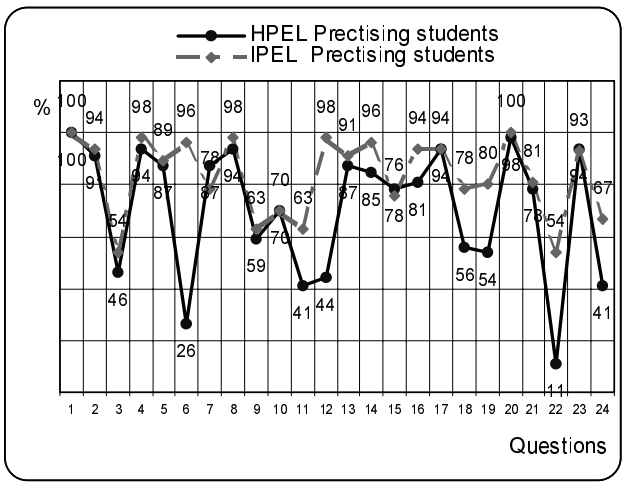


Fig. 4
Attitude of practising students toward habitual and individualise physical education lessons
Second practical training 2001



Qualitative record of interview about the assessment of individualisation by practising students during the first pedagogical training session in 2001

Practising students, while carrying out individualised lessons, used the models they were given. Of specific didactic forms they were familiar with, *circuit training* was the most often used, applying task cards that pupils had available to them at each location. Pupils had the chance to choose from different variations of exercises, namely both in severity of performance and in content according to individual expectations and abilities of pupils. Practising students often "tolerated" pupils' own pace during exercising and allowed them to choose their own kind of transfer to another position. In some cases pupils were allowed not only to choose by themselves but also to individually "form free positions". Pupils had to be instructed in the basic principles of circuit training, especially as to changes in the loading of particular parts of muscles.

Practising students used individualised figures very often in *sports gymnastics*, namely in acrobatic exercises during formation of their individual exercise arrangements.

In *physical education lessons orientated towards games* (preferably volleyball), individualisation meant that pupils had a chance to choose the way they exercised as well as the length, type and intensity of practising. While carrying out these lessons, correction and elimination of individual deficiencies were used more often than anywhere else. This meant that pupils or groups of pupils did different activities when eliminating individual deficiencies.

Individualised figures were applied preferably *in the main part* of the lesson. From other parts of the lesson they used preferably the introductory part, for a choice of "games" activities, ways of transfer and choice of group activity. In the preparatory part, their own choice of exercises was used ("you yourself choose an exercise for the enhancement of shoulder joint flexibility…"), etc.

Answers to open questions relating to the carrying out of individualised physical education lessons were categorised into four fundamental spheres:

1. "How did practising students manage individualised physical education lessons from the point of view of target settings?" To this question practising students answered:
   - "From the beginning I had my doubts about this kind of lesson, but my worries disappeared quite soon."
   - "When it is used more often, pupils get used to it and the results may be even better."
   - "Pupils had more space but I had to prepare thoroughly."

- "Individualisation enabled higher effectiveness in fulfilling tasks."
- "Clever pupils had a chance to display their talents, weaker pupils did not have the feeling that they could not keep up."
- "Pupils were able to correct themselves in pairs."
- "During the solution of different tasks, pupils thought about biomechanical rules and *why some people can do it and others cannot*."
- "Pupils did not even choose individually from among the offered choices, preferring to think up new variants."
- "Pupils were able to choose something independently and this fact enhanced their motivation."
- "From the theoretical point of view, I was well-prepared. I gave practical examples and warned about the difficulties". "More of this type of lesson!"

2. Having detected the *acceptance of individualised attributes* in pupils, the practising students stated:
   - "In this way the lessons taught allow us to connect small groups through natural co-operation."
   - "I had the impression that pupils had a good feeling from exercising and they also expressed it."
   - "Pupils savoured it and I did not have the feeling that I always directed them."
   - "The atmosphere in the lesson was excellent, flowing and friendly. The girls' loading was sufficiently high."
   - "Flowing atmosphere, greater strain and opportunity for expression."
   - "I had a good feeling from the pupils' interest."
   - "Pupils had a positive attitude towards the application of individualised lessons, I was surprised by their prompt approach and high concern for independent creativity."
   - "Girls were totally excited about the lessons!"
   - "Exciting engagement of all the pupils."

From negative reactions which were in the minority we noticed two problem areas:

3. Which main problems or deficiencies appeared during the carrying out of individualised physical education lessons?
   - "I prepared the lesson but pupils did not want to carry it out it."
   - "Pupils were not able to warm up sufficiently by independent practising."
   - "A teacher did not allow me to do something like that."
   - "In order for such a lesson to be worthwhile it is necessary to carry it out in small groups."
   - "For the teacher, such a lesson is more demanding to prepare as well as to differentiate during the lesson itself."
   - "I succeeded in engaging the whole class actively but, on the other hand, pupils did not acquire any new skill."
   - "I had troubles with finding suitable exercises for this type of instruction."
   - "Pupils are not used to such independent work and this way of practising and they did not maintain discipline."
   - "Lack of discipline, pupils were not able to come to an agreement."
   - "I did not manage to maintain suitable discipline."

4. What was *the degree of readiness of practising students* for this way of managing the lessons?
   - "We are not sufficiently prepared for this type of instruction at the Faculty."
   - "I myself will not use this type of instruction, I do not know what to do with it."
   - "It is hard to try something new in practical training if we did not go through it as students. Why didn't anybody show us (e.g. during garnet toss instruction) how he/she pictures an individualised process?"
   - "Improve professional preparation in this trend!"
   - "Individualisation is talked about all the time but our professional preparation does not provide it."
   - "More impulses for realisation."
   - "For the present there is a lack of working material which could serve as a starting point."
   - "It is not possible to carry out something without thorough preparation, for normal instruction it cannot be realised from the point of view of time."

Practising students (n = 27) after finishing the *second* pedagogical training session assessed individualisation of the teaching-learning process on enclosed anonymous questionnaires. Assessment concentrated on five categories:

1. Assess existing professional preparation from the point of view of your readiness for the process of creativity, individualisation and co-operation in the teaching process in physical education.

During the assessment of the readiness of practising students for individualisation, creativity and co-operation in the didactic process of PE, very opposite reactions often appeared. Some practising students have a feeling of "good theoretical and practical readiness", preparation for this way of teaching did not cause any difficulties and basically they support this

way of instruction. On the other end of this spectrum there are practising students who call attention to insufficient readiness and criticise an unsatisfactory connection between their own preparation and the task they are to perform during pedagogical training. Practising students assess almost identically certain preparation for this way of teaching in the subjects of "Theory and didactics of physical education, gymnastics, and movement games". They mark as inconsistent their athletics lessons. They see deficiencies in this sphere, especially in sports games. Practising students altogether demand more practical materials and the chance to "try" this way of teaching by having practical presentations during pedagogical training. Practising students would also welcome presentation of these trends during "normal" teaching at the Faculty. There also appeared opinions that in some subjects this way of instruction is more likely to be suppressed and that the guidance of seminars and workshops is univocally lead in a "deductive way". During overall assessment almost half of practising students supported this way of teaching PE lessons with certain reservations. Those who clearly marked preparation as insufficient are in the minority (two students). The rest of the students displayed "neutrality" to this problem because reservations to their readiness in one sphere are "compensated" by positive facts in other spheres.

2. Assess your successfulness during individualisation of the didactic process

Practising students assessed their successfulness during the individualisation of the didactic process positively. Their successfulness was evaluated especially according to the reactions of their pupils. A pleasant and creative atmosphere in these lessons was transferred to students who had a feeling of better contacting their pupils and enhancement of their motivation for the performed activity. Practising students altogether had to prepare more for these lessons. They see deficiencies in a lack of discipline, in problematic fulfilment of cognitive tasks and insufficient habits of pupils to work independently.

3. Assess pupils' approach to individualisation

Pupils accepted individualised lessons to a great extent positively according to the practising students' answers. Pupils welcomed the possibility to work independently, to participate in controlling the instruction and they expressed a prompt approach and interest during task solving. A good and open atmosphere was also appreciated together with the spontaneity of pupils during task solving, co-operation of pupils and mutual help. Agreement, to a great extent, in practising students was shown in their assessment of deficiencies. Practising students almost identically marked a big difference in the approach of some individuals who took advantage of the free atmosphere for the purpose of "doing nothing" and passivity. Big differences were monitored in activity or rather passivity in some pupils. Practising students called attention to a lack of discipline very often. It is a good question to what extent practising students distinguished between "working atmosphere" bringing together also a "bigger stir and noisiness" and a real lack of discipline.

4. Assess the approach of the faculty teacher to individualisation

Faculty teachers mostly did not apply this style of instruction with individualised episodes in their teaching and they did not know about basic principles of instruction. With some exceptions, they supported the process passively and did not obstruct practising students in the carrying out of such directed lessons. Some teachers were sufficiently interested in this way of teaching to want to also try, in the near future, these types of physical education lessons. Teachers' remarks were directed primarily at organisational difficulties and problems with pupils' discipline. Another problem with assessment of this issue was also that practising students did not know who is, in the questionnaire, the indicated "faculty" teacher. This doubt was one reason that this problem was not sufficiently commented upon.

5. Mention other suggestions and reminders that could contribute to the improvement of the carrying out of our plans (enhancement of the "pupil's role" in the didactic process) during the second pedagogical training session

Practising students did not provide many other suggestions. Most of them are aware of the necessity to enhance the "pupil's role" in the didactic process and they demand more preparation at the Faculty and more materials on this topic. Some individuals regard professional preparation relating to this trend as insufficient and they will not want to use this style of teaching in their practise, as they prefer the traditional way of management.

CONCLUSIONS

* Individualised physical education lessons during two practical training sessions were successfully carried out. These lessons corresponded with contemporary modern trends in didactics.
* New individualised didactic means were designed and they were provided to students practising during pedagogical training. Practising students themselves demand more of these materials.
* Research proved that in professional preparation of practising students during pedagogical training

it is possible to use individualization successfully in physical education lessons with various content.

* Designed and partially verified didactic models of physical education lessons for application of the figures of individualised instruction in PE lessons proved to be suitable teaching tools for support of individualisation in the lessons taught by practising students.
* Overall, pupils and practising students accept significantly better lessons with individualised marks of control.
* The biggest differences in assessment of the lessons were found in the creative dimension and the supplementary dimension of the "pupil's role".
* Individualisation of physical education lessons offered great opportunity and space for independent and creative solving of given tasks and allowed pupils to decide freely more often. It is necessary to investigate the observed phenomena from various angles and points of view.
* Practising students, during the application of offered individualised didactic means, postured with a positive attitude and are willing to further accept impulses for enhancement of individualisation within instruction.
* Practising students evaluated positively an enhancement of motivation, independent work and creativity of pupils, a free atmosphere, a "good feeling", and the interest and enthusiasm of pupils.
* Individualised lessons make greater demands on preparation for the teaching process.
* In some lessons, lack of discipline and aversion to working independently appeared.
* This style of teaching is not normally realised at schools and practising students do not have support from their faculty teachers.
* Practising students largely reported unsatisfactory or minimal preparation for this type of instruction during their time of study. It was shown that preparation during seminars before pedagogical training is not sufficient for the number of practising students.
* During then professional preparation of student teachers it is necessary to connect more modern trends into "practical – methodological subjects" at the Faculty. These subjects are, all the time, oriented preferably towards cognitive targets and strict implementation of ordered demands that do not always correspond with the present reality at schools and demands for new conceptions. This way of instruction is automatically taken over by practising students.
* Some practising students did not manage to apply "individualised models of lessons" into reality in school conditions.
* We assess the attitude of students on an overall scale: *positive, prevalence of positive, neutral prevalence of negative, negative*, as "prevalence of positive".
* According to the findings of verification of evaluation of effectiveness during pedagogical training in students, pedagogical training curricula and the subject of didactics of physical education were brought up to date.

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INDIVIDUALIZACE V PROFESNÍ PŘÍPRAVĚ UČITELE TĚLESNÉ VÝCHOVY
(Souhrn anglického textu)

Pro zkvalitnění profesní přípravy učitelů tělesné výchovy byly vypracovány „individualizované didaktické prostředky“. V rámci pedagogické praxe v roce 2001 byly tyto prostředky poskytnuty praktikantům (studentům Fakulty tělesné kultury UP) nastupujícím na pedagogickou praxi. Praktikanti byli poučeni o uskutečnění „individualizované vyučovací jednotky“ (IVJ). Úspěšnost realizace byla předmětem kvantitativního i kvalitativního šetření. Celkem se šetření zúčastnilo 62 praktikantů a 802 žáků na základních a středních školách.

Výsledky ukázaly na pozitivní přijetí IVJ u praktikantů i jejich žáků. Praktikanti hodnotili především zvýšení motivace, samostatnou práci a tvořivost ve třídách, uvolněnou atmosféru, „dobrý pocit“, zájem a nadšení u žáků a jsou ochotni dále přijímat podněty pro zvyšování individualizace ve výuce. Dle výsledků hodnocení efektivnosti pedagogické praxe studentů bylo inovováno curriculum pedagogické praxe a vyučovacího předmětu didaktika tělesné výchovy.

Klíčová slova: profesní příprava, individualizace, pedagogická praxe, učitel, žák.

