INDIGENOUS GAMES OF SOUTH AFRICAN CHILDREN: A RATIONALE FOR CATEGORIZATION AND TAXONOMY

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ABSTRACT

In the international area of sport and national educational spheres traditional and/or indigenous games are instrumental in resisting cultural imperialism, developing a national identity and branding national unity. Local research and educational programmes are proliferating and may benefit from scientific inquiry. The aim of this paper is to provide a framework for categorizing indigenous games of South Africa that could be utilized for research and implementation. This paper draws on the National Indigenous Games Research Project of 2001/2002 in which 11 tertiary institutions collaborated. They collected data from 6489 participants through questionnaires, triangulated with focus groups, case studies, observations and visual recordings. The sample is representative of an ethnic, gender, geographic (urban and rural), and socio-economic diversity in all nine provinces of the Republic of South Africa. This paper offers a rationale for an ethno-scientific taxonomy, representing a culturally informed reconstruction of South African children's games as microcosm of their lived experiences.

Key words: Indigenous games; Traditional sport; South Africa; Taxonomy.

INTRODUCTION

Sporting traditions offer a metaphor for constructing and affirming a sense of national identity and an imagined community. High profile festivals (Forsyth, 2002), blocking the spread of imperialist games (McKay, 2001) and showcasing 'indigenous' culture and athletes (Gardiner, 2003) are some mechanisms of steering the discourse of national identity development through physical culture and sport.

Various African countries are launching educational programmes and structures instituting traditional sports and indigenous games for various ideological and socio-political objectives (Kentel, 2003). These games can be used as a strategy to advocate and invest in the notion of 'nation-building' whereby diversity is celebrated, multiculturalism fostered and intercultural sensitivity promoted (DeSensi, 1995). This paper aims to provide a scientific base for categorizing such indigenous games that may serve as a framework for documenting games for educational and research purposes.

LITERATURE STUDY

The Field of Study

The study of play and games in the 21st century poses conceptual and classification challenges as it did to the play theorists such as Huizinga (1950), Callois (2001), Schwartzman (1978), Avedon and Sutton-Smith (1979), Cheska (1981; 1987) and Van Mele and Renson (1990). An understanding of play-related behaviour and games as a subject worthy of scholarly investigation, dates back for more than a century to the anthropological contributions of Sir Edward Burnett Tylor and Stewart Cullin (Blanchard, 1995). Research on play, games and traditional sport was proliferated since the seventies, often guided by the paradigmatic framework and perceived value of scientists that impacted on the conceptual framework. Utilizing insights from diverse disciplines and practices, play theorists (Cheska, 1987; Van Mele & Renson, 1990; Callois, 2001) meaningfully contributed to the development of a comparative framework for documentation, analysis and classification of play-related behaviour.

From an evolutionary perspective, there seems to be evidence of a developmental and hierarchical relation, but this relationship lies as much in the mode of performing these activities, as in the structuring thereof. There seems to be a progression from a self-structured activity done for its own sake (play), an activity directed by rules (games) to an activity that is an instrumental event and essentially officiated or judged (sport) (Schwartzman, 1983). The structural and semantic qualifications inherent in the different play-related phenomena, necessitate differential treatment within a framework for analysis and classification (Harris & Park, 1983). The play-sport continuum as adapted from Guttmann (1978) and integrated with Callois' categorization (2001) serves as a heuristic tool to distinguish between the structural aspects and semantic qualifications of these phenomena (see Figure 1).
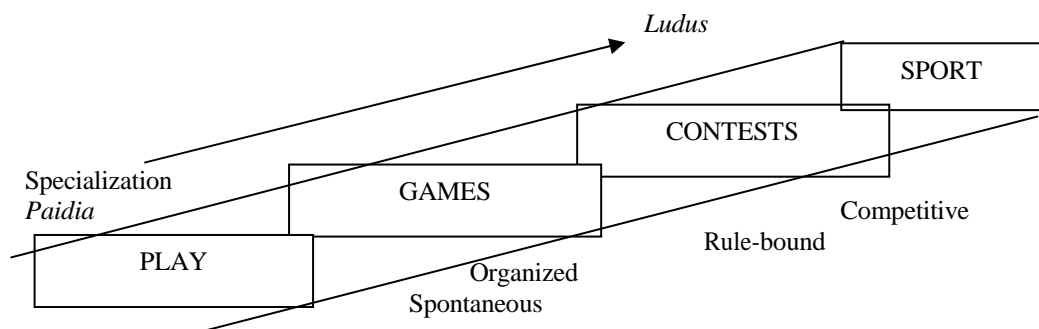

FIGURE 1: **PLAY-SPORT CONTINUUM ADAPTED FROM GUTTMANN (1978) AND CALLOIS (2001)**

Despite the distinct characteristics of the different play-related phenomena, the boundaries become less clear in real-life settings (Guttmann, 1978). A dichotomy is apparent when play

content is taken as the frame of reference for classification. At the conceptual level, the practice of play meets certain observable criteria but on the attitudinal level, an activity may

thus be considered as being 'play', 'game' or 'sport' where the intention of the player ('emic' or insider's approach) and context of the activity, predominantly determine the categorization of the activity (Harris & Park, 1983; Meier, 1988). The scholarly explanation and analysis of play and games should thus take cognizance of the "significant cultural dimension" (Blanchard, 1995: 40).

Van Mele and Renson (1990) distinguish between traditional and modern sport forms as the former are recreational activities with local and cultural dimensions, having roots in traditional life of people, and are distinguishable from later adaptations as being "contemporary traditional games". The 'traditional' label represents a time dimension of being preserved and transmitted from one generation to the next among a particular group (Van der Merwe, 1999). In this sense, traditional games communicate localized ethnic and socio-cultural identity of earlier times (Hirth, 1991).

Indigenous Games

For the National Indigenous Games Research Project completed in 2002 on which this paper is based, the rationale for identifying 'indigenous games' within the South African context articulated with the focus area of Indigenous Knowledge Systems identified by the National Research Foundation. It refers to the knowledge base that reflects the circumstances, traditions and cultures of the various population groups and communities in the South African context which have been identified by the people as being part of their cultural heritage (Corlett & Mokgwathi, 1986).

In this sense, the Afro-centric nature of knowledge and games form an integral part of the Nguni, Sotho and Venda-speaking peoples as they had originally migrated from the central lakes of Africa, and settled in the southernmost end of Africa during the 12th century (Schapera, 1966). In the same way, a more Euro-centric and Oriental knowledge base is reflected by the Afrikaans- and English-speaking populations which include people from European, Asian and Indian descent (Stow, 1905; Bailey, 1991). Another pool of indigenous knowledge and games is derived from the traditional life and livelihood of the Bushmen and Coloured races (Afrikaans and English-speakers), also known as the Khoisan, (collectively referring to the San or Bushmen, and the Khoi or Hottentots) (Van der Merwe, 1999).

Over the years, indigenous games research in South Africa has received sporadically *ad hoc* attention without any inclusive, co-operative and systematic effort to compile a representative inventory of traditional play patterns, adequate historical and social-cultural contextualization and interpretation. Depending on access and research interests, the majority of attention has come from anthropological writings, describing the physical culture and games of the Khoisan (Van der Merwe & Salter, 1990), the Coloureds (Van der Merwe, 1997), the Ndebele (Van Warmelo, 1930); the Xhosa (Van der Merwe & Bressan, 1995); the Pedi (Pitje, 1950); the South Sotho (Casalis, 1930); the Tswana (Corlett & Mokgwathi, 1986); the Venda (Blacking, 1967) and the Whites (De Jongh, 1984).

The traditional sports and games include play activities that are structured, having rules, a pattern of organization and that range from sport forms such as *Jukskei* and *Morabaraba* that

have been institutionalized to more informal games such as the many variations of chasing games. As culture is never static, emerging play patterns and games develop through acculturative influences such as cultural exchange in schools and the western-based sport (Van

Mele & Renson, 1990). The acculturation process most common to play and games is known as syncretism which refers to a process by which ideas from one culture are adopted by another so that what ultimately evolves, are actually novel ideas and manifestations (Blanchard, 1995).

The adaptation and creation of local content reflecting indigenous ideas, are evident in the many variations of games such as *Hopscotch* and *Hide-and-seek*. These games were identified (from an 'emic' or insider's perspective) as traditional or indigenous ('belonging to us'), having been passed on from older generations or created locally. Modern forms of sports such as karate, netball or football were thus excluded, but indigenous adaptations such as *Kitchen* (based on soccer skills) and *Spider* (based on netball skills) were collected as products of syncretism reflecting eminent cultural content and meaning.

The classification of games

Classification systems, typologies and taxonomies of play and games have inevitably served the function of constructing some categorical structure informed by the focus of study and assumptions of underlying theoretical perspectives and academic disciplines. The classification became the text within the context of theory, interpretation and practice (Goldstein, 1979).

Within the field of biology and psychology, the focus tapped into a phenomenological approach and psychological dynamics inherent in the universal stages of growth, whereas social scientists developed game-related theories with mathematical sanctification in the traditional games of chance and strategy (Avedon & Sutton-Smith, 1979). Play and games were treated as integrated phenomena and categorized in terms of the instrumental value and contribution to implementation and practice.

Following a pedagogical rationale for the classification of children's recreational games in the first half of the twentieth century, Piaget and Chateau followed a developmental rationale compatible with the developmental phases of childhood, by categorizing games from simple (not having rules) to complex (rule-bound) (in Callois, 2001). The didactical paradigm also draws on the ecological taxonomies of play and focuses on the identification of those features of the activity, independent of the individual who represents the person-environment relationship such as cooperative play versus the interactive play which can be applied to a developmental framework for identification and implementation (Levy, 1978).

A major thrust for the development of fundamental and universal categories relevant for cross-cultural research, came from Callois (2001) who proposed four broad categories for the classification of games, namely competitive games (*Agôn*), games of chance (*Alea*), simulation games (*Mimicry*) and games that are based on the pursuit of vertigo (*Ilinx*). Within each of these categories, he placed the games along a continuum from *Paidia* (spontaneous play) to *Ludus*, representing an increase in the elements of discipline, rules, skill, problem solving, conventionality and institutionalisation (Harris & Park, 1983). This concept has also been applied to the game-sport continuum.

Classification parameters for cross-cultural analysis were further developed through anthropological frameworks, despite the earlier attempts of folklorists to document, classify, analyse and explain the cultural dimensions of traditional games (Opie & Opie, 1959; Avedon & Sutton-Smith, 1979). Redl *et al.* (1979) developed 30 such categories to represent the

'dimensions of games'. Classifying games according to the structural elements thereof, seems to be the dominant framework of researchers from diverse theoretical or practical backgrounds, as well as for cross-cultural research frameworks.

Cheska (1987) developed a typology of games based on their structural characteristics which deductively informed several studies which set out to contributed to the preservation of ludodiversity (Goslin & Goslin, 2002), or contribute to the existing body of knowledge by classifying games according to the 'basic idea of the game' (De Jongh, 1984), or the movement content (Saayman & Van Niekerk, 1996).

In search of a cross-cultural classification model for the classification of traditional games, local researchers (Van der Merwe & Bressan, 1995) 'tested' the applicability of the seven-category classification system of Cheska for the organization of information about the traditional games of the Xhosa of South Africa, by utilizing documented sources. This type of deductive research posed rather grave methodological (an analysis of eleven historical documentations of Xhosa games) and epistemological deficiencies (lack of socio-cultural context) and did not make a convincing case for the possible adoption of an external framework for a universal game classification.

The mere utilization of structural elements for classifying games, often results in vague and unclear categories such as 'games without rules' (Saayman & Van Niekerk, 1996), 'small games' (De Jongh, 1984) or 'warfare skills related games' versus 'non-warfare skills related games' (Wanderi, 1999), and 'manipulative and guessing games' as a separate category (Kirchner, 1991). Classifying games according to the educational values (Utuh, 1999), play formation and logistical parameters (Malan, 1973), the setting or place of play (Taljard, 1969), or play objects such as 'dice' or 'dominoes' (Bailey, 1991), presented similar deficiencies. Scheerder (1996) provides an annotated bibliography of traditional games and competition games in Africa, utilizing the framework of the play-sport continuum, yet without critical reflection on the paradigms utilized by the summarized studies.

The majority of studies however could be identified as ethno-historical as they attempted to document play behaviour within a given cultural and historical context. These types of folkloristic accounts provide broad cultural or folk characteristics identifiable in the functional (traditional) and non-functional (western play forms) (Van der Merwe & Salter, 1990). The view of acculturative forms of play behaviour and games as being 'non-functional', typifies a relatively narrow focus of functionality in terms of a traditional society, and demystifies the cultural dynamics and adaptations over time (Lowenfeld, 1991).

Inductive studies such as the collecting and mapping out of traditional or indigenous games in South America within a phenomenological and cultural framework, can be considered as a prolegomenon to a more systematic and encompassing inventory of traditional games within a given cultural-geographical area (Van Mele & Renson, 1990). The manifested (recognized by the cultural bearers) and latent (identified within the context of play) functions of indigenous games can only be analysed within the cultural context of their manifestations.

Moving toward a post-modernist rationale where indigenous games are viewed as part of the social fabric and lived experiences of a given collective, categories of games will reflect the customs and values (physical, educational and social) contained with them. Within this type of 'emic' framework, Masiea (1973) who analyzed the traditional games of Basotho children, developed nine culturally meaningful categories. Roberts and Enerstveldt (1986) developed a

similar ethno-graphic framework by the multidimensional scaling of the play activities of Norwegian boys and girls. The labels of the various clusters and dimensions identified and categorized by the children, represent the ethnographic approach of the authors, yet could be developed in terms of eliciting category labels from the children. The classification of indigenous games by South African children represents such a development. The construction of an 'emic' paradigm and taxonomy represents an ethno-scientific endeavour in theory and method that reflects the cognitive domains of South African children as they give meaning to their play and game experiences perceived as 'their own' (indigenous).

RESEARCH OBJECTIVE

In accordance with political goals, and six years after the 1994 democratic elections in South Africa, the National Research Foundation established a research programme to support and promote research in the Indigenous Knowledge Systems (IKS) in South Africa. In response to this programme, academics from the Rand Afrikaans University (since 2005 known as the University of Johannesburg), and Stellenbosch University recruited senior researchers from 11 Human Movement Studies or related departments at tertiary institutions in South Africa. The research was to be exploratory in nature, being informed by diverse anthropological and sociological paradigms, ranging from the broad structural approaches to interpretive frameworks (Burnett-Van Tonder & Fischer, 1989).

METHODOLOGY

A workshop was held for all senior researchers from the 11 participating institutions prior to the data-collection phase of the research. A comprehensive manual was developed and utilized for training and discussions to standardize the procedures, sampling, data-collection, interpretation and report writing. The traditional heritage and indigenous games were traced by utilizing questionnaires, interviews, observations, case studies and visual documentation (photos and video recordings) among grade seven pupils, adults and senior citizens in different communities (see sampling).

After initial pilot studies by senior researchers, quantitative data was collected through the completion of questionnaires by a representative sample of grade seven learners and senior citizens. The respondents were randomly selected with prior allocation of participants from different cultural, language and/or population groups. Depending on the language proficiency and level of literacy, senior researchers made some adaptations to the questionnaire, offered assistance to respondents and in some cases, the complete questionnaire was translated in the local vernacular. The questionnaire was adapted from the one used by De Jongh (1984) and requested the respondent to identify all indigenous games known to him/her, who the main players were, localities where games were played, social agents, seasonal patterns and special events where specific games were played.

Researchers from the different tertiary institutions had to obtain ethical clearance from their own institution. Participation was voluntary and principals of schools were approached well in advance to obtain permission for children's participation. In turn, the principals accepted the responsibility to ensure permission from the parents or guardians of children who volunteered to participate in the research.

Qualitative data provided rich contextual information and was collected through structured

interviews (case studies of senior citizens), focus groups and observations of play activities. Visual and tape recordings assisted in the capturing of songs, physical skills, strategies and play patterns. Once the qualitative data had been collected, it was transcribed, coded and classified. The different methods of data collection ensured the validity and reliability of the data. Triangulation was thus achieved by utilizing different methods and different researchers in the data-collecting process.

For the classification of games by the participants, the researchers followed the procedure of first writing down the names of all the games provided by the participants in completing the questionnaire. The next step was to add the names of these games to the ones given by the participants who were interviewed (case studies) and participated in the focus group. Games that children played during school breaks were observed and added to complete the list. Lastly, games that were collected from literature sources were explained to the children, and if they were familiar with the game or a variation thereof, these games were also included.

Once the list of indigenous games was completed, some participants were added to the focus group so as to ensure adequate and informed representation within the group. The games provided by the participants were numbered, and the participants were requested to group games by: 'calling out the numbers of games that belong together'. Once the categories were sorted out and consensus was reached, the participants provided reasons for their categorization and suggested descriptive terms that would offer a rationale for a particular category.

SAMPLE

De Jongh (1984) reported that grade seven learners are the most reliable informants when it comes to reporting about play patterns and games as they could not only better explain the games compared to younger children, but they are in their last year of primary schooling after which there seems to be a sharp decline in frequency of their play activities. The selection of senior citizens is a cross-sectional representation of age categories, as they could provide valuable information on traditional play patterns and games. The senior citizens could reflect on traditional play forms, rules and provided contextual information on older forms of physical culture.

Due to geographical ethnic representation of the research, a target was set for each tertiary institution to conduct research in at least two urban and three rural communities, representing the major ethnic and/or language groups within a region. Limited funding impacted on selection of rural communities as most researchers chose communities within a 100-metre radius from their institutions. Some institutions covered a wider area to ensure geographical representation. Two researchers visited an urban and two rural communities in the Northern Cape Province to ensure their inclusion as there is no tertiary institution offering courses in

human movement sciences in that province. In total, approximately 17 863 kilometres were covered to gather research information in all the nine provinces.

Although guidelines were provided to all institutions to select a representative geographical spread in terms of community locality, a total 170 communities (89 urban and 81 rural) eventually took part in the research, representing all four major population and eleven language groups in the nine provinces of South Africa.

The research targeted the grade seven learners (between ages 11 and 13) and senior citizens (above 60 years of age) to complete questionnaires, participate in focus groups and demonstrate games for visual recordings. Three thousand four hundred and one (3 401) grade seven learners completed questionnaires and an additional two thousand and sixty (2 060) also took part in focus group sessions. Data was also gathered from one thousand and twenty eight (1 028) senior citizens who completed questionnaires, participated in focus groups sessions and/or were interviewed as case studies to provide the context and content of traditional play patterns and games.

The 'ethnic' representation of the sample (N=6 489) also reflects the representation of the language groups, as the 'Black population' (30%) indicated an African language as their first language, the 'White' (38%), and 'Coloured' (30%) population groups were more or less equally represented by Afrikaans and English speakers, whereas the Indian population group indicated English as their language of communication.

RESULTS

A total of 536 indigenous games were collected although a relatively large number of the games seemed to be variations of similar games. There were 37 variations of *Rope jumping,* 18 variations of *Hide-and-seek* and 13 of *Hop scotch* alone. Participants also utilized different frameworks for classifying the games, although the differences exist mainly along the lines of age, rather than any other denominator. Senior citizens mainly utilized 'place' (indoors versus outdoors), 'context' (hunting or different social gatherings), 'intention' (lover's games) or 'apparatus' (ball games) for category labels. Differences between the categorization of games based on race and environment were mainly in the presence of more subcategories among the White and Coloured children from urban areas, as opposed to their Indian, black and rural counterparts. Children mainly differentiated between physical, imitative and mind games, and added psychologically informed sub-categories of 'challenge', 'strategy' and 'interaction', as well as qualifying the movement content in terms of a 'rhythm and singing' category of games. The categories and sub-categories are presented in the following taxonomy (see Figure 2).
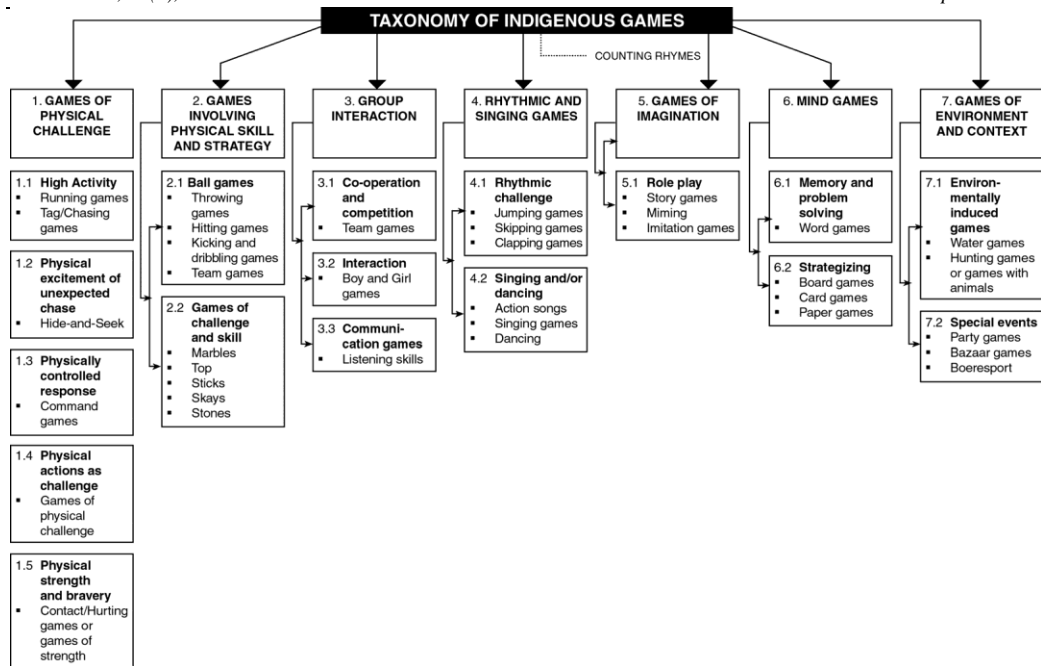
FIGURE 2: **INDIGENOUS GAMES TAXONOMY**

The lived experiences of children's play are represented in the construction or intention of the act of playing, as well as the identified 'nature' of a game. The 'games of physical challenge' utilize the intensity of the activity ('high', such as tag games), a controlled ('command', such as *K.I.N.G. spells King*) and uncontrolled ('excitement and unexpected chase', such as *Blikkies aspaai* or *Hide-and-seek*) response, skill level ('challenge', such as *Fly*) and physical strength ('strength and bravery', such as *Sting ball*) as psychological and physical-related qualifying labels. The second major category and sub-categories indicate an integration and application of physical skills and challenges with game strategy in games where apparatus is handled, such as in identifiable skills in 'ball games' or where a combination of physical skills is utilized in 'team games'. 'Games of challenge and skill' in this sense, refer to games in which children find a challenge in improving their own skill (*Marbles, Top, Five stones* or *Diketo*) or compete against others ('challenging others', such as stick fighting). A progression in terms of 'interaction' in the first sub-category ('games of group interaction', such as *Dibeke*) is identified. This reflects an increase structure and rule application that Callois (2001) describes as *udus*. Competitive team games require intra-team 'co-operation' and inter-team 'competition'. Other sub-categories of 'group interaction games' refer mainly to the interaction between boys and girls in games such as *Touch-and-kiss*. The main aim or experience of this type of chase is not the physical challenge, but the chase and tag of a player of the opposite sex to be 'rewarded with a kiss'.

The fourth category of games relates to the rhythmic structure, accompaniment and aesthetically adapted movements within the sub-categories of 'rhythmic challenge' and 'singing or dancing'. In the first sub-category a challenge is posed for players to follow a certain rhythmic pattern such as in jumping games like *Kgati, Ugqaph* or *Huis-paleis*. In the

second sub-category all players may join in the singing, whilst some or all of them may 'dance

to the accompaniment', mostly to 'act out the words of the song' such as *Top seven* or *Sila sila mielie meel*. Language and cultural content form an integral part of this category, and ethnic-related content is expressed as part of the legacy of segregated living and socialization. The lyrics of the songs are mostly in the mother tongue and convey different experiences, circumstances and values in song and action.

Children identify '<u>games of imagination</u>' as those games in which role-play in terms of acting out a story, miming or imitating different characters are prominent. The creation of a different and purposeful 'new reality' either in terms of fantasy (such as the game *Wolfy, Wolfy* (where the 'Wolf' tries to 'steal the children from the Mother'), or in games in which the behaviour of adults are imitated or mocked (as in the game of *House-house* or *School-school*).

Children also differentiate between 'physical games' and '<u>mind games</u>' (sixth category) in which the memory and problem solving as cognitive skills play a prominent role. Strategizing as another problem solving strategy is evident in 'board', 'card' and 'paper' games. The participants did not perceive an element of chance or luck to determine the outcome of these games such as *Meule* or *Morabaraba*, and thus did not offer such a concept as a possible label or descriptor of this category.

The seventh category identified by the participants allows for the grouping of <u>games</u> that are mainly determined by a form of <u>interaction with the 'environment'</u> ('hunting games') or '<u>context</u>' ('party games' or 'boeresport' such as a three-legged race). The latter sub-category refers to the more traditional games of the Afrikaans-speaking white population group that have over the years become part and parcel of public gatherings or social events such as New Year celebrations or folk festivals.

Counting rhymes are perceived as a 'count-out activity' and serve the purpose of being democratic and fair in allocating certain tasks or roles which are either liked (being the 'Mother' or 'King' who will determine or command the action), or disliked (being 'on' in a *Hide-and-seek* game). It is not perceived as an independent game, neither is it utilized when the group is relatively big or the time for playing is limited.

The categorization scheme represents the collective perceptions, meaning and value ascribed by the participants to the wide spectrum of indigenous games or play activities they have identified as 'belonging to us'. It represents the 'emic' and self-constructed representation and rationale of indigenous games and culturally informed representative categories.

The construction of this taxonomy reflects mainly the biological and psychological orientation of players which is linked to the aim, intention or perceived nature of the game. The only category falling outside this paradigm seems to be the more traditional or environmentally determined games where the medium (water), functionality or survival (hunting) or special occasions (a party, a bazaar or traditional sports day) either bears witness of the particular context, or cultural content.

CONCLUSION

Inductive and empirical research underpinned by multi-disciplinary perspectives not only contribute to the existing body of knowledge on indigenous game research in methodology and epistemology, but offer some insight into the cognitive and cultural dimensions of this phenomenon. This research explores the ethno-scientific construction of a taxonomy of

indigenous games based on the experiences and perceptions of players within the South African context. The identification and rationale of the cultural-informed content and perceived intent or lived experience of indigenous games as products of residue ('traditional') and eminent ('indigenous') culture, are multi-layered. At one level it offers a psycho-biological and perceptual awareness of the manifested function and structural components of a game, and at another level it represents the shared values and collective culturally-informed perceptions offered as descriptive labels of game categories ('context').

This paper reflects on the research trends concerning the research and dissemination of results of play, indigenous games or traditional sport. From identifying patterns of cultural diffusion, socialization or educational parameters, traditional games have lately emerged as a vehicle for socializing participants into developing a collective identity and consciousness of a cultural heritage. Future research may thus as in this case, revisit some of the earlier academic enquiries to address the gaps in the existing knowledge base, or it may pragmatically contribute to the understanding and promotion of inter-cultural analysis.

REFERENCES

AVEDON, E.M. & SUTTON-SMITH, B. (Eds.) (1979). *The study of games. A source book*. Huntington, NY: Robert E. Krieger.

BAILEY, A. (1991). *Kaapse binneshuise speletjies 1652-1806* (trans. *Indoor games of the Cape 1652-1806*). Research by the National Cultural History Museum, Volume 2, No 2, Pretoria: National Cultural History Museum.

BLACKING, J. (1967). *Venda children's songs*. Johannesburg: Witwatersrand University Press.

BLANCHARD, K. (1995). *The anthropology of sport. An introduction*. London: Bergin and Garvey.

BURNETT-VAN TONDER, C. & FISCHER, A. (1989). Spel, navorsing en menseverhoudinge: Op soek na 'n vrugbare paradigma (trans. Games, research and human relations: Investigating a meaningful paradigm), *South African Journal for Research in Sport, Physical Education and Recreation Social Sciences,* 12(2): 103-115.

CALLOIS, R. (2001). *Man, play and games*. New York, NY: Free Press.

CASALIS, E. (1930). *Les Bassoutos.* Paris: Nouvelles Editions.

CHESKA, A.T. (1978). The study of play from five anthropological perspectives. In M.A. Salter (Ed.), *Play*: *Anthropological perspectives* (17-29). New York, NY: Leisure Press.