EFFECT OF FEEDBACK ON THE LEVEL OF MOTION ACHIEVEMENT

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Submitted in January, 2002

This contribution deals with the investigation of the effect of feedback on motion achievement of each individual. The effect of positive, negative and neutral feedback on the achievement of individuals of pre-pubescent, pubescent and post-pubescent age and individuals with mental handicaps is studied. Results proved the correlation between motion achievement and the type of feedback: higher achievement as a reaction to positive feedback and lower achievement as a reaction to negative feedback. The level of dependence of each level of achievement on the type of feedback is influenced by age differences in pupils and probably also by their mental level.

Keywords: feedback, motion achievement, pupils, motivation.

INTRODUCTION

Feedback (mentioned as F) is a subject of research not only in kinanthropology scientific disciplines (Mossto n & Ashworth, 1977; Schmidt, 1991; Silverman, Kulinna, & Crull, 1995; Anshel & Hoosima, 1998; Coull, Luc, & Digby, 2001), but also in a wide range of human sciences (pedagogy, cybernetics, psychology, etc.). These scientific disciplines examine feedback from different positions, all of them regarding feedback as an important factor influencing the somatomental development of each individual manifested by his or her behaviour.

Feedback about activity during the course of learning is undoubtedly one of the main topics of the theory of learning and especially motor learning theory. As early as when Thorndike published his "Pedagogical psychology", the attention of researchers has been focused on the investigation of feedback effect. Schemmp (1992) affirmed that those who teach movement have been telling us for ages that feedback is a key factor in learning, but pedagogical research, when trying to prove this statement, has not succeeded yet. Daugs (1991), Schmidt (1991), O'Sullivan and Schmitz (1994) call attention to the negative effects of frequented feedback when a pupil is directly led to a target. Dependence on feedback is increased and it also happens that he or she loses in concentration of his or her attention to the given information.

Feedback fulfils the following fundamental functions: motivation, activation and retention (Daugs, 1991). Considering the decreasing interest of the population in active motion activity, motivational function seems to be very relevant. The motivational impulses of feedback helps the individual to maintain a good level of activity during long lasting motion achievement (Anderson & Rodin, 1989; Brklová, 1998; Lewthwaite, 1990). Similarly Kulič (1971, p. 212) says, "it is frequently temporary conflict, failure, and wrong achievement that may become a challenge for an even higher activation of activity".

According to Čelikovský et al. (1985), we can illustrate motion achievement as a function f of movement predisposition P, motivation M and intervenement variable I.

$$V = f (P, M, I)$$

Because we prefer correlation of motion achievement, that is $V = f (M)$, we eliminate:

a) Movement predisposition in that we concentrate on intraindividual co-operation of achievement in each participant.
b) Intervenement variables by standardisation of measurement so that we minimise the effect of external variables.

We focus our attention on the research of feedback in connection with motor learning under school physical education conditions. Within this context, feedback covers forms of behaviour in a teacher but also other information that the pupil gets from the external environment, for example from classmates. Feedback provides also inner enjoyment and perception to a pupil. All the perceived information is revised by eventual mistakes made by a pupil during activity and it has the effect of providing impulses motivating each pupil in other activities (Brklová, 1998). It is evident that the investigation of feedback in the context of each pupil's motivation toward activity is a very interesting concern (Watzlawick, 1999) but at the same time complicated by the number of independent variables including surely one of the most important variables – the personality of each pupil.

Description of all variables is objectively difficult – that's why we have ignored the wider context when formulating our research aim even at the cost of limi-

ted generalisation of research findings. We'll devote our attention only to verbal feedback provided by a teacher to a pupil.

In a handbook of the technique of "Analysis of didactic interaction" (Dobrý et al., 1996), feedback is defined as a form of the teacher's behaviour relating to the course or result of performed activity of a pupil. Verbal feedback regulates the activity of each observed subject (pupil) and it is a result of the micro-diagnostic activity of a teacher (Kalhous, 2001). In school physical education the source of feedback is observation of a pupil, including physical movement and facial expression. In this way, the teacher obtains 58 % of feedback information (Wiesner, 1992). O'Sullivan and Schmitz (1994) and Pasch (1998) halve feedback into positive and negative. As for other aspects, feedback is divided into constructive and destructive, into verbal and non-verbal; with explicit or implicit content, into positive, negative and neutral.

Positive feedback belongs to the strategy techniques of positive moments. It should express valuation of success or effort, it must excite and encourage, and be related to a concrete event.

Negative feedback has got a wider and deeper wave effect on a pupil than positive feedback. It is very often felt as well by pupils whom is not aimed at. It should be precise, fair and tactful because it is not an assault on a pupil's personality but it is a normal part of the education process.

An effective teacher does not use neutral feedback very often. Neutrality of impulses means that they do not contain emotional meaning. When a pupil understands the meaning of impulses and can classify them as pleasant, unpleasant, sad, joyful, etc., these impulses evoke his interest. Neutral information is also neutrally accepted (Pokorná, 2001).

We intuitively feel that, evidently, differences in pupils' achievement will exist as a reaction to verbal feedback from a teacher if this information is oriented preferably to the positive or negative aspects of movement achievement.

RESEARCH DESIGN

During the investigation of feedback effect on the level of movement achievement of a pupil we had to solve the following problems:

Suitable movement test

It was necessary to choose a movement test without time and material demands, suitable for large scale school population groups. We chose standardised test by authors Puddefoot, Hilliard, & Burl (1997): each participant leans back against the wall with arms raised forward and knees bent into a right angle as if seated on an imaginary chair (Fig. 1). The task is to stay in this position as long as it is possible while time is measured in seconds. The test was carried out three times a week. During the first measurement the investigator is silent (neutral feedback). During the second measurement, the participant obtains positive feedback in twenty- to thirty-second intervals (*that's it, good, wonderful, good position, excellent,* etc.) without regard to whether or not it is deserved. During the third measurement, the participant obtains negative feedback under the same conditions (*it is not quite right, you could do better, you are not concentrating, you are not trying hard enough,* etc.). For ethical reasons this feedback was only slightly negative. In order to eliminate undesirable competition, measurement results were not told to participants.

Fig. 1

Elimination of some independent variables

- A variable adversely influencing participants' achievement in the movement test can be the effect of learning. This eventual effect was checked by random division of participants into two groups with a different order of feedback given during each measurement.
- Another possible variable is the effect of the inter-individual level of the motor competency of participants. This variable was eliminated during each measurement by comparison of intra-individual differences in participants' achievements.

If we ignore other intervenement variables we may formulate the following research question:

Does a relationship between the type of verbal feedback used by each teacher and the pupil's movement achievement exist?

30 male participants of pre-pubescent age (8–9 years), 30 participants of pubescent age (13–14 years), 15 participants of post-pubescent age – secondary grammar school students (16–17 years) and 25 participants with moderately serious mental handicaps (18–26 years) underwent this measurement.

The value of achievement of each participant during the provision of positive and negative feedback was transferred into a percentage value regarding achievement while being provided neutral feedback.

For statistical proceedings of difference significance within the groups we used a pair-test and for comparison between groups an unpaired-test of difference significance. Difference significance was stated on the level $p < 0.05$. Empirical results were statistically processed by Dr. Kršková, employee of the Centre for Computer Techniques at Palacký University in Olomouc.

RESULTS AND DISCUSSION

Effect of verbal feedback on movement achievement of participants of pre-pubescent age (Fig. 2)

The average value of pupils' achievement during measurement without feedback reached for 78 s, while being given positive feedback 108 s, while being given negative feedback the average value of achievements was 56 s.

With the provision of positive feedback more than 80 % of participants improved their achievement compared to neutral feedback even though the higher value of standard deviation indicates a certain non-homogeneity of the research group. It is evident that the average difference of 48.5 % means a statistically significant improvement.

With the provision of negative feedback the achievement in 23 out of 30 people was weaker than during measurement with neutral feedback. On an average, the achievements were lower by about 13.8 % but the incidence of negative feedback did not mean a statistically significant deterioration of achievement.

Effect of verbal feedback on the level of participants in pubescent age (Fig. 3)

Participants in pubescent age naturally obtained, on an average, higher values during all the measurements than participants of pre-pubescent age. Also in this research group the best achievements were obtained by providing positive feedback and the worst by providing negative feedback.

When we compare differences between achievements obtained during measurement when providing neutral feedback and positive feedback we may state that there is higher achievement in 97 % of participants. An average difference of 69.2 % means a statistically significant improvement.

With the provision of negative feedback the achievement in all the pupils from the observed group decreased. Performed achievement were on average about 40.6 % weaker than the achievements while being providing with neutral feedback – that means a statistically significant deterioration.

Probably enhanced sensitivity in connection with an age distinction of participants is the main cause of the more intensified reaction to positive or negative impulses from the environment.

Fig. 2
Relative values of intraindividual differences in physical test performances with positive, negative and neutral feedback information – subjects in pre-pubescent age

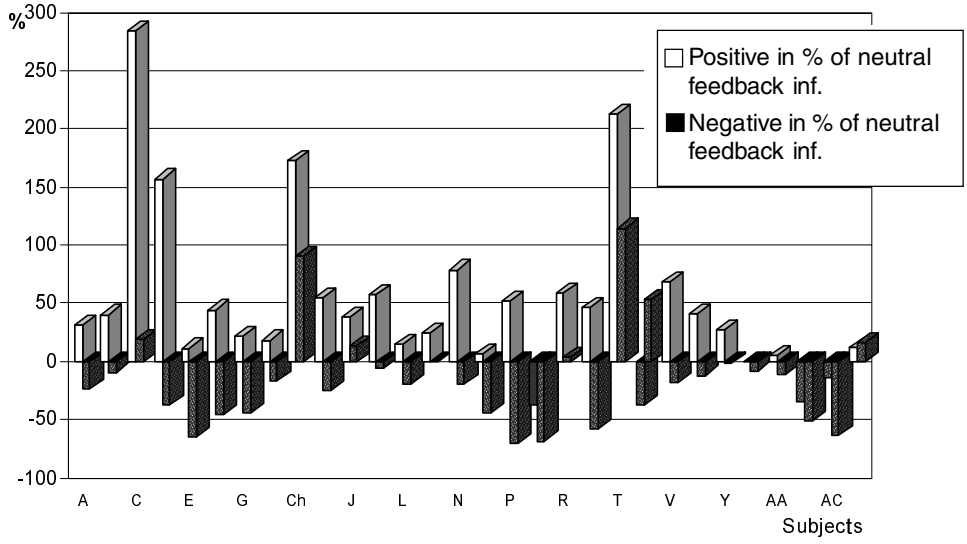


Fig. 3
Relative values of intraindividual differences in physical test performances with positive, negative and neutral feedback information – subjects in pubescent age

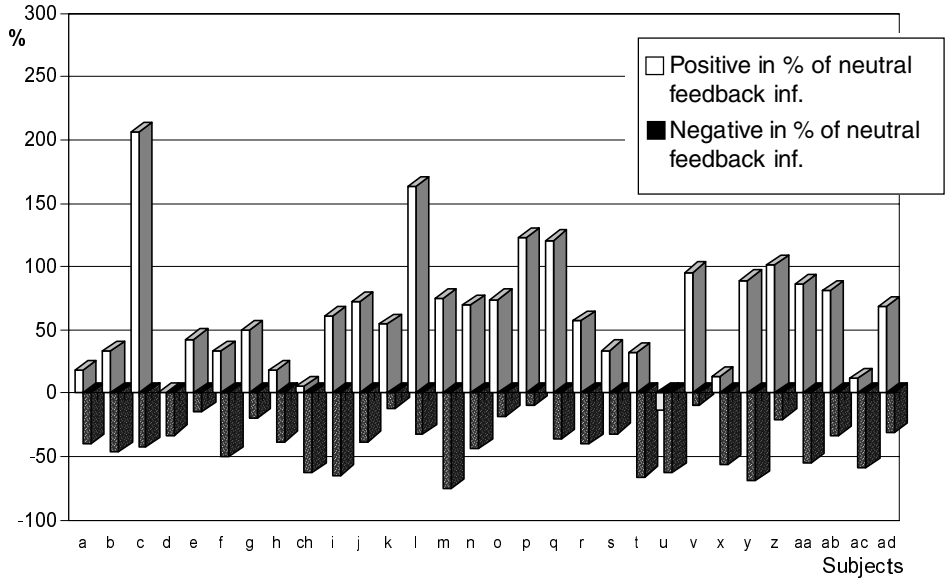


Fig. 4
Relative values of intraindividual differences in physical test performance with positive, negative and neutral feedback information – subjects in post-pubescent age