CHESKA, A.T. (Ed.) (1981). *Play as context*. West Point, NY: Leisure Press.

CHESKA, A.T. (1987). *Traditional games and dances in West African nations*. Schorndorf: Verlag Karl Hofmann.

CORLETT, J.T. & MOKGWATHI, M.M. (1986). Play, games and sports preferences of Tswana children. In J.A. Mangan & R.B. Small (Eds.), *Sport, culture, society: International historical and sociological perspectives*. *Proceedings of the Commonwealth and International Conference on Sport, Physical Education, Dance, Recreation and Health* (253-261). London: E and FN SPON.

DE JONGH, J.H. (1984). Kleinspele onder die blanke bevolking van die Suidwes-Kaap (trans. Minor games among the white population of the South Western Cape). Unpublished thesis for the M. degree in Physical Education. Stellenbosch: Stellenbosch University.

DESENSI, J.T. (1995). Understanding multiculturalism and valuing diversity: a theoretical perspective. *Quest*, 47: 34-43.

FORSYTH, J. (2002). Strong, proud and true – the 2002 North American indigenous games. *The Newsletter of Athletes, Canada (Toronto)*, 9(1): 10-13.

GARDINER, G. (2003). Running for country: Australian print media representation of indigenous

athletes in the 27th Olympiad. *Journal of Sport and Social Issues,* 27(3): 233-260.

GOLDSTEIN, K.S. (1979). Strategy in counting out: An ethnographic folklore field study. In E.M. Avedon & B. Sutton-Smith (Eds.), *The study of games. A source book* (167-178). Huntington, NY: Robert E. Krieger.

GOSLIN, A. & GOSLIN, B. (2002). Traditional games in the Tshwane area of South Africa: A comparative study. *African Journal for Physical, Health Education*, 8(2): 373-391.

GUTTMANN, A. (1978). *From ritual to record*. New York, NY: Columbia University Press.

HARRIS, J.C. & PARK, J. (Eds.) (1983). *Play, games and sports in cultural contexts*. Champaign, IL: Human Kinetics.

HIRTH, M. (1991). West Africa, games, sport and tradition, *Olympic Review,* 283(May): 214-219.

HUIZINGA, J. (1950). *Homo Ludens*. Boston, MA: Beacon Press.

KENTEL, J.A. (2003). Movement, the lost literacy: what Kenyan children can teach us about active play. *Physical and Health Education Journal,* 69(1): 12-17.

KIRCHNER, G. (1991*). Children's games from around the world*. London: WmC. Brown Publishers.

LEVY, J. (1978). *Play behavior*. New York, NY: John Wiley and Sons.

LOWENFELD, M. (1991). *Play in childhood.* Oxford: Blackwell Scientific Publications.

MALAN, C.M. (1973). S*peleversameling* (trans. *Compilation of games*). Potchefstroom: Potchefstroom University for CHE.

MASIEA, J.R. (1973). The traditional games of Basotho children: a fragment of Sotho oral traditions and their significance for the development of a written literature. Unpublished MA thesis. Cape Town: University of Cape Town.

McKAY, A. (2001). Kicking the Buddha's head: India, Tibet and footballing colonialism. *Soccer and Society,* 2(2): 89-104.

MEIER, K.V. (1988). Triad trickery: Playing with sports and games. *Journal of the Philosophy of Sport* XV: 11-30.

OPIE, I. & OPIE, P. (1959). The lore and language of school children. Oxford: Oxford University Press.

PITJE, G.M. (1950). Traditional systems of male education among the Pedi and cognates tribes, Part 1. *African Studies,* 9(2): 53-76.

REDL, F.; GUMP, P. & SUTTON-SMITH, B. (1979). The dimensions of games. In E.M. Avedon & B. Sutton-Smith (Eds.), *The study of games. A source book* (408–418). Huntington, NY: Robert E. Krieger.

ROBERTS, J.M. & ENERSTVELDT, A. (1986). Categorization of play activities by Norwegian children. In B. Mergen (Ed.), *Cultural dimensions of play, games and sport* (5-28). Champaign, IL: Human Kinetics.

SAAYMAN, M. & VAN NIEKERK, T. (1996). *Traditional games of South Africa*. Potchefstroom: Leisure Consultants and Publications.

SCHAPERA, I. (Ed.) (1966). *The Bantu-speaking tribes of South Africa. An ethnographical survey*. Cape Town: Maskew Miller.

SCHEERDER, J. (1996). Geannoteerde bibliografie der traditionale spelen en wedstrijdspelen in Africa (trans. Annotated bibliography of traditional and games for matches in Africa). Unpublished Master's thesis. Leuven: Katholieke Universiteit Leuven.

SCHWARTZMAN, H.B. (1978). *Transformations: The anthropology of children's play*. New York, NY: Plenum.

SCHWARTZMAN, H.B. (1983) Child-structured play. In F.E. Manning (Ed.), *The world of play. Proceedings of the 7th Annual Meeting of the Association of the Anthropological Study of Play* (200-214). West Point, NY: Leisure Press.

STOW, G.W. (Ed.) (1905). *The native races of South Africa*. London: Swan Sonnenschein.

TALJARD, L. (1969). *Speletjies vir almal.* (trans. *Games for everyone*). Pretoria: J.L. van Schaik.

UTUH, M.C. (1999). Traditional games in Nigeria: Ibibio Tribe. In L.O Amusa; A.L. Toriola & I.U. Onyewadume (Eds.), *Physical Education and sport in Africa* (59-76). Ibadan, Nigeria: LAP Publications.

VAN DER MERWE, F.J.G. & SALTER, M.A. (1990). Moontlike veranderinge in die speelpatrone van die Qgû-Boesmans van Suidwes-Afrika/Namibië. (trans. Possible changes in the play patterns of the Qgû-Bushmen of South West Africa/Namibia), *South African Journal for Research in Sport, Physical Education and Recreation Social Sciences,* 13(2): 117-128.

VAN DER MERWE, F.J.G. & BRESSAN, E.S. (1995). Traditional games of the Xhosa of South Africa. *African Journal of Physical Education, Recreation and Dance,* 1(1): 32-46.

VAN DER MERWE, F.J.G. (1997). 'n Verkenning van die vryetydsbesteding onder die Maleise slawe aan die Kaap (trans. An exploration of leisure time activities among the Malay slaves at the Cape), *Suid-Afrikaanse Tydskrif vir Kultuurgeskiedenis,* 11(2): 23-29.

VAN DER MERWE, F.J.G. (1999). Historical perspectives of Physical Education and sports in Southern Africa. In L.O. Amusa; A.L. Toriola & I.U. Onyewadume (Eds.), *Physical Education and Sport in Africa* (1-20). Ibadan, Nigeria: LAP Publications.

VAN MELE, V. & RENSON, R. (1990). *Traditional games in South America.* Schorndorf: ICSSPE Sport Science Studies 4. Schorndorf: Verlag Karl Hofmann.

VAN WARMELO, N.J. (1930). *Transvaal Ndebele texts. Ethnological Publications I.* Pretoria: Department of Native Affairs.

WANDERI, M.P. (1999). Traditional games in Africa: East and Central Africa. In L.O Amusa; A.L. Toriola & I.U. Onyewadume (Eds.), *Physical Education and sport in Africa* (77-83). Ibadan, Nigeria: LAP Publications.

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SENSATION SEEKING, GENDER AND PROGRAMME PREFERENCES IN TELEVISED SPORT

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ABSTRACT

Sport has emerged as one of the major media events of our time of such magnitude that it is no more possible to distinguish between the phenomena of television and sport. The purpose of this study is to determine the relations between sensation seeking, gender and preferences in viewing televised sport. The reason being that the sensation seeking theories can offer media researchers a valuable approach to understanding why and how people use television to create their own excitement and entertainment. The survey methodology was used in this study. The questionnaire included the Sensation Seeking Scale (SSS), which is a standardised psychological test, as well as a questionnaire that categorises a variety of sport in three major groups. Group A consists of violent combative sport, group B of aggressive combative sport and group C consists of non-aggressive stylistic sport. Ninety two (N=92) respondents were randomly selected to complete the Sensation Seeking Scale and to indicate their preferred sport programmes in terms of the three groups that range from extreme combative aggressive to more stylistic and artistic sport programmes. Results in this study indicated a direct relation between high sensation seeking and viewing violent combative sport (Group A). Low sensation seeking viewers also tend to view more stylistic sport on television (Group C). The hypothesis on gender differences was also supported. The male population is more attracted to violent combative sport, while the female population prefers to view more stylistic and artistic sport on television.

Key words: Sensation seeking; Gender; Preferences; Violent combative;
                     Aggressive combative and non-aggressive stylistic sport.

INTRODUCTION

The phenomenon of televised sport has changed radically over the last 50 years. New and cheaper technologies and the subsequent availability of television for all (even satellite television that offers a greater variety of sport programmes), have made watching sport one of the most commonly loved leisure activities in our global society. There has been a major shift from the fifties in broadcasting televised sport as pure information orientated news which had to be reported free of charge, up to a highly commercialised entertainment industry that runs on billions of dollars. The watershed in the paradigm shift in the broadcasting of televised sport came with the 1956 Melbourne Games which sparked an intensive debate on sport reporting as information versus entertainment. The charter concerning the television rights of the International Olympic Committee (IOC) was consequently revised and from that point on the Olympic Games became the exclusive property of the International Olympic Committee. All rights to broadcast the Olympic Games could now be sold to international television

networks. Through this exclusive mandate to sell broadcasting rights to major networks, the IOC generated a new record income of 1.5 Milliard Dollars in Athens compared to the 1.35 Milliard in Sydney 2000 (Weingarten, 2004).

The real consumer in sport is the spectator. When we hear the term "spectator" we immediately think of big stadiums and big crowds shouting and applauding their teams. In scientific terms this first consumer level of sport is known as the primary consumer. The

secondary consumer includes all the sport spectators who watch their favourite sport on television and listen to radio commentary programmes on sport. Tertiary level of sport consumers are those people who read all about their favourite sport in papers and magazines after the sport event (Potgieter, 2003). Although new spectacular stadiums have been erected in the last decade and the attendance of live matches has increased, the phenomenon of the primary consumer itself has not changed significantly. The most radical changes of consumer sport have been on the secondary level of watching sport programmes on television. The Olympic Games as mentioned above can be used as an example to illustrate the magnitude of changes that have taken place in terms of the phenomenon of televised sport, and the exponential effect of the television in our global society can be fully appreciated. During the 2004 Athens Games 300 television networks broadcasted from Athens and a record 35 000 hours of Olympic Games coverage were broadcasted all over the world compared with the 29 600 hours that were reported in Sydney in 2000 and 20 000 in Barcelona in 1992. Even in our own country a record 1 965 hours were broadcasted on the Olympic Games 2004 in Athens (Weingarten, 2004). If this is an indication of the growing demand of television viewers watching sport as their most favourite leisure activity, it is imperative that the psycho-social sciences must come to a deeper understanding of this fascinating phenomenon. This scientific information can also be valuable to the decision makers in the industry of televised sport to target their audiences more effectively.

Sensation seeking can provide some of the answers that explain the rapid developments in the viewing of televised sport. Sensation seeking according to Maslow's theory lies on a very basic physiological level. The antecedence of sensation seeking in a person is probably a combination of a genetic origin and the way the person was raised by the parents (Potgieter, 2003).

Sigmund Freud stated that healthy people are constantly exploring new ways to reduce tension and stress by engaging in activities that create excitement and stimulate the nervous system that will lead to an aroused state (Puretz, 2000). A wide variety of theories that include arousal, sensation seeking, self-efficacy and self-mastery have attempted to scientifically explain the tendencies for people to participate in sport and extreme sport (Skinner, 1992). It is clear from available literature that sensation seeking is an integral part of the field of Sport Psychology and it is also clear that more intensive research is needed in this area to clarify all the scientific constructs that are associated with the fascinating phenomenon of sensation seeking.

According to Zuckerman (1994: 27) sensation seeking can be described as a deep urge and eagerness for "varied, novel, and intense sensations and experiences". These peak experiences can also be described as a rush, a blast or a high. Sensation seeking can also be seen as a psychological trait where the individual seeks out novel experiences and dangers and enjoys the thrill that comes with it (Wann, 1997).

Sensation seeking, according to Zuckerman (1994), is one of the most creative areas in personality research that assisted significantly in the prediction of a wide variety of leisure behaviours that include the media and specifically the viewing of televised sport. Consequently, the primary aim of this study is to look at sensation seeking as it relates to the viewing of certain sport programmes. This study is also an attempt to go beyond the normal demographic analysis and to cut deeper into the true nature of the phenomena that are researched in this study. This more intensive research has become necessary, because television programming has become extremely specialised (Perse, 1996). This research on the

different types of sport is placed on a continuum of violent and aggressive combative sport on the one side to stylistic, artistic and non-aggressive sport on the other side of the continuum. The notion is that while fans are watching their favourite sport on television, they can create their own unique high levels of stress and arousal. This stress is usually positive because viewers can control their own involvement in the game.

Zuckerman's (1979; 1983) Sensation Seeking Scale ideally suits the assessment of sensation seeking levels that can be associated with positive stressful situations, for example, the viewing of exciting sport on television. The Sensation Seeking Scale has effectively been used to determine the sensation seeking levels in a variety of contexts in sport, specifically the participant itself. The Scale has effectively discriminated among high- and low-risk sport (Jack & Ronan, 1998) and between athletes and nonathletes (Schroth, 1995). The Sensation Seeking Scale has also been effectively employed to uncover the relationship between sensation seeking, extroversion and openness to experience (Aluja *et al.*, 2003). Although it is not possible to compare the quality of excitement of the real participant and the spectator that watch their favourite sport on television, experts start to accept the fact that televised sport has become the most common mode for modern man to create his/her own excitement and thrills (McDaniel, 2003). The nail biting uncertainty of outcomes in big sport events that serves to create suspenseful endings can be effectively provided by sport programmes that involve violent and aggressive play (Gan *et al.*, 1997). Research also shows that the television viewer is not only attracted to violent combative sport, but can also appreciate stylistic sport as a form of entertainment. This is in alignment with the fact that the viewer can create his/her own optimum levels of stimulation (OLS) by regulating his/her own involvement in viewing televised sport (Zuckerman, 1994).