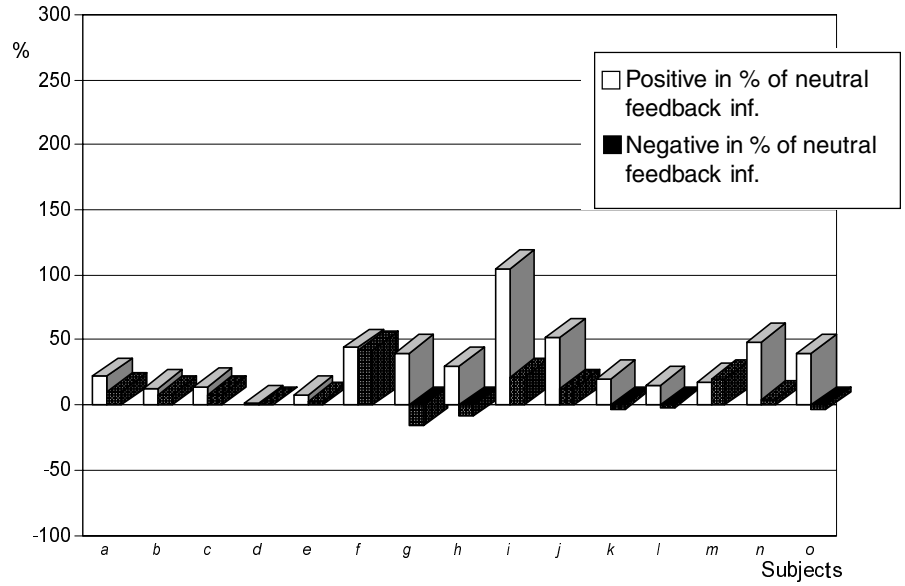
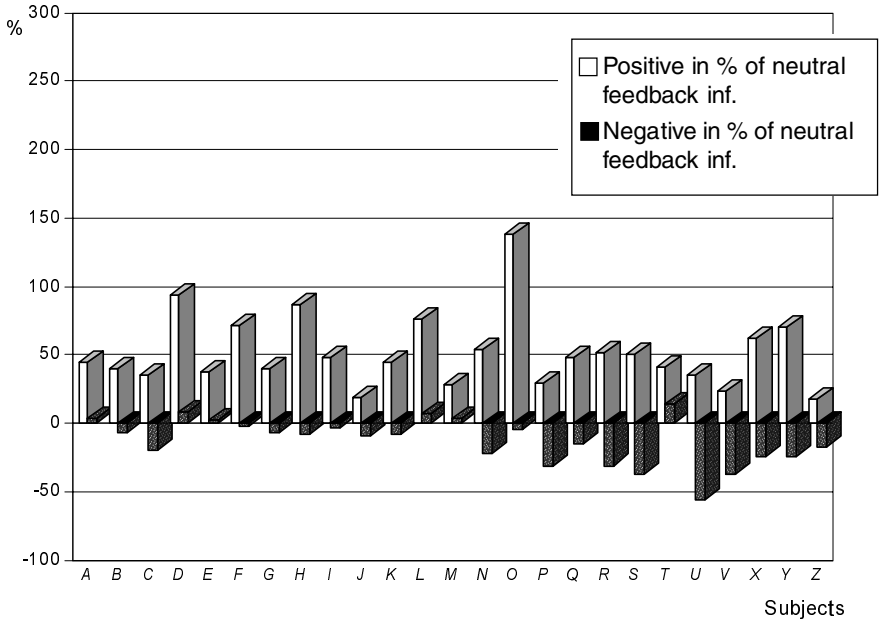


Fig. 5
Relative values of intraindividual differences in physical test performance with positive, negative and neutral feedback information – subjects with mental handicap



Effect of verbal feedback on movement achievement of participants in post-pubescent age (Fig. 4)

Differences in achievements of pupils in post-pubescent age during each type of feedback are not statistically significant. Improvement through providing positive feedback is lower in participants of post-pubescent age compared to pupils of pubescent age. While 57 % of pupils of pubescent age improved about more than 50 % when being provided with positive feedback compared to achievement with neutral feedback, in the group of participants of post-pubescent age it was only 13%. Negative feedback evoked only in 25 % of participants of post-pubescent age lower achievement than by providing neutral feedback. It follows that participants of post-pubescent age evidently, on a rational basis, try to perform well under any conditions. Verbal feedback does not give such a strong motivational impulse as it does with younger individuals.

Effect of verbal feedback on movement achievement of mentally handicapped participants (Fig. 5)

The average values of achievements of participants with mental handicaps while providing all three types of feedback were the lowest compared to other research groups. Providing positive feedback caused a statistically significant improvement of achievement in all the observed participants to occur as compared to achievement while receiving neutral feedback (an average of about 51 %). When providing negative feedback, a statistically insignificant decrease occurred in 76 % of participants (on the average about 13 %). The reaction of participants with mental retardation is comparable with the reaction of participants of prepubescent age.

CONCLUSIONS

The answer to our research question is positive.

- Verbal feedback has influence on the pupil's achievement.
  Differences in pupils' achievement in a movement test by providing different types of feedback were found.
- Positive and negative feedback provided to pupils evokes differentiated movement achievement.
  Results proved the correlation between movement achievement and the type of feedback: higher achievement as a reaction to positive feedback and lower achievement as a reaction to negative feedback.
- Dependence of achievement on the type of feedback is influenced by age distinctions of pupils.
  It is shown that each age period has got its specificity from those especially psychological distinctions and can influence the tightness of correlation between pupils' achievement and the type of provided feedback information.

Further it was found:

- The chosen movement test corresponds with the desired research aim.
  For sports pupils the test is less suitable because it is demanding of time and pupils regard the movement task as trivial.
- The process of learning does not influence achievement in the given movement test.
  Differences in achievement in the groups of pupils with a different order of provided feedback is not significant.
- Values of movement achievement of participants from all the observed groups with negative feed-

back are more homogenous than with positive feedback.

Towards the above-mentioned findings, we are assuming a critically confident attitude until the time when we will verify the results in more numerous sets of participants and other groups of the population.

Finally, we may state that positive feedback motivates univocally individuals of pubescent age.

Positive feedback also motivates to higher achievement an individual of prepubescent age as well as an individual with a mental handicap, but these people tried to perform as best as they could even when being provided with negative feedback. The polarity of feedback on results in movement achievement in individuals in post-pubescent age is irrelevant.

In context with didactic happenings in a physical education lesson, a teacher uses different strategies for the improvement of a pupil's achievement. An effective teacher should manage also basic techniques of feedback. Because he cannot naturally elude negative feedback, at the end of our contribution we offer impulses reducing their strictness:

- conditional clause ("What could you…", "If…")
- use of present tense ("You start running and…", "You lean backward…")
- use of the first person in plural pulling a teacher into what is happening ("We'll jump up…")
- personalised sentences ("Jump over me…")
- interrogative sentences ("Will you try…?" "Will you manage…?")
- use of diminutives ("Next you'll jump a little bit higher!")
- direct and indirect forms of address ("Peter, …" "Boys, …" "Look at, …" etc.)
- also items of non-verbal communication (for example a touch, a look or face-play) may lead to reduction of the dominance of negative feedback.

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VLIV ZPĚTNÉ INFORMACE NA ÚROVEŇ POHYBOVÉHO VÝKONU
(Souhrn anglického textu)

Stať se zabývá zkoumáním účinku zpětné informace na pohybový výkon jedince. Je řešen vliv pozitivní, negativní a neutrální zpětné informace na výkon jedinců v prepubertálním, pubertálním a postpubertálním věku a jedinců s mentálním postižením.

Výsledky prokázaly korelaci mezi pohybovým výkonem a druhem zpětné informace:

- Verbální zpětná informace má vliv na výkon žáka.
- Pozitivní a negativní zpětná informace podávaná žákovi evokuje diferencovaný pohybový výkon.
- Míru závislosti výkonu na druhu zpětné informace ovlivňují věkové zvláštnosti žáků a pravděpodobně i jejich mentální úroveň.

Klíčová slova: zpětná informace, pohybový výkon, žák, motivace.

THE STROOP COLOUR-WORD TEST IN PSYCHOLOGY AND BIOMEDICINE

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Submitted in December, 2001

The presented report is focused on the Stroop colour-word test. The test was first introduced into professional practice almost seventy years ago and it became a part of the limited "golden fund" of psychodiagnostic tools.
The introduction outlines important studies based on research works on the different aspects of the method itself (interference effect, validity, reliability, etc.) followed by detailed information on the use of the Stroop colour-word test for research in human psychophysiological reactivity under experimental stress conditions. The conclusion is a summary of the author's research, confirming that the Stroop colour-word test is an important experimental stressor and that during its administration, the subjects showed evident changes in the autonomic modulation of heart rate (predominance of sympathetic activity over parasympathetic). These changes can be monitored by spectral analysis of heart rate variability. The suggested examinational procedure could be used widely in psychosomatic medicine (e.g. for studying the impact of psychosocial stress or in the planning of appropriate therapeutic procedures).

Keywords: Stroop colour-word test, stressor, spectral analysis, heart rate variability, psychosomatic medicine.

INTRODUCTION

The psychologist's arsenal offers hundreds of psychodiagnostic methods based on differences in origin, orientation, age, etc. It is also obvious that while some of them are highly objective, valid and reliable, others – taking into account their psychometric features – are not so worthy of inclusion. After a closer look at psychodiagnostics, we are able to ascertain that together with newly developed methods, psychologists also use methods that originated some decades ago (e.g. The Rorschach Inkblot Method). The presented report is dedicated to a test that was introduced into professional practice relatively long time (almost seventy years) ago, but which could be, in our opinion, ranked as a part of the limited "golden fund" of the psychodiagnostic tools, the exceptional diagnostic and scientific values of which cannot be denied.

STROOP COLOUR-WORD TEST

According to Daniel (1983) many researchers study the influence of different psychosocial factors, burden and stress on humans and the possibilities of how to evoke (by means of appropriate psychological methods) experimental stressful situations and assess the degree of resistance of examined persons. This author stresses the fact that in the field of perceptional stress, the Stroop colour-word test is considered to be one of the most suitable methods. Its components are subtests of quick reading, identifying colours and interference.

When implementing the classic form of the Stroop colour-word test, the subject is initially required to read words representing names of some basic colours, then he/she tries to quickly name the colours of, for example, small rectangles and at the end he/she goes through the so-called subtest of interference. The subtest of interference is based on the assumption that looking at the name of a colour which is other than what the actual colour is (e.g. the word red is written in green), the subject strongly tends to read the name instead of saying the colour in which the word is written (which is what the instruction requires). When reading quickly, the person gets into a conflict-filled stressful situation because the answer is influenced by the learned reaction (in this case by the tendency to read words, not to name the colours).

It can be said that the classic form of the Stroop colour-word test was the most used variant for a long time, even though new forms were gradually introduced in practice. Houwer et al. (1994) suggest that at present the dominant variant is probably the one where the stimuli are pictures of common objects with a word printed across. It is being realised that the time needed to name the picture is longer if the word (distractor word) represents a different object. According to the mentioned authors, the success of the picture-word variant is not difficult to explain: the colour and word combination offers only a limited set of colours, however the picture-word variant allows to choose out of a great number of semantic categories and the relationship between the picture and the word can be determined with greater flexibility.

In recent decades, the Stroop colour-word test (in addition to its application in individual diagnostics in clinical, forensic or industrial psychology, etc.) has been used by many researchers in an almost uncountable number of research studies of different orientation. The following text aims to give an outline of at least some of the researched areas.

RESEARCH WITH THE HELP OF THE STROOP COLOUR-WORD TEST

Research on the fundamentals of the method

First of all, the different aspects of the method itself are studied: for example Tzelgov and Henik (1995) studied the relationship between the size of the Stroop effect and the level of reading ability, thereby ascertaining that interference decreases with age and it negatively correlates to reading ability. According to the above-mentioned authors, the Stroop effect and similar phenomena are a sum of facilitating and inhibiting components. The inhibiting component (often described as interference) is operationally defined as a difference in the reaction times as compared to non-agreeing stimuli as opposed to neutral stimuli (stimuli that are not colour words). However, the facilitating component refers to a difference in the reaction times to neutral and agreeing stimuli. The inhibiting component is usually more obvious than the facilitating component and reflects primarily the automatic aspects which are not under the control of one's will.

Siegrist (1995a) attempted to prove the reliability of the different forms of the Stroop test and found satisfactory coefficients of reliability together with a high inner consistency of this method. Klein et al. (1997) researched the influence of the administration length on the differences in performance that are age conditioned. The impact of different strategies on overall performance in Stroop task (Chen & Johnson, 1991), or differences between performance in both genders under conditions of moderate performance anxiety (Kluge, 1992) are studied, the relations of general cognitive abilities, individual types of answers and personality adaptation patterns are investigated as well (Rubino et al., 1997; Rush et al., 1990). The effects of taboo words on performance (Siegrist, 1995b), the possible distractive influence of words connected with alcohol in relation to the performance of alcohol abusers and non abusers (Bauer & Cox, 1998) or words related to trauma on the performance of children and teenagers with posttraumatic stress disorder (Moradi et al., 1999), are studied as well. Particular attention is paid to performances under different circumstances, for example when suffering from flu (Smith, 1992), after alcohol consumption (Gustafson & Kallmen, 1990), after nicotine use (Provost & Woodward, 1991) or in relation to the ageing process (Uttl and Graf, 1997). The variants of the Stroop test (e.g. The Serial Colour-Word Test) are used not to study the influence of interference but to assess the different types of adaptation in conflict situations (Rubino et al., 1998). The Stroop test is being used to evaluate the level of cognitive deficits in Alzheimer's disease patients (Fisher et al., 1990) or the degree of vulnerability to negative emotional stimuli in Parkinson's disease patients (Serra-Mestres & Ring, 1999), to appraise the influence of ageing and mental activity on cognitive functions (Houx et al., 1993), and also to monitor the changes in serum lipid levels, resp. those of catecholamines, while under mental stress (Muldoon et al., 1992; Perini et al., 1990). The latter study used the Stroop colour-word test as an experimental stressor, which is the subject of further discussion.