With regard to gender, one of the aims of this study is to establish the gender differences in preferences for televised sport. Available literature suggests that levels of sensation seeking differ for males and females. Studies on sensation seeking suggest meaningful age and gender differences which can be attributed to the variations in testosterone levels between males and females (Zuckerman, 1994). "Males tend to report higher levels of sensation seeking than females, which declines over the course of the lifecycle in both sexes" (McDaniel, 2003: 16).

PURPOSE AND SCOPE

The purpose of this study is to determine the relations between sensation seeking, gender and preferences in viewing televised sport. The first aim of this study is to determine whether high levels of sensation seeking relates significantly to the preference of viewing violent combative televised sport. A second aim is to determine whether low sensation seeking is linked to the preference of viewing non-aggressive stylistic televised sport. The third aim is to determine whether the male population tends to view more violent combative televised sport and

whether the female population prefers to view more non-aggressive stylistic televised sport. According to available research it is hypothesised that a positive relation will exist between high sensation seeking and the preferences of viewing violent combative televised sport. The second hypothesis will be to relate low sensation seeking with the preference of viewing non-aggressive stylistic televised sport. The third hypothesis, also extrapolated from available literature, suggests that the male population will prefer the viewing of violent combative televised sport and the female population will prefer more non-aggressive stylistic televised sport.

METHODOLOGY

The standardised Sensation Seeking Scale of Zuckerman (1979; 1983) was the survey method utilised in this study. The statements on the Sensation Seeking Scale contain two options, A or B. The preference for one of the two statements is indicated by circling either A or B. The preference for the viewing of televised sport is categorised in three major groups, namely group A which consists of violent combative sport for example boxing, kick boxing and rugby, group B which represents the aggressive combative sport for example, basketball, soccer, hockey and auto motorcycle racing and group C which represents the non-aggressive stylistic sport for example gymnastics, figure skating, dancing and tennis. These categories are based on the research done by McDaniel (2003), as well as taking into account the South African sport context.

Data were selected by emailing and handing out questionnaires to the general public. No inclusion or exclusion was set, the reason for this non criterion approach is to sample a representative group of people from the general public. The population was extrapolated from the Ekurhuleni Municipality geographic area. The reason for choosing this specific sampling group is that they represent an average urban population that watches televised sport on a regular basis. The only prerequisite for the respondents was that they had to have a television set and watch televised sport on a regular basis. The sample group included 150 respondents and the obtained response rate was 61.33%. Ninety two questionnaires were returned.

The Sensation Seeking Scale consists of four subscales. The four subscales constructs are: thrill and adventure seeking (TAS), experience seeking (ES), disinhibition (Dis) and boredom susceptibility (BS). The total sensation seeking score is obtained by adding the four subscales scores. The TAS scale measures the desire to engage in thrill seeking risky and adventure activities like hang-gliding, parachuting, mountain climbing and other extreme sport activities. The ES scale assesses the desire to seek arousal through the mind and senses. The non-conformist lifestyle of reaction groups like the hippies of the 1960's who lived spontaneously and loved unplanned travel is an effective description and representation of this scale. The Dis scale involves a more traditional type of sensation seeking which includes activities like gambling, drinking, partying and sex. The BS scale is directly linked to the aversion for boring experiences like repetitive routine work. People who measured high on this scale are extremely restless under conditions of monotonous, repetitive activities and consistent conditions (Zuckerman, 1979).

Descriptive statistics are applied and the data are presented in figures to give a simplistic explanation of the data. Spearman's rank order correlation was used to determine the strength of the relation between the variables, sensation seeking and the viewing of various televised

sport. This is the non-parametric alternative to Pearson's correlation. If the p-value (sig. 2-tailed) is equal to or below 0.05, there is a significant relation (at the 5% level of significance) between the two variables under observation. If the p-value is equal or below 0.10, there is a significant relation at the 10% level of significance (Wilcox, 2003).

RESULTS AND DISCUSSION

Demographic profiles

In Figures 1 and 2 the ages and gender profiles of the respondents are presented. The ages of the respondents range from 19 to 60 years with a frequency percentage varying across the different age categories. All the age groups are sufficiently represented. The age group between 19 and 25 represents more than half the population used in this study. The over representation of this age group may be a good indication of the new technologically young generation who grew up with television and the broad choice of DSTV satellite. With regard to the gender of the respondents, 43.5% were male and 56.6% were female, which is a sufficient representation of both genders (Figures 1 & 2).
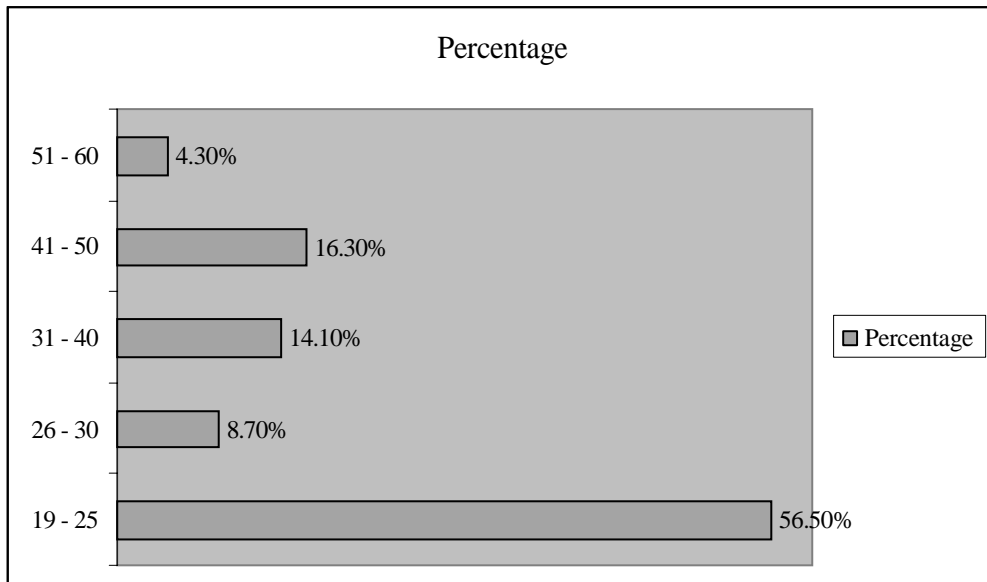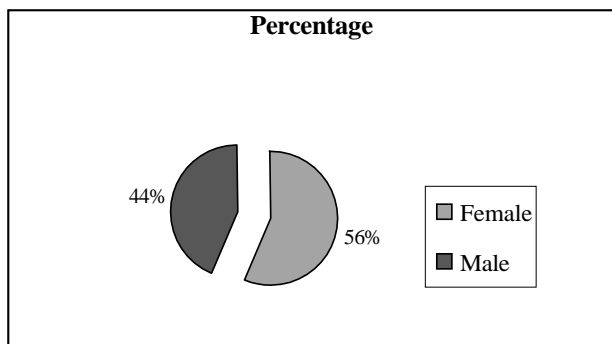

FIGURE 1. **AGE PROFILE**

FIGURE 2. **GENDER PROFILE**

Sensation seeking and preferences in viewing televised sport

High sensation seeking relates significantly to group A (violent combative sport). The results indicated a significant (p=0.018) positive relation that exists at the 5% level of significance (p<.05) between group A and the general scale (total sensation seeking count). A significant relation also exists between the subscales TAS (thrill and adventure seeking) and Dis (disinhibition) with group A (violent combative sport) (Figure 3). The implication is that people who like to engage in thrill seeking, risky and adventure activities (TAS) and people who are attracted to social disinhibition like gambling, drinking and partying have a strong attraction to watching violent combative sport on television. These findings are supported by the research of McDaniel (2003). No significant relations between group A and all the other subscales of sensation seeking were found.
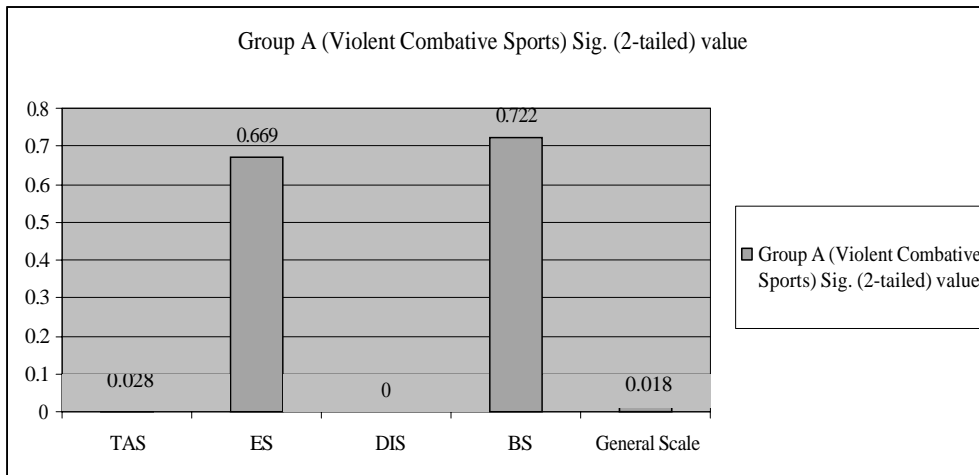

FIGURE 3. **THE RELATION BETWEEN SENSATION SEEKING AND THE PREFERENCE OF VIEWING VIOLENT COMBATIVE SPORT**

No significant relation between group B and the general scale and other subscales was found. A possible reason why no significant relation was found between sensation seeking and group B may be that group B represents the middle or neutral zone on the continuum from extreme violent combative to the non-aggressive stylistic sport. The sports listed in group B like basketball, soccer, hockey and auto motorcycle racing are not too aggressive and cannot be classified as stylistic either (Figure 4).
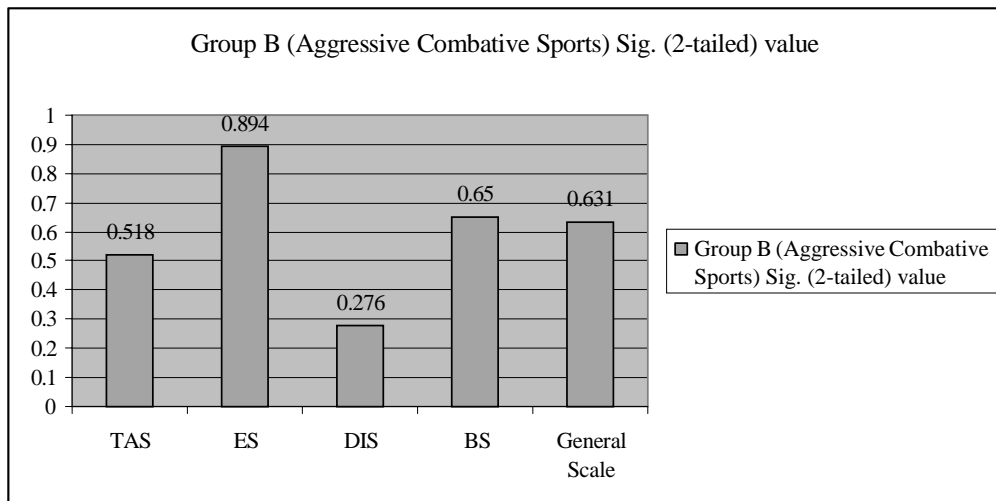
FIGURE 4. **THE RELATION BETWEEN SENSATION SEEKING AND THE PREFERENCE OF VIEWING AGGRESSIVE COMBATIVE SPORT**

A significant negative relation on the 10% level (p<.10) of significance between sensation seeking (general scale - p=0.086) and group C was confirmed by the results in this study. The subscale thrill and adventure seeking (TAS) related negatively on the 10% level of significance (p=0.071) with non-aggressive stylistic sport (Group C). The subscale disinhibition (Dis) related negatively on the 5% level (p<.05) of significance (p=0.008) with non-aggressive stylistic sport (Group C). Due to ES=0.559 and BS=0.832 it can be stated that a significant relation exists between low sensation seeking and group C. The implication of these findings is clearly that low sensation seeking individuals prefer to watch non-aggressive stylistic sport on television (Figure 5). These findings are in line with the results of similar studies done by McDaniel (2003) and Perse (1996).
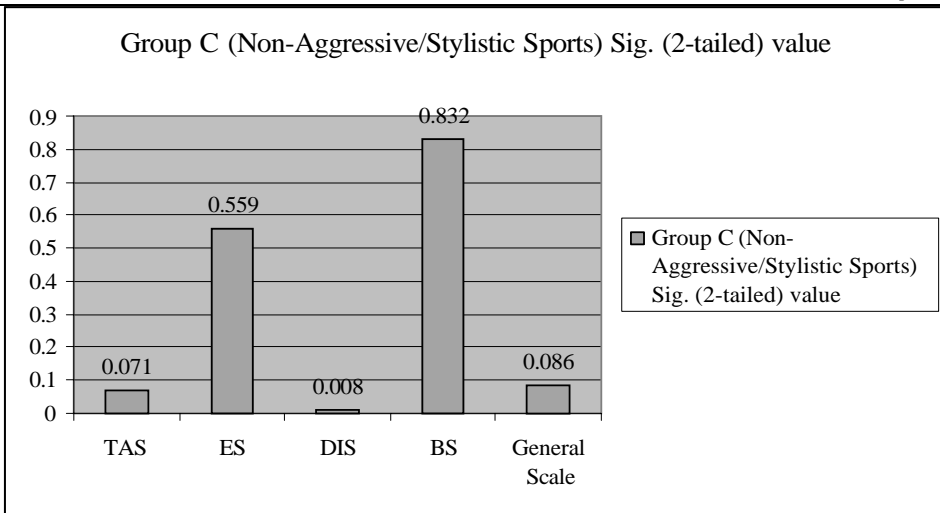
Group C (Non-Aggressive/Stylistic Sports) Sig. (2-tailed) value

FIGURE 5. **THE RELATION BETWEEN SENSATION SEEKING AND THE PREFERENCE OF VIEWING NON-AGGRESSIVE STYLISTIC SPORT**

Gender differences and preferences in viewing televised sport

Research shows that significant differences exist between males and females in terms of their enjoyment and excitement levels that they derive from viewing televised sport (McDaniel, 2003). The results in this study support the third hypothesis. Results indicated a statistically significant difference (p=0.000) on the 5% level of significance that exists between group A for males and females. Figure 6 represents significant differences between males and females in terms of group A. Twenty six males (65% of all the males) indicated group A (violent combative sport) as their first choice and only nine females (17.6% of all the females) indicated group A as their first choice. Therefore, the male population tends to view more violent combative televised sport like rugby and boxing.
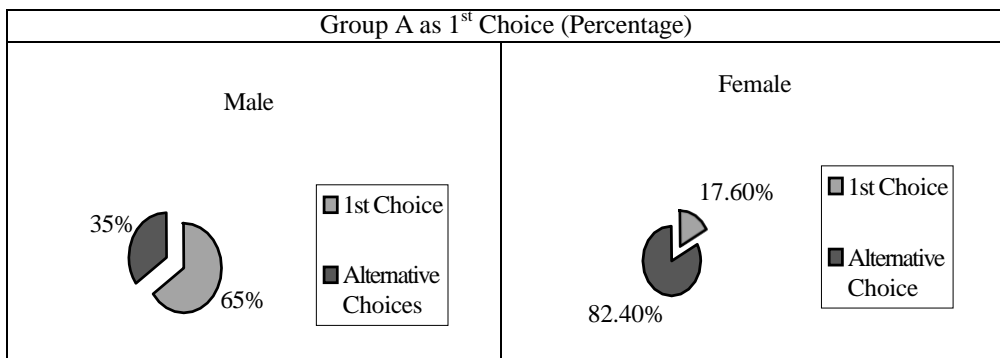

Group A as 1st Choice (Percentage)

FIGURE 6. **THE RELATION BETWEEN GENDER AND THE PREFERENCE OF VIEWING VIOLENT COMBATIVE TELEVISED SPORT**

The differences between males and females who prefer watching aggressive combative sport

like basketball, hockey, soccer and auto motorcycle racing (group B) were not significant in the findings of this study. As possible rationale, it may be reasoned that sport like basketball, hockey and soccer are the middle or neutral zone of sport that can either be classified as violent combative or stylistic artistic (Figure 7). Only 17.6% of females and 27.5% males preferred group B as their number one choice in viewing televised sport.
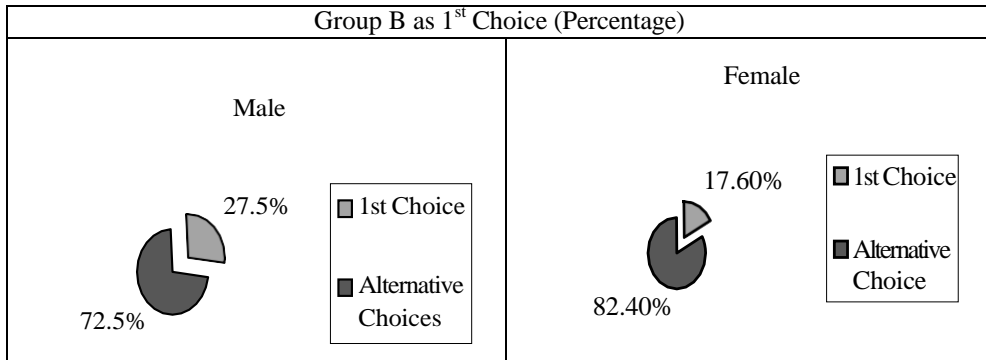

FIGURE 7. **THE RELATION BETWEEN GENDER AND THE PREFERENCE OF VIEWING AGGRESSIVE COMBATIVE TELEVISED SPORT**

As hypothesised, the female population tends to view more non-aggressive stylistic sport than the male population. A statistical difference exists (p=0.000) between the males and females and their rating of group C (stylistic sport). Only two males (5.1% of all males) indicated group C as their first choice and 33 females (64.7%) indicated group C as their first choice (Figure 8). Therefore, the data in Figures 6, 7 and 8 are consistent with the third research hypothesis and suggest that a significant difference exists between males and females in their ratings of groups A and C.
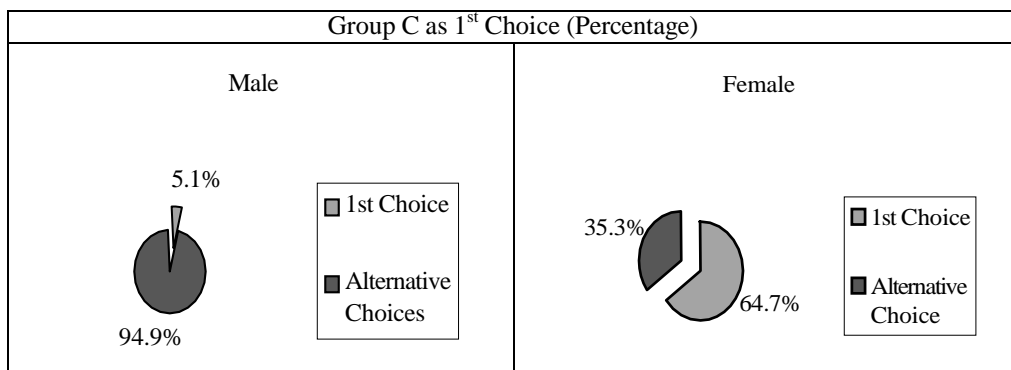

FIGURE 8. **THE RELATION BETWEEN GENDER AND THE PREFERENCE OF VIEWING NON-AGGRESSIVE STYLISTIC SPORT**

These findings support the research of McDaniel (2003) who also found gender differences in their preferences to watch either violent combative or non-aggressive stylistic sport. Another

explanation for these findings in gender differences is the fact that different testosterone levels in males and females are related to different levels of sensation seeking tendencies. Zuckerman's (1988) research shows that a tendency to live on the edge is more common in male population than in female population. Twenty years of research in this area suggests that significant differences between males and females exist in terms of their optimal level of stimulation and arousal (McDaniel, 2003).

CONCLUSION

The rapid developments in the industry of broadcasting televised sport as a secondary spectator phenomenon has outrun the research in Sport Psychology, as well as all the psycho-social sciences involved in the study of the spectator phenomenon. This study is a small effort and a humble building block in the development of a proper scientific body that can assist social scientists to come to a deeper understanding of the phenomenon. This information can also be useful in more effective targeting of audiences and especially commercials through which profit margins can be improved. Some commercials with a high sensation seeking quality can be aligned with high sensation seeking sport programmes that will improve the total impact on the high sensation seeking individual watching the programme. The use of high stimulating images combined with dynamic music like hard rock can psych up the viewer to an optimal level of arousal. A more scientific based approach can increase the total efficiency in promoting sport more effectively, as well as improving the quality of the commercialised nature of sport.

The research in this study clearly indicates the difference between the preferences of viewing televised sport between high sensation seekers and low sensation seekers. High sensation seekers prefer to view violent combative sport and low sensation seekers prefer to view a more non-aggressive stylistic sport. The male population tends to view more violent combative sport, while the female population prefers to view more non-aggressive stylistic sport. It can be concluded that, because of the complexity and the rapid development of the phenomenon of televised sport in the last three decades, the significant findings of this study are promising and further research in this fascinating field of study is not optional, but a necessity.

REFERENCES

ALUJA, A.; GARCIA, O. & GARCIA, L.F. (2003). Relationships among extraversion, openness to experience, and sensation seeking. *Personality and Individual Differences,* 35(3): 671-680.

GAN, S.; TUGGLE, C.A.; MITROOK, M.A.; COUSSEMENT, S.A. & ZILLMAN, D. (1997). The thrill of a close game: who enjoys it and who doesn't? *Journal of Sport and Social Issues,* 21(1): 53–64.

JACK, S.J. & RONAN, K.R. (1998). Sensation seeking among high- and low-risk sports participants. *Personality and Individual Differences,* 25(6): 1063-1083.

McDANIEL, S.R. (2003). Reconsidering the relationship between sensation seeking and audience preferences for viewing televised sports. *Journal of Sport Management,* 17(1): 13-36.

PERSE, E.M. (1996). Sensation seeking and the use of television for arousal. *Communication Reports,* 9(1): 37–48.

POTGIETER, J.R. (2003). *Sport Psychology: theory and practice.* Stellenbosch: Institute for Sport and Movement Sciences, Stellenbosch University.

PURETZ, D.E. (2000). *The novelty-seeking gene.* [http://www.Ithaca.edu/buzzsaw/0203/phrill.ht]. Retrieved 22 October 2004.

SCHROTH, M.L. (1995). A comparison of sensation seeking among different groups of athletes and nonathletes. *Personality and Individual Differences,* 18(2): 219-222.

SKINNER, B. (1992). Risk recreation: Expecting the unexpected. In J.R. Potgieter (Ed.), *Readings in Sport Psychology* (79–84). Stellenbosch: Institute for Sport and Movement Studies, Stellenbosch University.

WANN, D.L. (1997). *Sport Psychology.* New Jersey, NJ: Prentice Hall.

WEINGARTEN, G. (2004). Television coverage of the Athens Games: a developmental perspective. Keynote speaker: Proceedings of the 10th ICHPER–SD EUROPE Congress, Antalya, Turkey, (17–20 November 2004), Turkish Sports Sciences Association (TSSA).

WILCOX, R.R. (2003). *Applying contemporary statistical techniques.* Amsterdam: Academic Press.

ZUCKERMAN, M. (1979). *Sensation seeking: beyond the optimum levels of arousal.* Hillsdale, N.J.: Erlbaum.

ZUCKERMAN, M. (1983). Sensation seeking and sports. *Personality and Individual Differences,* 4(3): 285–293.

ZUCKERMAN, M. (1988). Behaviour and biology: Research of sensation seeking and reactions to the media. In L. Donohew; H. Syper & E.T. Higgins (Eds.), *Communication, social cognition and affect* (173–194). Hillsdale, N.J.: Erlbaum.

ZUCKERMAN, M. (1994). *Behavioral expressions and biosocial bases of sensation seeking.* Cambridge, England: Cambridge University Press.

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(Subject editor: Prof. J.R. Potgieter)

USING A GENERAL PURPOSE SPREADSHEET SOFTWARE PACKAGE TO ESTIMATE EXPONENTIAL PLUS CONSTANT MODEL FITS FOR

BLOOD LACTATE CONCENTRATION VERSUS WORK RATE DATA

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ABSTRACT

The objective of this analysis was to evaluate the accuracy of a standard spreadsheet software package to estimate best-fit parameters for an exponential plus constant model ($y=a+b.e^{cx}$) applied to blood lactate concentration versus work rate data. During an incremental cycle test, blood lactate concentrations were measured in six endurance-trained athletes. A spreadsheet (Microsoft® Excel) and a dedicated curve-fitting software programme (GraphPad Prism®) were used to obtain model coefficients, model fit parameters, interpolated work rate at a fixed blood lactate concentration ($WR_{4mmol/l}$) and work rate at a curve gradient of 1 mmol/l per watt ($WR_{dy/dx=1}$). Model coefficients and model fit parameters were identical to the sixth decimal place for four subjects and differed by ≤ 0.000006 in two subjects. $WR_{4mmol/l}$ differed by <0.003 watts in five subjects, while a difference of <1 watt was found for one subject. $WR_{dy/dx=1}$ differed by 0.0018 watts in only one subject. These findings suggest that a general purpose spreadsheet software package can be used by sport and exercise physiologists to accurately determine model coefficients, model fit parameters, $WR_{4mmol/l}$ and $WR_{dy/dx=1}$.

Key words: Blood lactate; Modelling; Parameter fits; Spreadsheet.

INTRODUCTION

Twenty years ago Stanley *et al.* (1985) established that the rate of blood lactate appearance and disappearance (μmol/min/kg) and consequently blood lactate concentration (mmol/l) increases exponentially with increasing work rate. Since then, several papers have presented convincing evidence that the exponential plus constant model ($y=a+b.e^{c.x}$) provides a better fit than transformed linear models (Hughson *et al.*, 1987; Campbell *et al.*, 1989; Dennis *et al.*, 1992; Tokmakidis & Leger, 1992). Moreover, not only have these reports demonstrated statistically better fits (Hughson *et al.*, 1987; Campbell *et al.*, 1989; Dennis *et al.*, 1992; Tokmakidis & Leger, 1992), but there is also a compelling body of evidence supporting the contention that a continuous rise in blood lactate accumulation with increasing work rate is physiologically more plausible than "threshold" models (Brooks, 1985; Dennis & Noakes, 1998; Gladden, 2004). In contrast, the linearized "threshold" models invoke the "oxygen deficit" paradigm such that at a certain point "anaerobic" metabolism is activated which leads to eventual fatigue (Wasserman, 1984; Weltman, 1995).

Prior to modern computing capabilities, linearized models (transformation of non-linear data to a general linear form) were the method of choice for researchers in general when dealing with any non-linear or continuous data (Davies & Hicks, 1992; Motulsky & Christopoulos, 2003). The popular use of linear methods to describe non-linear blood lactate vs. work rate data within the Sport and Exercise Sciences (Beaver *et al.*, 1985) was likely the result of two

significant factors. Firstly, linearized "threshold" models purported a physiological underpinning (Wasserman, 1984; Beaver *et al.*, 1985). Secondly, because of the simplicity of the calculations required for the solving of linearized "threshold" models, the calculations could be performed by hand or by writing relatively simple computer programmes (Van Wyk, 1984). As an example of the popularity of linear transformation of non-linear data or equations, hand-held calculators transform non-linear equations into general linear form to obtain model coefficients (Hewlett-Packard, 1988).

The advent of powerful desktop computers and accompanying software has provided researchers with the necessary analytical tools to describe non-linear data using appropriate numerical methods which do not rely on the inappropriate linearization of data. However, to estimate the model coefficients (*a*, *b*, *c*) for the non-linear equation $y = a + b.e^{c.x}$, sport and exercise physiologists have had to either write customised computer programmes incorporating more complex numerical methods (Hughson *et al.*, 1987; Myers *et al.*, 1994; Tokmakidis & Leger, 1992) or employ dedicated curve-fitting software (Dennis *et al.*, 1992). Consequently, if investigators do not have the expertise to write computer programmes nor the funds to purchase the required dedicated software, they cannot apply the exponential plus constant model to blood lactate vs. work rate data. However, commercially available spreadsheets offer iterative tools, which can solve for unknown x-values given a linear or non-linear equation and find optimal values for model coefficients. Spreadsheets are thus ideally suited to implement the methodology outlined by Hughson *et al.* (1987) in order to obtain the best-fit model coefficients for the exponential plus constant model.

Therefore, the objective of this analysis was to compare the accuracy of the output of a common spreadsheet software package (Microsoft® Excel) to the output of a dedicated curve-fitting software package (GraphPad Prism®) when estimating the exponential plus constant model for non-linear blood lactate concentration vs. work rate data. Since commercial curve-fitting software programmes often differ in the algorithms used, yet produce very similar outputs (Motulsky & Christopoulos, 2003), we hypothesized that the methods we employed would produce *practically* and *statistically* insignificant differences.