The Stroop colour-word test as an experimental stressor

The Stroop colour-word test is quite often used in laboratory stress research (for some methodological aspects of this type of research see e. g. Šiška, 2001). The question of the choice of adequate stressors was thoroughly elaborated mainly in the research of cardiovascular reactivity. In the group of commonly used stressors (e.g. stress ergonometry, exercise, cold test or Valsalva manoeuvre), an important role is played by so-called mental stressors – their usage was studied especially by Steptoe and Vögele (1991). The named authors stress that testing with mental stressors needs to be more standardised in order for us to be able to compare the results of individual laboratories and to precisely define the profiles of hemodynamic and neuroendocrinal answers connected with the different stimuli. In our opinion, the Stroop colour-word test is one of the methods that fulfil the standardization of research procedures criteria better than the others.

Review of selected studies

Survey of the respective special literature shows that the phenomenon of interference as an experimental stressor was applied many times in the past. The undertaken research projects using the Stroop test point out the quite complicated relations of resistance against interference with personality characteristics. It is stated (e.g. Broverman, quoted according to Daniel, 1983) that a person resistant to interference is dominant, demanding and effectively functioning, more frequently he/she does not respect authorities etc. Further researchers have studied other possible connections (e.g. relations of resistance to interference and anxiety level and neuroticism); it has been proved that these relations are quite complicated and the whole area needs to be researched further.

Talking about the Stroop colour-word test as an experimental stressor, we shall at this juncture mention at least a few important studies suggesting the usage of this method in experiments of different kinds. Bachen et al. (1992) used the Stroop test with the aim to assess the influence of acute mental stress on some aspects of cell immunity and they found out that administration longer than 20 minutes resulted in a sig-

nificant reduction of mitogenesis and in different changes in the circulating lymphocytes population. Similarly, Benschop et al. (1998) dedicated their research to the immune response to acute psychological stress using the Stroop test.

The Stroop test is relatively often used as a stressor to evoke experimental stress when researching cardiovascular functions. Waldstein et al. (1997) used the Stroop test when studying the process of active coping with stressful situations and they found out that – under certain conditions - active coping with stress (as opposed to passive one) raised blood pressure and the heart rate, most probably through increased α-adrenergic activation and as a result of a decrease in parasympathetic activity. Becker et al. (1996) used the Stroop test to study cardiovascular responses to mental stress with middle and older age groups without cardiovascular disease and they found a marked sympathetic reaction evoked by this laboratory stressor. The cardiovascular reaction to a repeated psychological stressor (the Stroop test) of trained and untrained individuals was studied by Boutcher and Nugent (1993). They concluded that within the group of trained individuals the absolute values of heart rate, under conditions of psychological stress, are lower than in the untrained group. In the following research using the Stroop test, Boutcher et al. (1995) found significantly lower values of the heart rate in people suffering from hereditary bradycardia than in the control group.

Callister et al. (1992) administrated the Stroop test when searching for answer to how the type of task, its absolute and relative difficulty and the perceived level of stress relate to sympathetic circulatory regulation, while Hobson and Rejeski (1993) studied the influence of the body activity level on the psychophysiological reaction of the body while undergoing stress. Seibt et al. (1998) compared the ability of the Stroop test to evoke respective cardiovascular reactivity in normotonics and hypertonics compared with other stressors (aiming to assess the usage of laboratory stressors when predicting cardiovascular changes in everyday life), Middlekauff et al. (1997) studied the influence of mental stress on the sympathetic nervous activity in people with advanced heart disorder and they found that this group shows higher values of sympathetic activity than the control group while undergoing mental stress – this finding is important relative to the assumed role of different "trigger" mechanisms in heart incident etiology.

The Stroop test as an experimental stressor is often used by the group of researchers of the State Health Institute in Prague, for example to study the differences in cardiovascular reactivity to experimental and natural (work) stressors in engine-drivers (Kožená et al., 1998). In the former Czechoslovakia, it was mainly Daniel (1972) who studied the possibilities of this method in practice. He researched changes in Stroop test performance, for example before work shift and after shift, and changes of vegetative functions of the studied persons during the test. This author used heart rate and skin bioelectric activity indices and found out that the heart rate is higher if the stress is caused by several sensory modalities simultaneously (visual and acoustic). This higher stress does not have to be reflected in a definite decrease in performance, but most probably in an increase in effort. The another research (Daniel, 1977) showed that the results of successful and unsuccessful sportsmen differ and the Stroop test could be also used in sports psychology. Finally, this author was studying the impact of perceptional stress to the activation level of students and operators and he found out that the sensitive indicator, changing during different forms of stress (test modification, combination of interference with auditive load etc.), is primarily the heart rate; significant correlations between scores in some personality questionnaires and performance in the Stroop test were not found (Daniel, 1984). The last mentioned study also offers a valuable overview of the results of several perceptional stress studies (undertaken in the Psychological Institute of Stockholm University, Frankenhaeuser et al.) that prove the important relationship between the Stroop test's subtests scores and the level of catecholamines in urine.

The Stroop test was also used in research by Slabý et al. (1983), studying cardiovascular reactivity to emotional stress. They presumed that a higher risk of cardiovascular disease could be expected in people that react with frequent and/or accentuated circulation responses to different stimuli during daily activities. The authors state that the psychophysiological aspects of cardiovascular reactivity were primarily studied in connection with so-called type A behaviour, but the area of problems related to the connection mechanisms of psychosocial factors with a cardiovascular pathology is much broader.

Together with the usage of the Stroop test as an experimental stressor in cardiology, the question of the prognostic value of similar methods is very important. Manuck et al. (1992) devoted their attention to this problem and using the Stroop test they evaluated the cardiovascular reactivity of people after the myocardial infarction. It was found that individuals who experienced another myocardial infarction or stroke in following 39 to 64 months were showing significantly higher cardiovascular reactivity to the Stroop test than individuals who did not experience it at all.

Grillot et al. (1995) used the computerized version of the Stroop test researching the cardiovascular reactivity (appraised with spectral analysis of heart rate variability) and possibilities of its modification by means of β-blockers. They concluded that it is a suitable, well-standardized method, capable of influencing the respective cardiovascular parameters and raising catecholamine secretion. Fauvel et al. (1996) used the computerized version of the Stroop test as well studying the cardiovascular reactivity in normotonics and hypertonics and they concluded that this method can be primarily useful in epidemiological studies and in therapeutic assessment of blood pressure changes and

heart rate changes under mental stress conditions. Similarly, Renaud and Blondin (1997) using the computerized version of the Stroop test concluded that administration of this method leads to an increased heart rate and could be used as an effective laboratory stressor. Stein and Boutcher (1993) used three different versions of the Stroop test (passive reaction, button and verbal one) with the aim to find out if the evoked cardiovascular reactions differ. They expressed an assumption that these reactions can be significantly influenced by the verbalization of the answer.

THE BASIS OF THE STUDY

In our clinical practice we relatively often meet individuals suffering from different types of psychosomatic diseases (including cardiovascular disorders) whose etiopathogenesis shows signs of an important role of stress. On the basis of this fact we decided to undertake research through which it would be possible to assess the heart reactivity to a standardized psychological stress. In our opinion, studies of similar type are important e. g. in the prevention (search of endangered people) as well as in the assessment of cardiovascular risk factors in already ill individuals, in planning therapeutic procedures, in assessing the efficacy of the pharmacotherapy or applied relaxation techniques, etc.

Aims

1. To asses the influence of the experimental stressor (Stroop colour-word test) on the autonomic modulation of the heart activity using spectral analysis of heart rate variability.
2. To verify the suitability of the Stroop colour-word test in researches of similar type.

Procedure and Methods

The basic principle of our procedure is as follows: at first the subject is required to fill in some psychological questionnaires and then he/she is relaxed while sitting ("pre-stress phase"). This introductory phase is followed by the application of an experimental stressor influence. Afterwards, the person relaxes again while sitting ("post-stress phase"). As an experimental stressor, the classic variant of the Stroop colour-word test is applied and the changes in the autonomic modulation of the heart rate were the monitored physiological variables. The method of spectral analysis of heart rate variability (SA HRV) is used to assess these variables. With the help of SA HRV we are able to obtain information on the specific regulatory efferent impacts of the sympathetic and parasympathetic nervous systems and their different representation in different situations (Berntson et al., 1997; Opavský and Salinger, 1995; Stejskal and Salinger, 1996; Šiška, 2000). To evaluate the heart rate variability, we used the telemetric system VariaPulse TF3 (Salinger et al., 1994, 1998).

It is necessary to state that our research was broad based and it was focused also on the possible correlations of selected personal characteristics with the reactivity of the autonomic nervous system under experimental stress conditions. However, considering the purpose of this report, we shall only concentrate on the findings directly related to the verification of the Stroop test suitability as an experimental stressor.

RESULTS

Aim 1

The first aim we tried to reach on the basis of examination of 91 persons (43 men and 48 women, average age 23 years). During testing, there was not a single person in the analysed group that would be treated for serious disease or would be using medicine that could systematically influence the experiment (e.g. β-blockers). Three analysed individuals in the group were vegetarian, ten were on the so-called rational diet. None of them stated that non-alcohol drugs were consumed (one person admitted short experience with "soft" drugs few years ago). Regarding the alcohol consumption, 20 persons considered themselves as abstainers, the rest evaluated their alcohol consump-

TABLE 1
Outline of the SA HRV differences between the pre-stress (Sitting1), stress (Stroop colour-word test) and post-stress phase (Sitting2)

Parameter	Sitting1 : Stroop	p	Stroop : Sitting2	p
PowerVLF	227,93 : 336,90		336,90 : 286,00	
PowerLF	669,40 : 862,80		862,80 : 934,71	
PowerHF	785,50 : 383,80	**	383,80 : 668,31	*
Rel.PowerVLF	13,50 : 19,83	**	19,83 : 14,28	*
Rel.PowerLF	41,40 : 52,10		52,10 : 46,31	
Rel.PowerHF	37,00 : 23,50	**	23,50 : 30,90	
Rat.VLF/HF	0,38 : 0,86	**	0,86 : 0,42	**
Rat.LF/HF	1,23 : 2,22	**	2,22 : 1,68	
RRInter	0,840 : 0,710	**	0,710 : 0,855	**

Explanatory note:
*: p(significance level) < 0.05
**: $p < 0.01$
PowerVLF – spectral power in very low frequency band [ms^2]
PowerLF – spectral power in low frequency band [ms^2]
PowerHF – spectral power in high frequency band [ms^2]
Rel. Pow. VLF – relative spectral power in very low frequency band [%]
Rel. Pow. LF – relative spectral power in low frequency band [%]
Rel. Pow. HF – relative spectral power in high frequency band [%]
Rat. VLF/HF – ratio PowerVLF : PowerHF [–]
Rat. LF/HF – ratio PowerLF : PowerHF [–]
RRInter – the mean value of R-R intervals (intervals between consequent heart beats) [ms]

(Note: Considering the character of distribution of studied variables, only nonparametric statistical methods were used to determine the significance of the differences – Friedman ANOVA and Wilcoxon, resp. sign test for two dependent samples. The same in case of Aim 2)

tion as occasional. There were 11 smokers in the group (7 men and 4 women). The comparison of selected parameters of the spectral analysis of heart rate variability is tabulated in TABLE 1.

Based on the received data, it is possible to conclude that application of the Stroop test leads to evident changes in the autonomic modulation of heart activity. These changes show significant decrease in parasympathetic (vagal) activity and an increase of sympathetic activity, it means a decrease in the spectral performance of the HF component in both absolute and relative units, increase in VLF/HF and LF/HF ratios, etc. The LF/HF ratio is considered as an index of the so-called sympathovagal balance and its increase is understood as a demonstration of a shift of the autonomic efferent stimulation to the sympathetic predominance; based on our results it is possible to consider the VLF/HF ratio as a marker of experiencing a stress situation.

Aim 2

Regarding the fact that the Stroop test administration leads to some changes in the breathing pattern of the studied persons that could influence changes in the SA HRV parameters, the neutral text reading phase was added to the examination of some subjects (60 persons, 30 men and 30 women, average age 22 years) in order to better control the breathing influence. Statistically significant differences in SA HRV parameters during the neutral text reading and during the Stroop test are tabulated in TABLE 2.

TABLE 2
Outline of the significant differences of the SA HRV parameters during the neutral text reading and the Stroop colour-word test

Parameter	Reading : Stroop	p
PowerVLF	197,31 : 378,39	**
PowerHF	622,35 : 503,67	**
Rel.PowerVLF	10,92 : 19,83	**
Rel.PowerHF	37,18 : 24,38	**
Rat.VLF/HF	0,33 : 0,82	**
Rat.LF/HF	1,36 : 2,08	**
RRInter	0,770 : 0,720	**

Explanatory note:
*: $p < 0.05$
**: $p < 0.01$
(The spectral analysis parameters – see TABLE 1 explanatory note.)