METHODS

Subjects and procedures

Six endurance-trained male athletes (cyclists, triathletes), with at least three years of competitive, provincial and/or national experience, were recruited. Anthropometric measurements and an incremental cycle test to volitional exhaustion were completed during a single visit. During the incremental cycle test micro-blood samples were obtained from the subject's earlobe for the determination of blood lactate concentration. All subjects provided signed informed consent prior to participating in the study. Ethics approval was obtained from the University of Pretoria.

Anthropometry

Stature and body mass were measured to the nearest 0.1 cm and 0.1 kg, respectively. For the purpose of calculating power output (see next section), a combined subject-bicycle mass was also obtained. To determine the percentage body fat, four skinfold thicknesses (triceps, biceps, subscapular, suprailiac) were measured, in triplicate to the nearest 0.1 mm, using a Harpenden skinfold caliper (Siri, 1956; Durnin & Wormersley, 1974).

Incremental cycling protocol

Subjects completed an incremental cycling protocol to volitional exhaustion (Hagberg *et al.*, 1978, Hagberg *et al.*, 1981). The incremental protocol involved cycling on a motorized treadmill (Quinton, Tiernay Electrical Co., Seattle, WA, USA) using the subject's own bicycle at a constant speed (32.2 km/hr) and increasing the gradient by increments of 0.5%, starting at 0% gradient. To ensure sufficient time for a steady-state blood lactate concentration to be reached the stage duration was increased from the original 1 min stage duration of Hagberg *et al.* (1978) to 5 min stage durations. A 10 min ride at 0% gradient served as familiarization and warm-up. No restrictions were placed on preferred gear ratios or pedal cadences. At the end of each stage and at the end of the incremental test the subject stopped pedalling and held onto the treadmill side-railings while a small blood sample was obtained from the subject. An assistant, straddling the treadmill belt, steadied the subject during the blood collection phase by holding onto the bicycle seat. Once the subject started pedalling, the assistant removed any support. The assistant remained available during the test to assist should the subject have lost his balance. However, no such incidents occurred during the test.

Power output was calculated using the formula,

$$Power = (mass \times velocity \times \sin\theta) + (0.185\,\text{kp} \times velocity) + (0.000434\,\text{kp.min/m} \times velocity^2)$$

where *Power*=kilopond-meters/minute (kpm/min), *mass*=mass of cyclist and bicycle (kg), *velocity*=treadmill belt velocity (m/min) and *sin θ*=angle of the treadmill bed (deg) (Hagberg *et al.*, 1978). For the purposes of this analysis, power was expressed in watts (1 kpm/min=0.1634442 W). Prior to testing, the metered treadmill speed and inclination were verified. Firstly, to verify the metered treadmill speed, the actual treadmill belt speed was determined by measuring the belt length and the time it took to complete 30 revolutions at a reading of 32.2 km/hr. Secondly, the treadmill inclination was verified by comparing metered treadmill angles to manual measurements using a protractor and weighted line.

Determination of whole blood lactate concentration

Prior to the test, a vasodilator (Forapin) was placed on the right earlobe of the subject (the earlobe was chosen simply for ease of sampling). The earlobe was then hyperemized, and a resting blood sample collected in a calibrated capillete (0.02 ml) and emptied into an Eppendorf test tube containing a standard reagent solution (Eppendorf, Hamburg, Germany). The same collection procedure was performed at the cessation of each workload and at the termination of the incremental cycle test. Blood samples were collected within 30-60 seconds at the end of the stage and test. Electro-enzymatic analysis of whole blood samples was performed with an ESAT® 6661 Lactate Analyzer (Eppendorf, Hamburg, Germany) (Clark, 1979; Clark *et al.*, 1984). Whole blood lactate concentration was expressed as mmol/l.

Statistical analysis

All curve-fitting analyses were performed using Microsoft® Excel 2002 (version 10.2614.2625) and GraphPad Prism® for Windows (version 4.03). The latter was considered the "gold standard" against which to test Excel's output. For the purposes of this analysis output was defined as:

- model coefficients (*a*, *b*, *c*) for the exponential plus constant model ($y = a + b.e^{c.x}$),
- goodness-of-fit parameters (the coefficient of determination or R^2, absolute residual sum of squares or RSS),

- work rate (W) at a curve gradient of 1 mmol/l per watt ($WR_{dy/dx=1}$),
- and work rate (W) at a fixed blood lactate concentration of 4 mmol/l ($WR_{4mmol/l}$).

The two latter outputs, $WR_{dy/dx=1}$ and $WR_{4mmol/l}$, represent practical measures for quantifying the rate of blood lactate accumulation when evaluating athletic ability (elite vs. trained) or adaptation to endurance training (Hughson *et al.*, 1987; Tokmakidis & Leger, 1992; Dennis & Noakes, 1998). The four outputs were generated from the blood lactate concentration vs. work rate data for each subject using both Excel and Prism.

Microsoft$^{®}$ Excel

A numerical method (quasi-Newton method), found in Excel's Solver Tools, was used to implement the model coefficient estimation method of Hughson *et al.* (1987), and to calculate $WR_{4mmol/l}$. The work rate at a gradient of 1 mmol/l per watt was calculated by using the first derivative of the exponential plus constant model (see Figure 1) and solving for *x*,

$$WR_{dy/dx=1} = \ln\left(\frac{dy}{b.c}\right)$$

$$\frac{dx}{c}$$

where dy/dx = curve gradient = 1 mmol/l per watt and b and c are model coefficients (Hughson *et al.*, 1987). Model fit parameters (R^2 and RSS), were calculated in Excel using standard methods (Hughson *et al.,* 1987). (Note: the Microsoft®Excel spreadsheet used in this analysis can be obtained from the first author).

GraphPad Prism®

Model coefficients were estimated using the Prism Non-linear regression (Curve fit) function. As with the Excel analysis, once the model coefficients were optimized, the $WR_{dy/dx=1}$ was calculated by using the first derivative of the exponential plus constant model and solving for x. The $WR_{4mmol/l}$ was calculated by selecting the "Unknowns from a standard curve" option in Prism's Non-linear regression (Curve fit) function. Model fit parameters (R^2 and RSS) were computed by Prism using standard methods (Motulsky & Christopoulos, 2003).

To evaluate the outputs of the two software programmes, simple differences (Excel minus Prism) were calculated for model coefficients (a, b, c), model fit parameters (R^2 and RSS), $WR_{dy/dx=1}$ and $WR_{4mmol/l}$. These differences were tested for significance using paired t-tests. Appropriate statistical software (SPSS for Windows 11.0.1) was used for inferential statistics and significance was set at $p<0.05$.

RESULTS

Descriptive statistics for subject characteristics are reported in Table 1.

TABLE 1. **SUBJECT CHARACTERISTICS**

Age (years)	26.0 (2.9)
Body mass (kg)	77.6 (4.9)
Stature (cm)	180.8 (6.0)
Percentage body fat (%)	13.6 (3.7)
Peak work rate (watts)	342 (38)

n=6, data reported as mean (standard deviation)

The blood lactate concentration vs. work rate data were well described by the continuous exponential plus constant model such that 98% and above of the variation in the blood lactate concentration could be explained by the work rate (Figure 1).
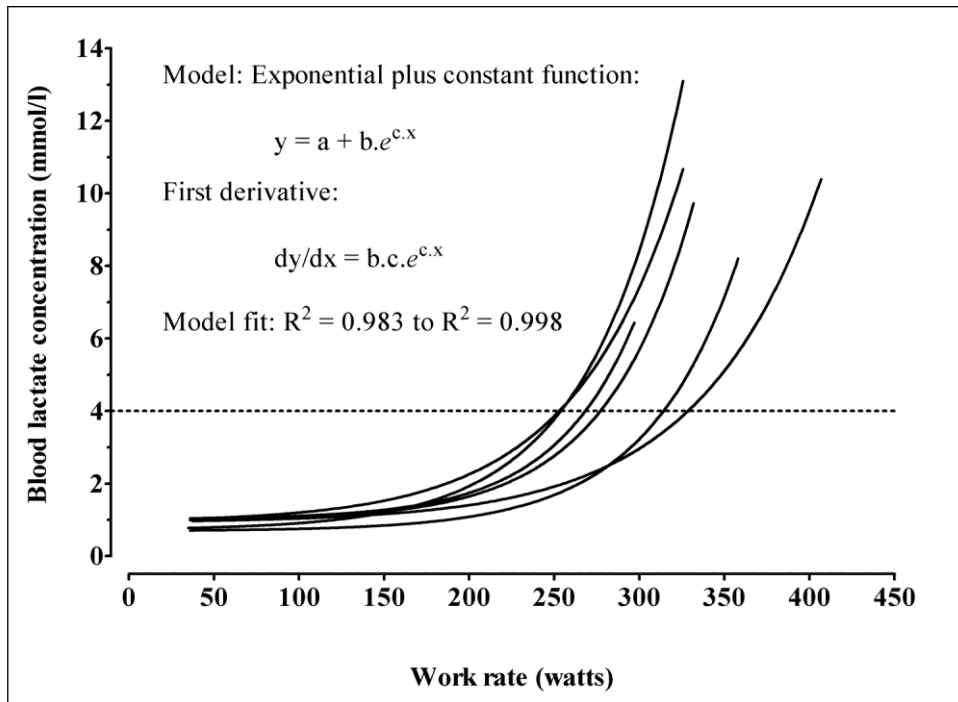
FIGURE 1. **LINES OF BEST-FIT FOR AN EXPONENTIAL PLUS CONSTANT MODEL APPLIED TO BLOOD LACTATE CONCENTRATION VS. WORK RATE DATA FOR SIX ENDURANCE-TRAINED MALE SUBJECTS**

There were no significant differences ($p > 0.3$) for model coefficients (*a*, *b*) or model fit parameters (RSS), up to the sixth decimal place (Table 2). For model coefficient *c* and model fit parameter R^2 there were no differences (row differences equalled zero). Only two subjects (3 and 6) showed absolute differences of ≤ 0.000006 in model coefficients or model fit parameters (Table 2).

TABLE 2. **BEST-FIT VALUES ESTIMATED FOR THE EXPONENTIAL PLUS CONSTANT MODEL APPLIED TO BLOOD LACTATE CONCENTRATION (MMOL/L) VS. WORK RATE (WATTS) DATA USING A GENERAL PURPOSE SPREADSHEET SOFTWARE PACKAGE (EXCEL) AND A DEDICATED CURVE-FITTING SOFTWARE PACKAGE (PRISM)**

	Excel					Prism				
	Model constants			Model fit parameters		Model constants			Model fit parameters	
Subject	*a*	*b*	*c*	R^2	RSS	*a*	*b*	*c*	R^2	RSS
1.	0.918392	0.027781	0.014336	0.992953	0.620940	0.918392	0.027781	0.014336	0.992953	0.620940
2.	0.687277	0.009503	0.018634	0.997227	0.140393	0.687277	0.009503	0.018634	0.997227	0.140393
3.	1.015016	0.011691	0.020668	0.982648	0.442451	1.015015	0.011691	0.020668	0.982648	0.442451
4.	0.925818	0.056001	0.015842	0.998532	0.125842	0.925818	0.056001	0.015842	0.998532	0.125842

| 5. | 0.963549 | 0.014464 | 0.019301 | 0.996801 | 0.224518 | 0.963549 | 0.014464 | 0.019301 | 0.996801 | 0.224518 |
| 6. | 0.714368 | 0.030468 | 0.018446 | 0.992183 | 1.129400 | 0.714374 | 0.030467 | 0.018446 | 0.992183 | 1.129399 |

a, *b* and *c* are constants for the exponential plus constant model ($y = a + b \cdot e^{c.x}$), R^2=coefficient of determination, RSS=residual sum of squares, ☐ difference between spreadsheet (Excel) vs. dedicated curve-fitting software (Prism) ≤0.000006

The differences in model coefficients did not significantly influence $WR_{4mmol/l}$ (p=0.3680) or $WR_{dy/dx=1}$ (p=0.3632) (Table 3). In fact, differences in $WR_{4mmol/l}$ were only apparent from the third and fourth decimal places for five of the six subjects (Table 3). Only subject 6 demonstrated an absolute difference in $WR_{4\ mmol/l}$ of 0.9968 watt which affected a unit change due to rounding (Table 3).

TABLE 3. WORK RATES (WATTS) AT FIXED BLOOD LACTATE CONCENTRATIONS AND CURVE GRADIENTS FOR BLOOD LACTATE CONCENTRATION VS. WORK RATE DATA ESTIMATED USING A GENERAL PURPOSE SPREADSHEET SOFTWARE PACKAGE (EXCEL) AND A DEDICATED CURVE-FITTING SOFTWARE PACKAGE (PRISM)

Work rate at 4 mmol/l
($WR_{4mmol/l}$)

			Work rate at 1 mmol/l per watt $(WR_{dy/dx=1})$			
Subject	Excel	Prism	Difference	Excel	Prism	Difference
1.	328	328	0.0020	546	546	0.0000
2.	314	314	0.0026	464	464	0.0000
3.	268	268	0.0013	403	403	0.0000
4.	253	253	0.0029	444	444	0.0000
5.	277	277	0.0002	424	424	0.0000
6.	254	255	-0.9968	406	406	-0.0018

values are expressed in watts, difference calculated as Excel values minus Prism values

There were no differences in $WR_{dy/dx=1}$ for five of the six subjects up to the fourth decimal place. A difference was apparent in only one subject from the third decimal place.

DISCUSSION

This analysis shows that a general purpose spreadsheet software package produced outputs practically identical to that of a dedicated curve-fitting software package. Therefore, to apply the exponential plus constant model to blood lactate concentration vs. work rate data, sport and exercise physiologists can employ readily-available spreadsheet software to determine model parameters and work rates at specific gradients and blood lactate concentrations to a high degree of accuracy.

The objective of this analysis was not to exhaustively detail and compare the mathematical algorithms of the two software programmes we used. Rather, we needed to demonstrate that the method of Hughson *et al.* (1987) coupled with Excel's Solver Tools produced outputs that could be considered *practically* nearly identical, albeit not exactly equal, to a "gold standard". Prism's non-linear regression algorithms use iterative methods which include matrix algebra and optimization techniques such as the Levenberg-Marquardt method to minimize the sum-of-squares for a particular set of model coefficients (Motulsky & Christopoulos, 2003). The iterative approach of Hughson *et al.* (1987) coupled with the use of the quasi-Newton method in Excel's Solver Tools, although different in approach to Prism, will produce accurate and valid outputs because, as with Prism, the algorithm is geared towards minimizing the sum-of-squares. It is important to note that commercially available curve-fitting software programmes do not all use the same method to minimize the sum-of-squares yet produce outputs that are practically identical (Motulsky & Christopoulos, 2003). Therefore, the criterion for our implementation of the approach of Hughson *et al.* (1987) would be that the Excel output should be *practically* and *statistically* insignificant from that of a trusted curve-fitting programme. As such, our results show that in comparison to a more sophisticated software programme, the implementation of a non-linear regression method (Hughson *et al.*, 1987) using a general purpose spreadsheet software programme can be considered valid for continuous blood lactate concentration vs. work rate data.

The method of Hughson *et al.* (1987) uses an appropriate transformation of the x-axis ($e^{c.x}$) to obtain an estimate for the model coefficient *c*. Unlike the transformation of the y-axis, transforming the x-axis does not affect the best-fit model parameters (Motulsky & Christopoulos, 2003). Moreover, the x-axis transformation of Hughson *et al.* (1987) only spreads the data along the x-axis and minimizes the sum of squares of the vertical distance of the data points from the regression curve. Importantly, unlike y-axis transformation, x-axis transformation does not violate the assumption of a Gaussian distribution of data points about

the regression line, nor the assumption of homoscedasticity (scatter of residuals is constant for every x-value). It should be noted that by dividing or multiplying all the y-values by a constant does not alter the best-fit curve. However, this does not hold true when the y-values are converted to their logarithms, square roots or reciprocals. By transforming y-values through logarithms, square roots or reciprocals the relative position of the data points are altered and this results in a different curve. Only if the data scatter about the curve is not Gaussian should y-transforms be considered to improve the curve fit (Motulsky & Christopoulos, 2003).

The log-log model commonly employed to determine a "threshold" in blood lactate concentration vs. work rate data obtained from incremental testing, requires that both the x-axis and y-axis be transformed. Once the two segments have been identified, usually by visual inspection, it is relatively simple to obtain two linear functions (y=m.x+c) for the two segments and then to determine where the two segments intersect (Tokmakidis & Leger, 1992). This methodology could be excused prior to access to personal computers but present day desktop computers and software programmes are extremely powerful such that the proper numerical techniques can be applied to non-linear data sets (Davies & Hicks, 1992; Motulsky & Christopoulos, 2003). Instead of trying to identify physiologically questionable "thresholds" in blood lactate concentration vs. work rate data (Brooks, 1985), sport and exercise physiologists should rather report blood lactate accumulation as gradients at particular points on the exponential blood lactate concentration vs. work rate relationship (Hughson *et al.*, 1987; Tokmakidis & Leger, 1992).

Investigators have also employed linear interpolation or linear extrapolation methods to obtain the work rate at a particular blood lactate concentration e.g. 4 mmol/l (Olbrecht *et al.*, 1985, Ribeiro *et al.*, 1990; Weltman, 1995). This method necessitates the assumption of linearity between the two data points, used as reference, and the interpolated or extrapolated data point (Maglischo *et al.*, 1984, Olbrecht *et al.*, 1985). This assumption usually holds true because of the increasing curve gradients at increasing blood lactate concentrations. However, investigators have not reported comparisons between linear interpolation or extrapolation and non-linear methods. Therefore, there is uncertainty as to the amount of error produced by linear interpolation or extrapolation. It is likely that investigators have used linear methods primarily because of the simplicity of the linear interpolation or extrapolation methods. The results from this paper suggest that, once a spreadsheet is properly set up, researchers can just as easily use non-linear methods to determine work rates at fixed blood lactate concentrations. Importantly, numerical methods do not make assumptions about the linearity between non-linear data points that linear methods do. Another important advantage of using non-linear methods is that gradients at specific blood lactate concentrations and work rates can be accurately and easily calculated (Hughson *et al.*, 1987; Tokmakidis & Leger, 1992). We would however caution against using non-linear interpolation techniques such as Bezier curves and non-uniform rational B-splines. As with the popular two-point linear interpolation techniques, the blood lactate concentration vs. work rate data should rather be treated as an expression of a biological *system*. In other words, interpolation should ideally be made from the fitted model, and not the local conditions between two data points.

Researchers should be aware that polynomial equations can be applied to blood lactate concentration vs. work rate data (Zhou & Weston, 1997). A major pitfall of this approach is that researchers are tempted to produce higher order curves that produce *mathematically and statistically* excellent fits that follow the data points perfectly, but are *biologically* implausible. In other words, the fitted mathematical model has no relationship to the actual biological

processes (Morton, 1989). An extreme example of this approach would be cubic spline curves which go through every data point. It is important to note that many processes in biology yield exponential rate functions (Motulsky & Christopoulos, 2003) so that although polynomials can produce extremely good statistical fits, it is better practice to use biologically and statistically validated models (Dennis *et al.*, 1992; Hughson *et al.*, 1987; Stanley *et al.*, 1985).

Furthermore, polynomial equations are, strictly speaking, considered to be linear equations (Motulsky & Christopoulos, 2003).

Incremental tests can result in constant or decreasing blood lactate concentrations during the early stage of the test, which would reduce the goodness of fit of exponential models (Hughson *et al.*, 1987). In an earlier analysis of the present data set (Cook & Van Wyk, 1991), we found that the mean difference in R^2 values between polynomials and the exponential plus constant model was only +0.007; mean $R^2=0.997$ vs. mean $R^2=0.990$, respectively. Despite constant or decreasing early blood lactate concentrations during an incremental test, the overall fit of the exponential plus constant model still provides extremely good fits (Hughson *et al.*, 1987). It would thus seem prudent, for the majority of incremental testing scenarios, to settle for the most biologically *and* mathematically acceptable model. This would ensure that standard analytical techniques can be adopted to obtain practically relevant indices for measuring athletic ability or adaptation to training. This analysis provides an easily implemented methodology which is theoretically sound and practically relevant.

CONCLUSIONS

In conclusion, it has been demonstrated in this paper, that non-linear model coefficients and useful information, such as non-linear work rate interpolation and curve gradients, are easily and accurately obtained using an appropriately designed, general purpose spreadsheet. Importantly, the use of suitable numerical techniques allows blood lactate concentration vs. work rate data to be interpreted and reported by sport and exercise physiologists as a continuous, exponential function.

REFERENCES

BEAVER, W.; WASSERMAN, K. & WHIPP, B.J. (1985). Improved detection of lactate threshold during exercise using a log-log transformation. *Journal of Applied Physiology*, 59(6): 1936-1940.

BROOKS, G.A. (1985). Anaerobic threshold: review of the concept and directions for future research. *Medicine and Science in Sports and Exercise*, 17(1): 22-34.

CAMPBELL, M.E.; HUGHSON, R.L. & GREEN, H.J. (1989). Continuous increase in blood lactate concentration during different ramp exercise protocols. *Journal of Applied Physiology*, 66(3): 1104-1107.

CLARK, L.C. (1979). The hydrogen peroxide sensing platinum anode as an analytical enzyme electrode. In S. Fleischer & L. Packer (Eds.), *Methods in Enzymology,* vol. 56 (448-479). New York, NY: Academic Press.

CLARK, L.C.; NOYES, L.I.; GROOMS, T.A. & MOORE, M.S. (1984). Rapid micro-measurement of lactate in whole blood. *Critical Care Medicine*, 12: 461-464.

COOK, I. & VAN WYK, G.J. (1991). A comparison of two mathematical models applied to arterialized-venous whole blood lactate obtained during a continuous, prolonged, ramp protocol. Unpublished Honours thesis. Pretoria: Department of Human Movement Studies, University of Pretoria.

DAVIES, H.G. & HICKS, G.A. (1992). *Mathematics for scientific and technical students* (289-293). Harlow, Essex: Longman Scientific & Technical.

DENNIS, S.C. & NOAKES, T.D. (1998). Physiological and metabolic responses to increasing work rates: relevance for exercise prescription. *Journal of Sports Sciences,* 16: S77-S84.

DENNIS, S.C.; NOAKES, T.D. & BOSCH, A.N. (1992). Ventilation and blood lactate increase exponentially during incremental exercise. *Journal of Sports Sciences*, 10(5): 437-449.

DURNIN, J.V.G.A. & WORMERSLEY, J. (1974). Body fat assessed from total body density and its estimation from skinfold thickness. Measurement on 481 men and women aged 16 to 72 years. *British Journal of Nutrition*, 32: 77-97.

GLADDEN, L.B. (2004). Lactate metabolism: a new paradigm for the third millennium. *Journal of Physiology*, 558(1): 5-30.

HAGBERG, J.M.; GIESE, M.D. & SCHNEIDER, R.B. (1978). Comparison of the three procedures for measuring VO_{2max} in competitive cyclists. *European Journal of Applied Physiology and Occupational Physiology*, 39(1): 47-52.

HAGBERG, J.M.; MULLIN, J.P.; GIESE, M.D. & SPITZNAGEL, E. (1981). Effects of pedalling rate on submaximal exercise responses of competitive cyclists. *Journal of Applied Physiology*, 51(2): 447-451.

HEWLETT-PACKARD (1988). *HP-20S scientific calculator: owner's manual* (105-108). Corvallis, OR: Hewlett-Packard.

HUGHSON, R.L.; WEISIGER, K.H. & SWANSON, G.D. (1987). Blood lactate concentration increases as a continuous function in progressive exercise. *Journal of Applied Physiology*, 62(5): 1975-1981.

MAGLISCHO, E.W.; MAGLISCHO, C.M.; SMITH, R.E.; BISHOP, R.A. & HOVLAND, P.N. (1984). Determining the proper training speeds for swimmers. *Journal of Swimming Research*, 1(1): 32-38.

MORTON, R.H. (1989). Detection of a lactate threshold during incremental exercise? *Journal of Applied Physiology*, 67(2): 885-888.

MOTULSKY, H. & CHRISTOPOULOS, A. (2003). *Fitting models to biological data using linear and nonlinear regression: a practical guide to curve fitting* (1-96). San Diego, CA: GraphPad Software.

MYERS, J.; WALSH, D.; BUCHANAN, N.; McAULEY, P.; BOWES, E. & FROELICHER, V. (1994). Increase in blood lactate during ramp exercise: comparison of continuous and threshold models. *Medicine and Science in Sports and Exercise*, 26(11): 1413-1419.

OLBRECHT, J.; MADSEN, O.; MADER, A.; LIESEN, H. & HOLLMANN, W. (1985). Relationship between swimming velocity and lactic concentration during continuous and intermittent exercises. *International Journal of Sports Medicine*, 6(2): 74-77.

RIBEIRO, J.P.; CADAVID, E.; BAENA, J.; MONSALVETE, E.; BARNA, A. & DE ROSE, E.H. (1990). Metabolic predictors of middle-distance swimming performance. *British Journal of Sports Medicine*, 24(3): 196-200.

SIRI, W.E. (1956). The gross composition of the body. In J.H. Lawrence & C.A. Tobias (Eds.), *Advances in biological and medical physics* (239-280). New York, NY: Academic Press.

STANLEY, W.C.; GERTZ, E.W.; WISNESKI, J.A.; MORRIS, D.L.; NEESE, R.A. & BROOKS, G.A. (1985). Systemic lactate kinetics during graded exercise in man. *American Journal of Physiology*, 249(6): E595-E602.

TOKMAKIDIS, S.P. & LEGER, L.A. (1992). Comparison of mathematically determined blood lactate and heart rate "threshold" points and relationship with performance. *European Journal of Applied Physiology and Occupational Physiology*, 64(4): 309-317.

VAN WYK, G.J. (1984). *Rekenarisering van die FAK$_{170}$ en melksuurdraaipunt-prosedures in laboratoriums* (6-12). Pretoria: SAVSLOR.

WASSERMAN, K. (1984). The anaerobic threshold measurement to evaluate exercise performance. *American Review of Respiratory Disease*, 129(Suppl.): S35-S40.

WELTMAN, A. (1995). *Current issues in Exercise Science: the blood lactate response to exercise* (1-117). Champaign, IL: Human Kinetics.

ZHOU, S. & WESTON, S.B. (1997). Reliability of using the D-max method to define physiological responses to incremental exercise testing. *Physiological Measurement*, 18(2): 145-154.

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(Subject editor: Prof. E. Terblanche)

CUSTOMER SERVICE QUALITY AT COMMERCIAL HEALTH AND FITNESS CENTRES

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ABSTRACT

Despite the interest in service quality, little research has been reported in South Africa on health and fitness service quality. The study adopted a conceptual framework for identifying factors that influence fitness service quality in commercial health and fitness centres in South Africa. A structured questionnaire containing 59 variables relating to health and fitness service quality was administered to 251 health and fitness centre patrons. A 39 item scale was finally developed using exploratory factor analysis to measure service quality along eight dimensions, namely, personnel, programming and medical, convenience and information dissemination, functionality and layout, ambience and accessibility, facility attraction, safety and support and membership. Reliability and validity of the scale was established. The human interaction dimensions (personnel) emerged as the most pertinent in health and fitness service quality evaluation. The results indicate differences in items perceived by patrons in measuring health and fitness service quality compared to those developed previously in sport and recreation studies. The implications for future research are outlined.

Key words: Customers; Service quality; Commercial; Fitness centres.

INTRODUCTION

Quality, which has been of interest to marketing academics and managers, has received considerable attention from service marketing researchers in the last 15 years (Reynoso & Moores, 1995; Kelly & Turley, 2001). Whilst products, process quality, and total quality emerged as prime concerns in the manufacturing sector, service quality is acknowledged to be critical for all types of organisations (Ennew *et al*., 1993). Irrespective of whether quality initiatives are seen as innovators or a distillation of established models, service quality has become a staple of current management thought (Chelladurai & Chang, 2000). Attempts were made by researchers to answer some basic questions about service quality judgements made by customers, how customers evaluate quality, and what aspects of the service are assessed (Lentell, 2000). These questions are of significance to managers, including managers of sport and recreational services. Knowledge of service quality assessments made by customers would enable managers to track customer perceptions over time and to direct resources in areas which are important to customers. Whilst health and fitness service providers may produce the same type of services, they do not provide the same quality of service (Crompton

& MacKay, 1989). Services offered by different providers may look alike, but to users they may not "feel alike". On the subject of service quality in a recreation context, Wager (1966: 12) noted that, "quality is a human concept based on highly subjective criteria… and seems to be a highly personal matter. Thus it has to be investigated from the perspective of users".