Based on the obtained results, we can conclude that the Stroop test administration, compared to the neutral text reading, leads to changes in the autonomic modulation of heart activity thereby exhibiting significant predominance of the sympathetic nervous system activity – increase in heart rate, increase of VLF/HF and LF/HF ratios, decrease of Rel. PowerHF parameter value, etc. These changes occurred regardless of the sequence in which the studied persons completed the examination (reading → Stroop test or Stroop test → reading).

We believe that the obtained results qualify us to claim that the Stroop colour-word test is a very suitable experimental stressor. It was shown that this method enables dynamic evaluation of the pre-stress, stress and post-stress phases, which means that in these intervals we registered significantly different answers of the autonomic nervous system (ANS). The method of spectral analysis of heart rate variability is also sensitive enough to register changes in the circulatory system evoked by the Stroop test administration (especially the periodical changes in heart rate) that are significantly influenced also by an actual functional state of ANS.

It is also important, in our opinion, to state that after the Stroop test administration the evoked changes disappear rather quickly. This means that there is a low habituation to the experimental stress situation. Another advantage of the Stroop test as an experimental stressor is that it is not used in routine clinical practice very often.

CONCLUSIONS

It is possible to conclude that the Stroop colour-word test, one of the most frequently used experimental stressors, deservedly gained respect and an important place within the psychodiagnostic methods during last decades; both its validity and reliability are positively appraised. Our research confirmed that this method is strong stressor for the majority of studied subjects. This was proved not only by the changes in the autonomic modulation of heart activity in the sense of predominance of the sympathetic nervous system activity, but also by the behavioural changes in the studied persons and their subjective evaluation of the mental stress level during its administration. Our findings correspond with the results of the authors listed above.

We use the "classic" form of the test because we have the greatest experience with it and the local norms are at our disposal. It can be assumed though that it would be desirable to enrich the experimental procedure with new variants of the test (including the computerized ones) as it would enable to increase the variability of our examinational scheme. The described procedure, in our opinion, could be a starting point for a methodology that would serve for example for differentiating people with low and high reactivity to the stress stimuli, studying the psychosocial stress influence on humans, planning adequate therapeutic procedures or in evaluating the effects of the relaxation techniques on individuals with serious psychosomatic disorders, etc.

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VYUŽITÍ STROOPOVA TESTU INTERFERENCE V PSYCHOLOGII A V BIOMEDICÍNSKÝCH OBORECH

(Souhrn anglického textu)

Předkládané sdělení je věnováno Stroopovu testu interference, který byl do odborné praxe uveden již před téměř sedmdesáti lety a který lze bezesporu zařadit do rozsahem limitovaného „zlatého fondu“ psychodiagnostických nástrojů, jimž nelze upřít výjimečnou diagnostickou a výzkumnou hodnotu.

V úvodní části práce je podán přehled významných studií věnovaných výzkumu různých aspektů metody samotné (efekt interference, validita, reliabilita atd.), následovaný podrobnějšími informacemi o sděleních využívajících Stroopův test interference při výzkumech psychofyziologické reaktivity člověka v podmínkách experimentálního stresu. Závěrečná část práce přináší výsledky autorových výzkumů, v nichž bylo prokázáno, že Stroopův test interference působí jako významný experimentální stresor a při jeho administraci dochází u vyšetřovaných osob k významným změnám v autonomní modulaci srdeční činnosti (ve smyslu posunu na stranu převahy sympatické aktivity nad parasympatickou), které lze sledovat s pomocí spektrální analýzy variability srdeční frekvence. Navržený vyšetřovací postup může najít uplatnění v řadě oblastí psychosomatické medicíny (např. při zkoumání vlivů psychosociální zátěže nebo při plánování terapeutických postupů).

Klíčová slova: Stroopův test interference, stresor, spektrální analýza, variabilita srdeční frekvence, psychosomatická medicína.

THE NEED OF AUTONOMY IN SPECIAL OLYMPICS ATHLETES AND ITS SATISFYING THROUGH SPORTS ACTIVITY

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This research has revealed that it is possible to develop autonomy through sports activity for athletes with moderate mental retardation. It has been diverse level of autonomy need in the studied group. There were sportsmen expecting autonomy, but others avoided it requiring their need for independent functioning to be activated. The extent of autonomy offered to particular athletes by the coaches varied and was not always adjusted to their needs. A number of athletes declaring autonomy need obtained their coaches' consent to satisfy it, but the disturbing fact is the presence of individuals, whose aspiration for autonomy was blocked by coaches. A coach should consciously aim at shaping the mentally retarded competitor's ability to behave autonomously.
This reported study is a part of larger research program financed by KBN Poland.

Keywords: mental retardation, Special Olympics, autonomy.

INTRODUCTION

Autonomy is understood as the ability to direct one's behaviour responsibly, to make choices while taking into account one's own and others' needs, and to develop social relations based on reciprocity (Pilecka & Pilecki, 1996). Obuchowska (1996) distinguishes two main areas where the concept of autonomy operates: "internal" autonomy, which manifests itself first in the individual's awareness (thinking, feelings) and then in actions (spontaneous or intentional) and also "external", which basically means the consent of the environment to the realisation of an individual's own autonomy.

A strong tendency to act independently, which is a significant developmental factor, appears already in the infant stage up to the age of a normal one-year-old child. The development of autonomy goes through certain phases: from complete dependence, through independence, to co-dependence (Pilecka & Pilecki, 1996). The best conditions in which it can be realised are emotionally safe conditions. Children gradually gain autonomy "balancing between independence, which offers them the feeling of their own value, and dependence which gives them the feeling of safety" (Obuchowska, 1996). The psychological autonomy of an adult individual is characterised by the feelings of freedom, independence, determining one's goals, free choice, and self-determination within the framework of the norm. In other words, the person is able to function in a subjective way.

The slower rate at which the development of mentally disabled children occurs means that they require constant care, supervision, attention, help, and protection for a longer period of time than their healthy peers. There are few opportunities for them to act independently. The feeling of external control develops in them. They suppress the need for autonomy (Szychowiak, 1996). They become passive, dependent, externally directed, and function in an instrumental way (Bybee & Zigler, 1999; Kowalik, 1984; Obuchowska, 1994). This can lead to a condition of secondary, acquired helplessness, which becomes an obstacle in the complete realisation of their developmental potential (Seligman, 1994).

According to W. Pilecka and J. Pilecki (1996), there are two main factors responsible for this state. The first one is a low level of competence characterising these individuals. The second is the influence of the social environment providing the individual with information concerning his or her abilities. Social surroundings can place barriers limiting independence or create conditions favourable to his or her functioning as a subject. The context favourable for shaping autonomy in the mentally handicapped is achieved by correct personalisation and socialisation, as well as by the development of competence.

An activity taken up eagerly by the mentally handicapped, irrespective of the extent of the retardation, is sport. Its value for rehabilitation is attracting the attention of many researchers (e.g. Válková, 1998; Válková, 2000; Válková et al., 2001).

THE AIM OF THE STUDY AND THE CONCEPTION OF THE RESEARCH

This study aims at establishing answers to the following questions:

1. Is sports activity in the Special Olympics movement conducive to the development of autonomy in the mentally retarded athletes?
2. Do SO athletes feel the need to function autonomously in sports situations?
3. Do SO athletes have the opportunity to satisfy the need by sports activity?

As it is difficult to assess the influence of practising sport on autonomous behaviour in a direct way, we will comment on the conception of the research concerning this issue. Predicting an answer to the first question is not easy, as practising sport, on the one hand, requires complying with, e.g. training schedule, rules operating in a given discipline. On the other hand, it develops competence, enables competitors to observe their own effectiveness, which in turn help them build up self-confidence. Sports activity enables the athlete to perceive the relation between his/her behaviour and reinforcement, which follows. Thus, it develops athletes, belief in internal control. The feeling of having influence on effects of one's own activity is one of the important determinants of autonomous, subjective functioning. If sports activity helps to develop belief in internal control of events, then SO athletes can be said to possess high level of internal locus of control (LOC). To verify this thesis a following hypothesis has been proposed: mentally retarded individuals have higher level of internal locus of control than those who do not practise sport. Positive verification of this hypothesis can suggest that practising sport influences the development of internal LOC, although it can also be a result of selection of athletes in the moment of recruitment to the team (since it is not known whether sports activity is taken up by individuals with internal LOC, and if it is at all interesting for individuals with external LOC). To dispel, at least partially, the doubts concerning the issue we should look for factors in sports situations, which stimulate the development of internal LOC of athletes and their ability to behave autonomously and subjectively. It is the author's opinion that respecting and emphasising subjectivity of athletes are among the most important factors. Therefore a following question has been raised: Do coaches treat competitors in a subjective manner? Positive answer to the question together with positive result of the hypothesis verification will indicate if in sport within the SO movement exist conditions to develop in the mentally handicapped the abilities to function autonomously.

THE RESEARCH METHOD

Subjects

The study involved 27 athletes (SO group, 16 men and 11 women) with at least a two-year experience of competing in Special Olympics and 20 individuals (NON group, 11 men and 9 women) who did not practise sport. The SO group consisted of subjects aged 20–46 (age average 30.30 ± 8.37 yrs), the control group (NON) consisted of subjects aged 16–44 (age average 24.95 ± 9.04 yrs). All subjects were mentally retarded in moderate degree. Both groups SO and NON contained a similar number of subjects from day rehabilitation centre and from sheltered work centre.

Instruments

The study involved: 1) locus of control questionnaire (formulated by the author) and 2) set of questions concerning a) subjective versus instrumental treatment of the athletes by their coaches, b) stated extent of independence need, and c) satisfaction of the competitors from obtained autonomy. Both the questionnaire and the set of questions were filled in during an individual conversation with a retarded person.

LOC questionnaire contained 14 statements, 7 concerning positive events and 7 concerning negative ones. The second part of each sentence consisted of two alternatives, where subject was supposed to choose one. E.g. "If you trip over uneven pavement it is because a) you were not looking where you were going, or b) the surface of the pavement was not even". If the subject delayed providing an answer to the statement, the two alternatives were repeated but in reverse order, first b, than a. The subject provided two answers: one rejecting the fragment which was not accepted, and the other confirming chosen version (often in different order). 1 point was given for the answer diagnostic for internal LOC. The person questioned could receive maximal number of 14 points.

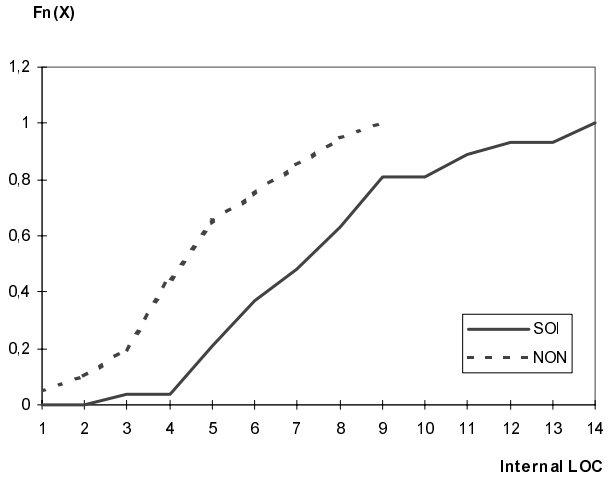
While designing the set of questions about subjective treatment of sportsmen by their coaches it was assumed that taking into consideration competitor's subjectivity consisted basically in respecting his/her individuality, acting in his/her sake. It was expressed among other things by: respecting the athlete's right to express dissent, justifying by the coach his commands so that the athlete could understand them and accept them, deciding together with the athlete e.g. in which discipline to compete, sharing the feelings of victory and failure, care athlete's health and his/her life outside sport as well as taking into account rational needs of the competitor. The set contained 16 questions, 8 concerning training and 8 concerning competition. 6 questions concerned autonomy. After receiving answer to the question about consent to autonomy or limiting it, an additional question was asked if the athlete was satisfied with this situation or not. Some questions did not concern all the competitors, e.g.: some subjects answered that they never took

up risky tasks, did not miss training sessions, did not know if the coach was observing their start. Therefore the number of obtained answers in table 1 varies.

THE ANALYSIS OF RESULTS

1. Is sports activity in SO movement conducive to the development of autonomy in the mentally retarded athletes?
   a. The level of internal LOC development in SO athletes.
      The comparison of the locus of control evaluation results in the SO and NON groups is presented in Fig. 1.

Fig. 1
Comparison of the internal LOC in SOI and NON groups



The clear discrepancy of individual results (varying from 3 to maximum 14 points) obtained by competitors in the locus of control questionnaire emphasises their substantial rehabilitation needs in this domain. Nevertheless, the most outstanding difference D between cumulative distribution of results obtained in both groups, and calculated with the Kolmogorov – Smirnov test, is statistically significant ($x^2 = 8.379 > x^2 = 5.991$ $\alpha = 0.05$). By the same token, the hypothesis has been confirmed, which means that competitors are characterised by a higher level of locus of control than those who do not practise sport are.
Such an outcome of the study can be an effect of the selection of subjects, or a result of treatment of the competitors in their sports activity in a subjective way. The answer to this question is provided, at least partially, by the analysis of the answers in the second set of questions (TABLE 1).

   b. The competitors' feelings concerning their subjective treatment by the coaches.
      The majority of situations studied in this questionnaire were described by the individuals as characterised by subjective attitude of coaches towards them. This means that in the coaching process there exist conditions to shape athletes' autonomy and that they are utilised, although to a varying degree, in the case of individual competitors. During the training sessions the least independence was offered while choosing a partner for exercises. During competition lack of independence concerned following situations: a warm-up before the start, entering the tent

TABLE 1
The competitors' feelings concerning their subjective treatment by the coaches

No.	Trainer's behaviour concerning: Training situation	N	n	%
1	Success of the athlete	27	20	74
2	Failure of the athlete	27	23	85
3	Refusal to perform tasks	24	16	67
4	Willingness to take risk	22	13	59
5	Encouragement to choose tasks	25	15	65
6	Encouragement to choose partner	25	6	24
7	Absence in training sessions	22	20	91
8	Focus on the competitor's well-being	27	21	78
	Competition situation			
1	Success of the competitor	27	24	89
2	Failure of the competitor	22	19	86
3	Leading the warm-up	27	8	30
4	Moving to start groups forming tent	25	6	24
5	Selection of discipline	25	6	24
6	Moving around the stadium	27	21	78
7	Observation of the competitor's start	25	23	92
8	Congratulations after the decoration	27	24	89

N: Number of provided answers in total
n: competitors declaring that they are treated in a subjective way by their coaches.

where starting groups were formed, and the decision which discipline to practise. The lack of autonomy in the above mentioned situations could be caused by: 1) avoiding it by the competitors, 2) limiting it by the coaches. Further analysis will provide an explanation to this problem.

2. Do SO sportsmen feel the need to function autonomously in sports situations?
   As the athletes gain experience in sport activity, they should also acquire better orientation in sports environment, and, thus, develop the ability to cope with different sports situations on their own. Having the feeling of being able to influence the effects of their own actions and positive experiences acquired in various situations concerning practising sport they should also possess the need to function autonomously in many sports situations. A number of situations in which the athletes wanted to be able to make decisions or to act independently reveal the level to which this need is developed.
   The competitors' need for autonomy varied. Only one person (4 %) wanted to function independently within all the situations taken into consideration in the study. No one was completely uninterested in the possibility to act independently, but many subjects revealed the need to be independent in only a few situations. Therefore, we will concentrate now on situations where they felt the need for autonomy and where they avoided independence.
   Generalising the results we can state that half of the athletes felt the need to function independently in the studied training situations, and in the situations before the start this percentage was even smaller. It indicates that as the feeling of emotional safety was decreasing so was decreasing the need of autonomy. A mistake often committed by trainers in education towards autonomy, as the data in the table suggest, is imposing on competitors a particular discipline in which they are to compete. The choice of the discipline should always be a result of mutual agreement, even when the competitors do not feel the self-determination need in this particular situation. Admitting their subjectivity requires it.
   So far we have determined that: 1) the coach's consent to autonomy varied in the case of individual competitors, and 2) the independence need is not developed to the same degree in all athletes participating in the study.

3. Satisfying the need for autonomous functioning in sports situations felt by SO athletes.
   Let us now consider the question of satisfying the need of autonomy by offering more independence or reducing it in the studied situations. It is interesting since the right to greater independence does not amount to providing psychical comfort of the athlete. A person with internal locus of control is likely to feel comfortable when he or she is allowed to function independently, and to feel stressed when this independence is limited. On the other hand,

TABLE 2
The extent of autonomy need in the athletes group

The number of situations	1	2	3	4	5	6
Competitors interested (%)	21	13	21	42	–	4

TABLE 3
Directing competitors' autonomy need (%)

Situations	Competitors	
	Without autonomy need	**with autonomy need**
Training		
5	34	65
6	52	48
Competition		
3	70	30
4	76	24
5	44	56
6	20	80

a person with external locus of control will prefer others to direct his or her behaviour. In this case more freedom leads to anxiety, fear, and inhibits his or her activity. TABLE 4 will help us recognise competitors' reaction to the extent of obtained autonomy.

In the situations taken into consideration in the study most competitors received expected extent of autonomy, which proves that coaches are well aware of competitors' needs and competence. However, some individuals were dissatisfied with the extent of autonomy. Their presence suggests that athletes are encouraged to greater independence than they feel necessary as a result of their subjective feeling of safety and competence. Such practices are positive only if the competitor is, at least partially, able to fulfil the tasks.

However, the presence of persons dissatisfied with lack of autonomy is a definitely negative phenomenon. It can be a result of either too high self-esteem (which is rather unlikely in the group of moderately mentally retarded), or it can indicate that the trainers' knowledge of the competitors' needs is incomplete, and sometimes even that those needs are disregarded.

A characteristic feature is that there were significantly more people satisfied with lack of autonomy than with obtaining it. In the situation just before the start it is understandable as caused by the need of support related to strong emotions operating in that moment. In training situation, however, it requires in-depth analysis of the causes and undertaking appropriate counteractions. Causes of avoiding independence include lack of safety feeling resulting from low competence or insufficient knowledge of one's own abilities (expectation of failure), the fear of refusal or disapproval of the coach, and acquired helplessness.

CONCLUSION

Summing up the research results we can state, that:

1. The extent of autonomy need in analysed sports situations varied in the case of individual SO athletes participating in the study. There were athletes who expected autonomy in analysed sports situations. There were others who avoided it, whose need for autonomous functioning has yet to be activated.
2. The extent of autonomy offered to the athletes by their coaches was not always adjusted to the extent their needs. In the studied group there were contenders who declared that they could function independently in many rather difficult sports situation. There were also others who expected consent to autonomy, but whose attempts to act independently were successfully blocked by trainers.
3. Sports activity offers means of developing in moderately mentally handicapped individuals ability to function autonomously, but these means are not fully used in coaching practise.
4. To make use of rehabilitation values existing in sport a coach should realise that he is aiming at educating an athlete:
   a) whose fitness level is constantly improving, who participates in ever more difficult disciplines with ever stronger rivals, and
   b) who is, at the same time, becoming more aware of his/her own skills, needs, and abilities to function efficiently and independently, possessing the ability to self-determination in different areas of life activity and to direct his/her own behaviour according to possessed competence.

TABLE 4
Satisfaction of the competitors with the extent of autonomy offered by the coaches (%)

Situations	In total		With offered autonomy		With lack of autonomy	
	satisfied	dissatisfied	satisfied	dissatisfied	satisfied	dissatisfied
Training						
5	65	35	48	17	17	17
6	70	30	22	4	48	26
Competition						
3	74	26	17	13	57	13
4	84	16	16	8	68	8
5	60	40	20	4	40	36
6	72	28	68	16	4	12

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POTŘEBA SAMOSTATNOSTI U ÚČASTNÍKŮ SPECIÁLNÍCH OLYMPIÁD A JEJÍ USPOKOJOVÁNÍ PROSTŘEDNICTVÍM SPORTOVNÍ ČINNOSTI

(Souhrn anglického textu)

Výzkumy prokázaly, že je možné prostřednictvím sportovních aktivit rozvíjet samostatnost sportovců se středně těžkým mentálním postižením. Ve zkoumané skupině byla zaznamenána rozdílná úroveň potřeby samostatnosti. Byli zde sportovci očekávající autonomii, jiní se jí však vyhýbali a jejich touha po samostatnosti musela být aktivována. Potvrdilo se, že míra autonomie poskytovaná trenéry jednotlivým závodníkům je na různé úrovni a ne vždy odpovídá skutečným potřebám postižených osob. Mnozí sportovci projevující potřebu samostatnosti získali svolení trenéra k jejímu uspokojení, znepokojující však je, že některým jedinců byla snaha o samostatnost trenérem znemožněna. Trenér by měl vědomě směřovat k rozvoji samostatného chování mentálně postižených závodníků.

Klíčová slova: mentální retardace, speciální olympiáda, samostatnost.

AGE AND SPECTRAL ANALYSIS OF HEART RATE VARIABILITY

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The aim of this study was to determine the dependence of individual parameters of spectral analysis of heart rate variability (SA HRV) on age in the standing and the lying positions. For the purposes of standardization, the results of short-term SA HRV analysis (5 min intervals) in the lying and subsequent supine positions for 216 healthy subjects ranging in age from 12 to 70 years were adapted. For calculation of SAHRV parameters, we used the Fourier fast transform method with partially adapted CGSA (Coarse Graining Spectral Analysis, Yamamoto, 1991a).

Our study shows that the course of dependency of parameters on age is not homogenous. It varies at different periods of age from more age-dependent to less age-dependent, or may run an entirely independent course.

The individual components of SA HRV are mostly age dependent. This dependence is not linear from 12 to 70 years of age and the course further changes between 30 and 50 years; in older subjects, the dependence is less pronounced.

Keywords: age, heart rate variability, spectral analysis.

INTRODUCTION

Spectral analysis (SA) of heart rate variability (HRV) is generally accepted to be a valid, noninvasive suitable method for evaluation of the autonomic nervous system (ANS) activity. Since advancing age in healthy subjects is related with deterioration in communication between the nervous and the cardiovascular systems (Xaio & Lakatta, 1991), HRV is known to progressively decrease in the adult age. Evidence from research studies suggests that age-dependence specifically effects not only the total spectral power but also its individual components (Byrne et al., 1996; Ingall et al., 1990; Korkushko et al., 1991; Piccirillo et al., 1995) (Fig. 1, 2).

In light of the fact that some disorders, along with aging, are related to a decline in HRV, it is necessary to define the reference values for those parameters that are important in interpreting the results. For this to be accomplished, it is essential to differentiate between the physiological changes accompanying aging and the pathological changes in HRV.

In the present study we evaluated the correlation between age and the SA HRV parameters in the supine and while standing. We divided the individual parameters into (1) age-dependent {descending and ascending with age} and (2) age-independent, and our study focused on defining the dynamic of these dependence in the form of mathematical equations (regression functions).

The aim of this study was to observe dependence of individual parameters of spectral analysis of heart rate variability (SA HRV) on age (in standing and in lying positions) on a group comprising 143 healthy males and 79 healthy females aged 12 to 70 years. On the basis of correlation between parameters and age, the parameters were divided into two groups. Group one exhibited a descending course of dependency (total spectral power, power of high frequency component HF, ratio of power HF to total power – % HF – in lying and in standing positions and power of low frequency component LF in the standing position). Group two followed an ascending course of dependency (power of very low frequency component VLF in standing, ratio LF/HF, VLF/HF and VLF/LF in supine, LF/HF in standing and % LF and % VLF in supine). We were not able to established age dependency for the remaining components.

Our study will show that the course of dependency of parameters on age is not consistent through the years. In fact, it varies at different periods of age from more age-dependent to less age-dependent, or may run an independent course. This change is more pronounced in the fifth decade of life in components with a descending course of age dependency and in the fourth decade for components with an ascending course. Further, we will show that the influence of age is less pronounced in the older than in younger subjects.

MATERIALS AND METHODS

From a total of 800 hopeful participants, 216 healthy subjects (143 men and 73 women) aged 12 to 70 years were selected. The selection procedure comprised the following elimination criteria:

- history or demonstrable evidence of diabetes mellitus and cardiovascular, respiratory, renal, hepatic, gastrointestinal, or systemic diseases,
- pathological baseline ECG or during stress,
- diastolic blood pressure higher than 155 mm Hg,
- history of medication for at least 3 months prior to examination,
- cholesterolaemia higher than 5.2 mmol.l^{-1},
- smoking of more than 5 cigarettes per day,
- periodical intensive training (20 min or longer) twice or more per week.

For the purposes of standardization, the results of short-term SA HRV analysis (5 min intervals) in the lying and subsequent supine positions for the 216 healthy subjects ranging in age from 12 to 70 years were adapted (TABLE 1).

TABLE 1
Distribution of subjects into age subgroups

Age range		n	$\overline{x}$	SD
from	to			
12.0	15.0	24	14.55	0.60
15.0	20.0	19	16.99	1.57
20.0	25.0	24	22.41	1.13
25.0	30.0	18	27.27	1.82
30.0	32.5	15	31.04	0.73
32.5	37.5	16	34.37	1.20
37.5	40.0	15	38.88	0.67
40.0	42.5	12	41.42	0.96
42.5	45.0	24	44.36	0.98
45.0	47.5	13	46.32	0.73
47.5	50.0	10	48.98	0.70
50.0	55.0	17	52.03	1.10
55.0	70.0	15	63.24	5.53
12.0	70.0	222	35.05	14.3

The HRV examination complied with the following standard testing protocol: The examination began between 8 and 9 a.m. Subjects had a lay in a quiet room with their eyes closed for the purpose of isolating their sensual perception and wore headphones playing relaxing music. A 5 minute ECG was recorded after five minutes of lying in the rest position on a tilted table. The subject was then made to stand vertical and after one minute of standing, a 5 minute ECG was recorded again. The subject was then made to lie down again and, after reaching a steady state, a 5 minute ECG was recorded. The first position, supine at rest, served only for the purpose of standardizing the examination and the results thus obtained were not taken into consideration.

The microcomputer-based diagnostics system VariaCardio TF4/TF3 (Salinger et al., 1995; Salinger et al., 1998) was used to monitor the R-R intervals and in the evaluation of HRV. The diagnostic system enables a routine short-term assessment of time and frequency domain of HRV whilst the findings detailed by the Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology (Task Force, 1996) are respected.

Hardware of systems VariaCardio TF4/TF3 consisted of a chest belt with two flat electrodes and onboard signal analysis unit which digitises time series of R-R intervals with sampling frequency 1000 Hz and one-channel ECG signal with 500 Hz sampling. Preprocessed signals were telemetrically transferred (UHF radio transmitter/infra) to the receiver connected to a standard IBM – PC computer, where special software controls artifact recognition and processing.

Standard mathematical algorithms are used for a cubic spline interpolation, sampling algorithms (4 Hz) and time detrending, before final analysis time series R-R intervals. The diagnostic systems incorporate program procedures enabling analysis of HRV in time- and/or frequency-domain.

Fig. 1
Three-dimensional graph of the 25 years old men

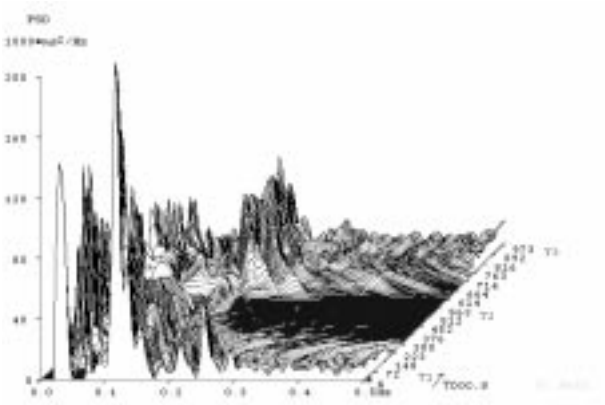
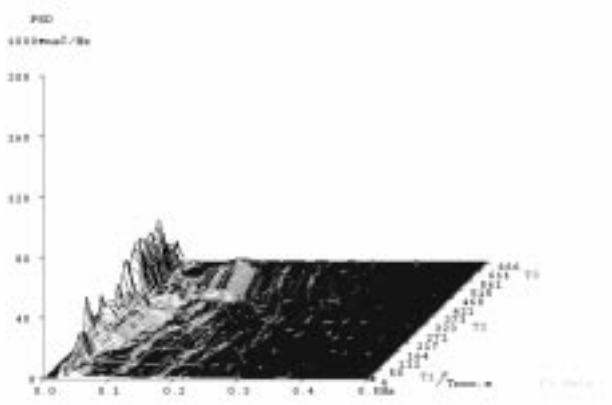


Fig. 2
Three-dimensional graph of 67 years old men



For the purposes of SAHRV, our study utilised the short-time R-R interval recordings (300 s each).

For the calculation of SAHRV parameters, we used the Fourier fast transform method with partially adapted CGSA (Coarse Graining Spectral Analysis, Yamamoto, 1991a). The algorithm assures optimum suppression of non-harmonics and noise components of the analysed signal, particularly in the low frequency domain (1/f component). The basic calculated parameter of SAHRV in the frequency band VLF (0.02–0.05 Hz), LF (0.05–0.15 Hz), and HF (0.15–0.40 Hz) is the power spectral density (PSD) [$ms^2.Hz^{-1}$] of separate components along with other derived parameters:

- position of its maximum values on the frequency axis (frequency) f VLF, f LF, f HF
- integral size spectral power in the separate component P_{VLF}, P_{LF}, and P_{HF} [ms^2],
- total spectral power in all frequency ranges P_T [ms^2],
- percentage expression for separate components % VLF, % LF, and % HF [%],
- ratio of spectral power of separate components VLF/LF, VLF/HF, LF/HF,
- ratio of square root spectral power of separate components to the mean values of R-R intervals expressed by coefficients CCVVLF, CCVLF and CCVHF (Hayano et al., 1991).

Non-normal distributed parameters (as determined by Kolmogorov-Smirnov test) were transformed to their natural logarithms [y = ln(x)], which resulted in the facilitation of additional statistical manipulation.

The entire file of the subjects was spread into 13 age groups (TABLE 1). Afterwards, by analysis of variance (monitoring average values and standard deviations in the groups) – Fig. 3 – we monitored dependency of the parameters on age (DAD). In this way, the age groups with significant changes in the course of dependency line of the age parameters were identified (conversion either from age-dependent to age-independent segment or from age-independent to age dependent segment).

The results of visual evaluation were verified by testing the significance of the estimated relation (that is dependence or independence), see above, in the adjacent age-groups by means of the Kruskal-Wallis test (Fig. 3). Thus, the age interval for any individual parameter, where the differences between age groups were either pronounced or insignificant, was estimated. The linear regression was calculated for the age intervals where a significant change in the age parameter occurred. In intervals where the parameter did not change with age, only average and standard deviations were calculated.

Age where the course of age-dependency of the parameter varies (break points) was calculated from these equations.

RESULTS

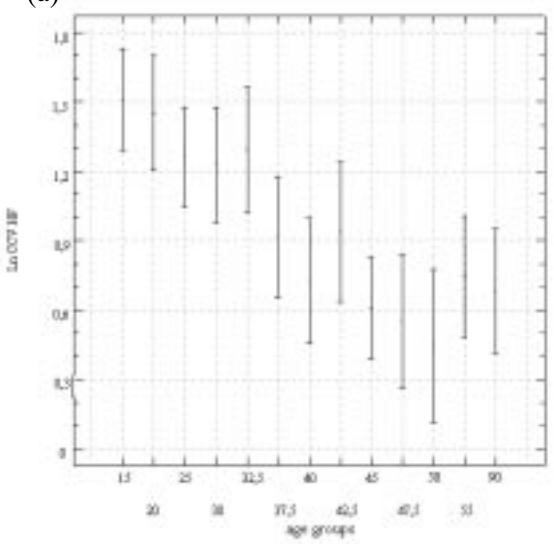
A description of the basic characteristics in all groups and both subgroups (men and women) are presented in TABLE 2.

Of the 32 monitored parameters, 28 were normally distributed after transformation to their natural logarithm (TABLE 3). Abnormally distributed parameters remained (% LF in supine and % VLF, % LF and f HF in standing).

TABLE 3 demonstrates the basic descriptive characteristics of individual parameters and their correlation with age. Most significant dependence on age

Fig. 3
(a) Graph of average values and standard deviations
(b) Multi-factor analysis of variance (LSD test)

(a)



(b)

Method: 95 Percent LSD

Level	Count	Average	Homog
50	10	.4458143	X
47.5	13	.5505083	XX
45	23	.6070506	XX
90	15	.6836973	XX
40	15	.7262992	XX
55	16	.7460737	XX
37.5	16	.9176881	XX
42.5	12	.9401674	XXX
30	18	1.2267408	XXX
25	24	1.2610597	XX
32.5	15	1.2936540	XX
20	18	1.4521318	X
15	23	1.5090704	X

TABLE 2
Description of basic characteristics of the entire group and subgroups – men and women

		Entire group n = 222	Women n = 79	Men n = 143
age	$\bar{x}$	35.05	35.03	35.05
	SD	14.30	16.26	13.16
	min	12.02	13.94	12.02
	max	70.34	68.60	70.34
weight	$\bar{x}$	72.92	66.80	76.30
	SD	14.62	15.35	13.07
	min	44.50	44.50	46.50
	max	123.50	112.20	123.50
height	$\bar{x}$	174.47	166.84	178.68
	SD	9.61	7.65	7.84
	min	154.00	154.00	154.00
	max	207.00	191.00	207.00
BMI	$\bar{x}$	23.91	24.05	23.83
	SD	4.33	5.74	3.33
	min	16.24	16.75	16.24
	max	46.10	46.10	38.98

$\bar{x}$ – average value
SD – standard deviation
n – number of the subjects in group
min – minimum
max – maximum

Fig. 4
Alternatives to age-dependent parameters with general downward course

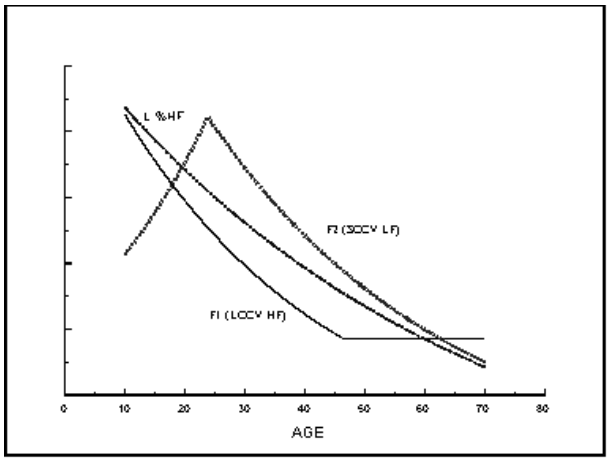
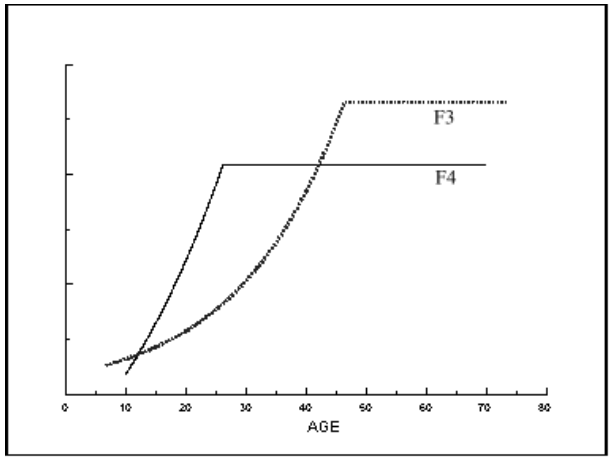


Fig. 5
Alternatives to age-dependent parameters with general upward course



was calculated for parameters CCVHF (negative) and VLF/HF (positive) in the supine position and for CCVHF (negative) in standing. Dependence of the parameters on age is more significant in the supine than in the standing position (an exception being the two parameters in the LF power component). By virtue of the prevailing course of dependency on age, the parameters were divided into two groups. The parameters decreasing with age were included into the first group (P_T, CCVHF, and PHF, % HF in supine and in standing, and CCVLF, P_{LF} in standing). Parameters increasing with the age were included into the second group (%VLF, %LF in supine, ratio VLF/LF, VLF/HF, LF/HF in supine, and ratio LF/HF in standing).

We defined four types of course dependence of parameters on age (Fig. 4, 5):

1. Parameters in the lower age-intervals decreased and in the higher age-intervals did not change significantly (CCVHF, P_{HF} in supine and standing, P_T in supine, %HF in standing).
2. Parameters in the lower age intervals increased and in the higher decreased (an all-round decrease) (CCVLF, P_{LF}, P_T in standing).
3. An all-round descending trend (only in one parameter it was not possible to find the "break point") (L %HF).
4. Parameters in the lower age-intervals increased and in the higher age-intervals did not exhibit significant changes (% VLF, % LF in supine and ratio VLF/HF, VLF/LF, LF/HF in supine, ratio LF/HF in standing).

TABLE 3
Basic characteristics of the parameters

	Lying (position)					Standing (position)				
Parameter	D	$\bar{x}$	SD	r	α	D	$\bar{x}$	SD	r	α
P_T	Ln	7.46	1.03	–0.3731	***	Ln	6.97	0.86	–0.2905	***
P_{VLF}	Ln	5.39	1.14	0.0785	NS	Ln	5.24	1.00	–0.0498	NS
P_{LF}	Ln	6.08	1.14	–0.1312	NS	Ln	6.35	1.01	–0.2886	***
P_{HF}	Ln	6.60	1.34	–0.4593	***	Ln	5.01	1.12	–0.3456	***
CCVVLF	Ln	0.39	0.54	0.0784	NS	Ln	0.57	0.46	–0.1619	*
CCVLF	Ln	0.74	0.56	–0.1373	*	Ln	1.13	0.49	–0.3958	***
CCVHF	Ln	1.00	0.62	–0.4994	***	Ln	0.45	0.55	–0.4466	***
% VLF	Ln	2.54	1.03	0.4606	***		23.69	16.21	0.2475	***
% LF		32.43	18.91	0.2178	**		57.88	18.87	–0.1183	NS
% HF	Ln	3.74	0.58	–0.4017	***	Ln	2.64	0.75	–0.1847	**
f VLF	Ln	3.14	0.36	–0.0001	NS	Ln	3.27	0.27	–0.1057	NS
f LF	Ln	4.48	0.32	–0.0188	NS	Ln	4.45	0.22	–0.0860	NS
f HF	Ln	5.47	0.30	–0.2282	***		195.97	56.89	0.1432	*
VLF/HF	Ln	–1.21	1.43	0.4934	***	Ln	0.24	1.24	0.2705	***
LF/HF	Ln	–0.51	1.29	0.3616	***	Ln	1.35	1.00	0.0934	NS
VLF/LF	Ln	–0.69	1.10	0.2196	**	Ln	–1.10	1.12	0.2149	**

D – type of a mathematical transformation
r – correlation coefficient between parameters of SA HRV and age
α – statistic significance (NS – $p > 0.05$, * – $p < 0.05$, ** – $p < 0.01$, *** – $p < 0.001$)
P – spectral power
T – total
VLF – very low frequency
LF – low frequency
HF – high frequency
f – frequency
CCV – ratio of square root spectral power of separate components to the mean values of R-R intervals expressed by coefficients CCVVLF, CCVLF and CCVHF (Hayano et al. 1991)

TABLE 4
Parameters with concurrent course and concurrent break-point

Group	Parameters
F1	L CCVHF, L P_T, L P_{HF}
F2	S CCVLF, S P_T, S P_{LF}
F3	S CCVHF, S P_{HF}, S %HF,
F4	L LF/HF, L %LF
F5	L VLF/HF, L VLF/LF, L %VLF

On the basis of common DAD (differences between break points were minimal), we were able to differentiate 5 subgroups for the parameters (TABLE 4, 5). In the first subgroup (F1) were incorporated P_T, CCVHF and P_{HF} in the supine. For this subgroup, the break point was calculated between 45 and 48 years. In the second subgroup (F2) (P_T, CCVLF a P_{LF} in standing), the break point was between 23 and 25 years and in the third subgroup (F3) (CCVHF, P_{HF} a % HF in standing) again between 45 and 48 years. All the presented parameters show an all-round descending DAD trend. Parameters incorporated into F1 were more age-dependent, with a steeper decline in DAD than the parameters in subgroup F3.

The parameters with an all-round ascending DAD identified two subgroups. In the first (F4) (LF/HF and % LF in supine), the break point was between 35 and 37 years, whereas in the second (F5) (VLF/HF, VLF/LF and % VLF in supine) it was between 48 and 50 years (TABLE 4, 5).

TABLE 5
Regression equation of dependency of parameters and age

Parametr	F	Int.	Age	$\overline{x}$	SD	A	B	CC	α
Parameters with descendent course of age-dependency									
in supine									
L CCVHF	F1	< 50	46.7	1.043	0.623	1.962	–0.03	–0.54	***
L CCVHF	F1	> 42.5		0.62	0.541	0.365	0.005	–0.07	NS
L %HF				3.742	0.577	4.312	–0.02	–0.4	***
in standing									
S CCVLF	F2	< 25	23.8	1.345	0.497	0.711	0.035	0.26	*
S CCVLF	F2	> 30		1.035	0.47	2.138	–0.02	–0.5	***
SCCVHF	F3	< 47.5	47.1	0.525	0.51	1.099	–0.02	–0.41	***
S CCVHF	F3	> 42.5		0.174	0.536	0.784	–0.01	–0.17	NS
Parameters with ascendant course of age-dependency									
in supine									
L LF/HF	F4	< 37.5	36.4	–0.88	1.434	–2.31	0.061	0.31	**
L LF/HF	F4	> 32		–0.08	0.983	–0.19	0.003	0.03	NS
L VLF/HF	F5	< 42.5	49.3	–1.65	1.401	–3.14	0.056	0.37	***
L VLF/HF	F5	> 40		–0.4	1.09	–0.76	0.007	0.05	NS
in standing									
S LF/HF		< 37.5	30.8	1.307	0.974	0.394	0.039	0.29	**
S LF/HF		> 37.5		1.407	1.033	1.911	–0.01	–0.08	NS

F – group of the parameters
Int. – age interval of the relevance of the equation
Age – calculated marginal age (beak-point)
A,B – coefficients of regression
CC – correlation of the parameter and age in given interval of age
α – statistic significance

The remaining two parameters had different DAD and it was not possible to incorporate these parameters with the others: % HF in supine decreased with age (uniformly) and it was not possible to find any break point. The ratio LF/HF, on the contrary, rose in the standing position after approximately the 31th year mark, later the value did not show any significant differences (TABLE 5).

The DAD was much steeper in the ascending part than in the descending. The parameter % HF had the least steep DAD. Its value decreased all-round. On the contrary, most changes were detected for parameters included in F5. Its value increased after 50 years. Relatively large increases in values were detected in parameters F4 (between 15 and 35 till 37 years) and in parameters F2 (between 15 and till 25 years). In the latter, the value showed a slow decrease after the referred age.

We did not detect any significant deceleration in the DAD decrease between the ages of 40 and 50 years in the three parameters with an all-round descendant course incorporated into F2 and in L % HF. In F2 (incorporating LF and P_T in standing), the largest values were not at the very outset of the monitored age as was the case in other parameters with decreased DAD, instead they were at immediately before the 25th year.

In parameters with an all-round ascending DAD, we found the age (breakpoint), where an ascendant course alternated with an age-independent course, to be around 50 years (parameters in F5), or 15 to 20 years earlier (parameters F4 and S LF/HF). In parameters with a longer ascend, incorporated in F5, the age dependency was expressively closer than in parameters with a shorter ascend. F5 incorporated parameters monitored in the supine, related to the VLF component, which in turn was related to other components. F4 with break point at a lower age incorporated parameters related to the LF component measured in the supine and further related to other components and LF/HF.

DISCUSSION

From our study it follows that the SAHRV parameters can be age-dependent relatively for a short time, culminating from the unequal trend of DAD. This fact can be masked by age-independence in other intervals, when the entire age spectrum is evaluated. In our research it was detected in the LF/HF in standing parameters in the process of evaluation of relationship between its value and age. The relationship was not significant within the entire age spectrum ($r = 0.093$). Monitoring of DAD by analysis of variance have shown that values of parameter increased significantly with age up to thirty years. It is generally accepted, that high frequency component HF is marker of vagal activity, which decreases with age (Malik & Camm, 1995; Piccirillo et al., 1995; Schwarz et al., 1991; Stejskal & Salinger, 1996). The power of LF component, which is often regarded as marker of sympathetic activity, also decreased significantly with age in the supine position (Kamath et al., 1993; Malliani et al., 1991; Piccirillo et al., 1995). It is probable that the component is not affected only by sympathetic activity, but also by the level of vagal activity (Akselrod et al., 1981; Malik et al., 1991; Schwarz et al., 1991; Stejskal et al., 1996). Vagal activity increased with age more significantly than sympathetic activity (Korkushko et al., 1991; Lipsitz et al., 1990; Singer et al., 1995; Ziegler et al., 1992). The ratios for components (VLF/HF, VLF/LF, LF/HF) involved into the parameters described sympatho-vagal balance. Thus the present concept of shift of the S-V balance towards sympathetic activity in the aging process is proved.

It appears that DAD, in some components of HRV, changes in the third to fifth decade of life in the course of aging (Bigger et al., 1995; Korkusko et al., 1991; Shannon et al., 1987; Soeijima et al., 1999; Stein et al., 1997) and that these changes run a progressive course from 40 to 50 years than in later ages. For instance Bigger et al. (1995) found sharp fall in P_T in the fifth decade of life. DAD was less steep in the higher age group. This finding is, to some extent, in accordance with our results, when we state the break-point of P_T in supine to be around the 47th year.

We can, therefore, suppose that the LF component in the standing position, reflecting baroreceptor activity, is more resistant to the negative influence of age (up to the age of 25 years) than to other parts of the HRV spectrum. However, from 25 years onwards, the power of LF component in the standing position decreases more sharply and for longer duration than the power of HF component.

Shannon et al. (1987) found a steeper decrease in the HF component up to 30 years of age. Its values then were stagnant, more expressively in supine than in standing. A linear decrease of LF component was observed more expressively in the standing up to 62 years. This result is in agreement with our finding – the power of LF component in standing slowly decreased from approximately 25 years till the end of the observed age range.

Soeijima et al. (1999) found a significant inverse relationship between age and HRV in the P_T, P_{LF}, and P_{HF}. The individual parameters decreased to a certain age and did not change thereafter; the rate of decrease differed between P_{LF} and P_{HF} – the latter decreased more sharply than the P_{LF}. A is true for our study, the above mentioned parameters decreased with age up to the 40 years. Even if the LF/HF ratio did not show significant decrease with age ($P = 0.23$), its tendency was clearly ascending. Given the fact that the authors evaluated the results from a 24h electrocardiographic monitoring (an RR interval signal was generated by taking a 2 min segment of data) and that the number of subjects fell short (40 male and 40 female ranging in age from 16 to 68 years), the results of their study are very similar and the conclusions congruent in all respects.

It is evident that localization of the break-points of individual components and their derived parameters vary (influence of the position of patient is probably less important). On the basis of the hypothesis that vagal activity decreases with age more than sympathetic activity, we identified two periods of change in human life between 12 to 70 years. The first is roughly between 25 and 40 years; the power of LF component seems to be, up to this age, more resistant against negative influences of age than the power of HF component, and the LF/HF ratio as a % LF increases.

The second period of change was identified between 45 and 50 years where a retarded decrease in HF component (did not stop, the fall was insignificant but more than reduction in other components) both in recumbence and after orthostatic stimulation was ascertained.

We can thus postulate that the sympatho-vagal balance stabilizes from 50 years onwards, when a substitution of the vagal component is less pronounced than in younger age.

The physiological basis of some parameters still demands a satisfactory definition (in particular, the P_{VLF} and P_{VLF} derived parameters, ratio parameters and frequencies of individual components). Therefore, it is important to adopt a cautious approach when using the SA HRV parameters. On the contrary, it is imperative not to entirely ignore the VLF component, because of its presumed significant dependence on age, body position and health changes (Bigger et al., 1995; Ingall et al., 1990; Korkushko et al., 1991; Malik & Camm, 1995; Piccirillo et al., 1995; Schwartz et al., 1991; Shannon et al., 1987; Stejskal & Salinger, 1996). In fact, it appears that inclusion of the VLF component in the interpretable parameters can be of great practical significance. However, one cannot doubt the importance of the search for an acceptable explanation of their physiological basis.

Change in the course of age-dependency of HRV parameters bears considerable significance. It must be

taken into account when files of other ages are compared. It is true for majority of the parameters, especially in young people. The changes are more discrete in subjects older than 50 years. It is evident, that the pronounced changes, which are feasible in the older subjects, are induced by influences other than age alone. This fact is very important in relation to the incidence of diseases, affecting the power of HRV, which is more frequent in older subjects.

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VĚK A SPEKTRÁLNÍ ANALÝZA VARIABILITY SRDEČNÍ FREKVENCE
(Souhrn anglického textu)

Metoda spektrální analýzy variability srdeční frekvence je využívána především pro kvantitativní hodnocení kardiovaskulární regulace. Současné práce jsou směřovány do oblasti rozvoje a zdokonalování interpretačních postupů a praktického klinického využití uvedené metody.

Cílem naší práce bylo postihnout dynamiku změn celkové HRV a jejich jednotlivých ukazatelů v klidu a při posturálním manévru, ke kterým dochází v průběhu lidského života s narůstajícím věkem. Tyto změny se projevují na výsledcích spektrální analýzy (SA) variability srdeční frekvence (HRV) specifickým vlivem na celkový spektrální výkon, i na jeho jednotlivé komponenty. Je přitom zřejmé, že vedle věkem silně ovlivněných ukazatelů jsou některé další ovlivněny méně a část není na věku závislá vůbec. Pokusili jsme se sdružit určité parametry SA HRV na základě stejného průběhu jejich věkové závislosti a pojmenovat jejich společné vztahy. Stanovit, které ze sledovaných parametrů SA HRV jsou závislé na věku vyšetřovaného.

Pro účely standardizace byly zpracovány výsledky krátkodobého záznamu SA HRV (5min intervaly) ve stoji a následujícím lehu 216 zdravých osob ve věku od 12 do 70 let. Pro výpočet SA HRV bylo využito metody Fourierovy rychlé transformace. Naše práce prokázala, že průběh závislosti parametrů na věku není homogenní. Mění se v různých věkových etapách od více, k méně závislému. U některých parametrů nebyla věková závislost prokázána vůbec.

Většina parametrů SA HRV je věkově závislých. Závislost však není ve věku od 12 do 70 let lineární. Její průběh se výrazně mění zpravidla mezi 30 a 50 rokem. U starších osob je již věková závislost parametrů méně významná.

Klíčová slova: věk, variabilita srdeční frekvence, spektrální analýza.

Published semiannually
MK ČR E 12792

Published and printed by Palacký University, Křížkovského 8, 771 47 Olomouc, IČO 61989592
Olomouc 2002

ISSN 1212-1185

INSTRUCTIONS FOR MANUSCRIPT FOR THE ACTA UPO GYMNICA

The magazine Acta Universitatis Palackianae Olomucensis Gymnica is an independent professional magazine. The content of the magazine is focused on presentation of research notifications and theoretical studies connected with the problems of kinanthropology. The Gymnica Editorial Board is looking forward to all manuscripts written on the above subject.

General instructions

The text of the contribution is in English. The contribution is not to exceed a maximum limit of 15 pages (including tables, pictures, summaries and appendices). A summary will be in the Czech language, and by rule 1 page at the most.

The text is to be presented in MS Word editor on a diskette and also as a printout.

All contributions are reviewed anonymously.

Interface of the contribution

Title of the contribution, name(s) of its author(s), workplace, date of handing in the contribution, summary of the text in English, key words.

Text of the contribution

Names of individual chapters are to be written in capital letter from the left margin. References to quoted authors see a brief from the FTK UP publication manual.

Epilogue of the contribution

A reference summary, (see a brief from the FTK UP publication manual), address of the main author, summary including the key words.

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To be written on separate pages. A table is to be marked as TABLE 1 with its name below, write on the left margin above the table (the same applies for appendices). A picture is to be marked as Fig. 1, write from the left above the picture (the same applies for a graph).
All contributions to Acta UPO Gymnica must have been corrected by an English expert before being submitted to us. Please enclose an official confirmation of this correction. If possible we would appreciate the text in the original language.

We look forward to our further cooperation!

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