Currently, service quality is a focus for many corporate and marketing strategies and high levels of services rendered are seen as a means for an organisation to achieve competitive advantage and differentiation (Berry, 1986; Reichheld & Sasser 1990; Metha *et al*., 2000). To achieve competitiveness and differentiation requires management of health and fitness centres to understand consumer needs and promote services in an efficient and co-ordinated way that satisfies these needs (Harris & Harrington, 2000). With the proliferation of sport and fitness centres, sport service providers place greater emphasis on quality issues and efficient operations in order to remain profitable (Papadimitriou & Karteroliotis, 2000).

Whereas literature on service quality is in its formative stages (Papadimitriou & Karteroliotis, 2000; Chang *et al*., 2002), an exponential growth has been witnessed, focussing on recreation and sport, resulting from concerns about wellness, changes in lifestyles and pressures of work (Chad, 1995; Porter, 2005). Customer perceptions of service experiences are vital to the success of all service organisations (Kelly & Turley, 2001). A service encounter in a sport context can be very complex in that it often takes place over an extended period of time and can be influenced by a wide variety of factors. Factors that influence the quality of a service encounter in service settings include *inter alia*, the aesthetics, functionality, layout, facilities and staff interaction.

PROBLEM STATEMENT

Service quality has emerged as a pervasive theme in recreational services (Crompton *et al*., 1991). However, service management is significantly different from product management. Researchers have suggested that it is the presence of customers in the service production, which distinguishes service management from product management (Lentell, 2000). The intangible and abstract nature of service quality makes it difficult for both public users of a service and researchers to articulate and evaluate quality. Service quality is difficult to define and measure. Although researchers have studied the concept of service for several decades, no consensus has been reached on the conceptualisation of service quality (Cronin & Taylor, 1992). Most authors identify four characteristics, namely intangibility, heterogeneity, inseparability and perishability, which distinguish a service from a physical product (Smith, 1990). These widely cited attributes penetrate any kind of service, including sport and recreational services. Understanding the complexity of service therefore requires a clearer understanding of its attributes.

Firstly, unlike mainstream business products, sport and leisure services are intangible and highly subjective. To reduce uncertainty, buyers look at signs or evidence of service (Lentell, 2000, Zeithaml & Bitner, 2000). Secondly, whereas goods are first produced, then sold and consumed, services are first sold then produced and consumed simultaneously. Many of the personnel involved in the production, such as instructors and administrators, are also consumers simultaneously. Thirdly, the quality of service performance is inconsistent and unpredictable, and thus also varies from one service organisation to another (Kotler, 2000), which results in non-standardisation of a health and fitness centre's output. Fourthly, services

cannot be stored and cease to exist the moment they are created. Service marketers are therefore unable to keep an inventory of their services for later use during peak demand (Du Plessis *et al*., 1995). As sport and leisure service do not have a shelf-life, the service provider therefore needs to get the service right the first time. Fifthly, in health and fitness, services cannot be counted, but only experienced or perceived while produced in a facility or arena, which further complicates measurement attempts, as the sport experience is accompanied by emotional attachment and identification. For instance, consumers may identify with, and become attached to specific brands, instructors, or health clubs (Parkhouse, 2005).

SERVICE QUALITY AND ITS MEASUREMENT

The unique nature of services has forced researchers to acknowledge that service quality is a construct, which requires multiple perceptual measures in order to be conceptually captured (Parasuraman *et al*., 1985; 1988) in the minds of people (Cameron & Whetten, 1983). This adds to the problem of obtaining a universally accepted definition of service quality. Some researchers used basic theories in an attempt to conceptualise service quality, namely, the Attribution and Satisfaction theories (Boshoff, 1990).

The Attribution theory views service quality from a product-quality perspective by describing the attributes of the service delivery system. The theory assumes that the attribute of that which is believed constitutes service quality can be manipulated by management. Gummesson and Grönroos (1987) for instance, identify four "qualities" that establish perceived quality: design quality, production quality, delivery quality and relational quality. These "qualities" are regarded by the authors as being just as equally applicable to services.

The Customer Satisfaction theory (Klaus, 1985) regards service quality as a perception of quality: a service is only of the desired standard if the customer sees it as quality. Within this theory, service quality is defined as the difference between expected service and actual service received. Delivering quality service means conforming to customer expectations on a consistent basis. Haywood-Farmer (1988) asserted that service quality comprises three elements, namely, physical facilities, processes and procedure, personal behaviour and professional judgement on the part of serving staff. To obtain good quality service, the appropriate mix of these three elements must be found and carefully balanced.

There also appears to be some degree of consensus that service quality is the user's judgement about an organisation's overall excellence or superiority of the delivery of service (Parasuraman *et al*., 1988; Terblanche, 1998; Sivadas & Baker, 2000). Parasuraman *et al.* (1988) identified various dimensions of service quality. The authors describe service quality as the difference between customer expectations and perception of the service actually received. On the other hand Grönroos (1984) maintains that service quality consists of three dimensions, namely technical quality, functional quality and corporate image. The technical quality of an outcome refers to the actual outcome of the service encounter. The customer will also be influenced by the way in which the technical quality is transferred functionally. The accessibility of the facility personnel, the appearance, behaviour, what they say and how they say it, also impacts on the customer's view of the service. The functional quality answers the question, how the customer gets the service. Corporate image refers to the consumer's general perception of the supplier of the service. Evident from these definitions is that service quality

is a highly subjective concept and many factors, both internal and external, influence a customer's expectations of a service.

Perhaps the seminal works in conceptualising and operationalising of service quality can be traced to the SERVQUAL instrument of Parasuraman *et al.* (1988), which measures service quality along five factors. It forms the cornerstone on which all other works have been built (Sureshchander *et al.*, 2002). Using ten dimensions initially, Parasuraman *et al*. (1988) made their first effort to operationalise the concept of service quality. A twenty-two-item scale, comprising five dimensions, namely reliability, responsiveness, tangibles, assurance, and empathy was finally developed. Reliability is defined as the ability to perform the promised service dependably and accurately; tangibles refer to the facilities, equipment and the personal appearance of staff; responsiveness refers to the prompt attention and willingness of the staff to help the service users; assurance represents courtesy, credibility and competence on the part of the staff; and empathy relates to care and individual attention given by staff to users, while purchasing the service. Whilst the original SERVQUAL instrument has been revised, refined and reformulated (Parasuraman *et al*., 1991; 1994) its primary content remains unaltered.

Although both academics and practitioners have utilised the SERVQUAL model extensively since its inception in the mid-1980's, it is not without its critics (Buttle, 1996; Williams, 1998). Analysis of the SERVQUAL literature indicates that the application of the model varies in different countries and cultures (Carman, 1990; Cronin & Taylor, 1992; Babakus & Boller, 1992; Teas, 1993). Buttle (1996) re-iterates that critics have raised a number of related questions about the dimensionality of the SERVQUAL scale. In the context of recreational services, Taylor *et al*. (1993) established that in a range of recreational services, the five SERVQUAL dimensions were unstable. This leads to the question of whether SERVQUAL is a generic model capable of being applied to all the service industries or if each type of service requires an adapted instrument.

In the field of Sport Management and Marketing, researchers have begun to conceptualise and measure the constructs of service quality and satisfaction (Kim & Kim, 1995; McDonald *et al*., 1995; Papadimitriou & Karteroliotis, 2000). However, the study of quality in sport services has been limited in terms of the number of studies and their scope. The few studies in this regard have focused on identifying dimensions of quality in specific services. The early studies of Chelladurai *et al*. (1987) identified five dimensions of fitness services, measured by a Scale of Attributes of Fitness Services (SAFS). These dimensions were categorised as primary-professional, primary consumer, primary-peripheral, primary-facilitating goods, and secondary goods and services. Later Kim and Kim (1995) measured service quality using thirty-three items, comprising eleven dimensions. These dimensions were labelled ambience, employee attitude, reliability, information, programming, personal consideration, privileges, price, ease of mind, stimulation and convenience. Howat *et al*., (1996) developed the Centre for Environmental and Recreation Management – Customer Service Quality (CERM-CSQ) scale to measure services in sport and leisure services. The authors categorised a service quality scale into four dimensions, namely, core services, staff quality, general facility, and secondary services. Recently Chelladurai and Chang (2000) proposed a framework for understanding quality in sport services. This framework was presented from three perspectives, namely targets of quality, standards of quality, and evaluators of quality. This perspective in essence encapsulates the various dimensions of quality of services in sport. Papadimitriou & Karteroliotis (2000) suggested a four-factor model (FITSSQ) with 24 items

for fitness service quality expectations. The factors extracted were instructor quality, facility attraction and operation, program availability and delivery, and other services. In addition the authors found that the SERVQUAL scale was not an adequate scale to measure service quality in a leisure activity setting.

On examining the studies done in sport marketing and recreation, one finds that the research has been context specific (Theodorakis *et al*., 2001). Howat *et al*. (1999) for example, attempted to establish if significant differences exist among service quality, satisfaction and future patronage. The authors have found that respondents scored higher ratings for both service quality and satisfaction when they did not experience a problem with the service. Studies undertaken by Taylor *et al. (*1993) of two sport settings (a health club and a golf course) found that service quality positively influences satisfaction.

Although service quality may be evaluated in an overall gestalt, such an evaluation is of little value to managers (Crompton & MacKay, 1989). To maintain or improve service quality, managers of health and fitness centres must identify the dimensions of the service that are most important to patrons so that they can modify their management practices and allocate their resources effectively.

Hence, the current study provides an exploratory empirical assessment of the important service attributes in health and fitness centres. The main aim of the study was to develop a set of attributes, which can be incorporated in the measure of service quality at commercial health and fitness centres in South Africa. Commercial health and fitness centres for the purposes of this study are centres having the following characteristics: corporate/franchised; membership open to public; membership-fee based; and profit oriented.

RESEARCH DESIGN AND METHODOLOGY

The sample

Students enrolled in Sport Management programmmes at selected universities in Gauteng who were serving their experiential training placement were used as fieldworkers for the data collection. The nature of the study necessitated the use of non-probability convenience sampling (Parasuraman *et al.,* 1991; Meidan, 1996; Espinoza, 1999; Churchill, 2001). Convenience sampling allows a large number of respondents to be interviewed in a relatively short period of time, and for this reason is commonly used in construct and scale measurement development. Since sample size formulas cannot be appropriately used on non-probability samples, the determination of the sample size was based on past or similar studies (Zikmund, 2000). The sample size of 250 was deemed to be adequate to develop and refine initial instruments (Taylor *et al*., 1993; Kim & Kim, 1995). Care was taken to randomise the data collection procedure by conducting interviews at different days and times of the week. To ensure randomisation every third person was interviewed. Further representivity was achieved by ensuring that respondents visited the facility at least two times a week. Geographical representivity was established by ensuring that respondents from different health and fitness clubs in the South, Central and Northern Gauteng were included in the sample. Data was collected at the facility in an intercept type situation. The rationale for such a data collection strategy was based on the theory that respondents will be more attentive to the task of

completing the questionnaire and will provide meaningful responses when contextualised in the environment they are evaluating (Dabholkar *et al*., 1996).

Development of the instrument

Health and Fitness centres are essentially engaged in the provision of services. These services performed are like any other services provided by other industries. Thus research undertaken on service quality in general can be used as starting blocks in compiling an instrument to measure health and fitness centre service quality (Kim & Kim, 1995).

In developing the measurement instrument the researchers have followed the route of identifying critical dimensions of service quality (Parasuraman *et al*., 1985; Kim & Kim, 1995; Theodorakis *et al*., 2001). In addition two focus group interviews were conducted by the researchers at the university in order to obtain a better understanding of how participants perceive service quality within a health and fitness centre context. Such conceptualisation of service quality scale development is also supported by literature (Johnson *et al*., 1995, Dabholkar *et al*., 1996; Vasquez *et al*., 2001).

Insights into the services that consumers desire from health and fitness centres were initially obtained through a review of literature on service quality. Service quality was measured by using the contributions of the SAFS (Chelladurai *et al*., 1987), SERVQUAL (Parasuraman *et al.*, 1988), RECQUAL (Crompton *et al*., 1991), QUESC (Kim & Kim, 1995) and the CERM-CSQ (Howat *et al*., 1996) instruments.

The questionnaire consisted of a list of items used by consumers to assess the quality of services at health and fitness centres. The survey method, using a structured questionnaire was used. A panel of three people were invited to screen the instrument for its content validity. These individuals were selected, based in their academic and administrative expertise in the sport and fitness industry. Four items were removed from the scale as it was judged to be inappropriate to the organisational setting. Eight items were re-worded to reflect more specific attributes of service quality.

The questionnaire was pre-tested test using a sample of 15 respondents, comprising people who patronised health and fitness centres. Pre-testing was done by personal interviews by the researchers in order to observe respondents' reaction and attitudes (Malhotra, 2004). Debriefing occurred after the questionnaire was completed. Again, changes were made to questions with regard to re-phrasing, sequence, and layout (Chisnall, 2005). The final questionnaire contained 59 evaluative statements on health and fitness service quality.

In addition the questionnaire included statements on overall service quality and loyalty. These evaluative statements were used to establish the convergent validity of the scale. Both male and female respondents over 18 years of age were included in the sample. Two hundred and fifty one (251) questionnaires were completed. The sample consisted of 60.4% male (n=148) and 39.6% female (n=97) respondents. Majority of the respondents were single (69.7%) whilst married persons constituted 24.9% of the sample. A broad range of age groups were represented from individuals in the early 20's to the late 50's.

ANALYSIS OF RESULTS

The first step in analysing the internal structures of the service quality construct was to

perform exploratory factor analysis based on the 59 evaluative statements. Prior to factor analysis the appropriateness of factorability on the data set was established. The approximated χ^2 value of Bartlett's Test of Sphericity was 7104.50 (df=1711) at an observed significance level of 0.0000 thus rejecting the hypotheses that the population correlation matrix is an identity matrix, *i.e.* with zero correlations. In addition, the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy (MSA) was 0.902, which is considered "marvellous" by Kaiser (1974: 35) for factor analysis.

The principal component analysis (unrotated) was first applied, extracting factors with eigenvalue greater than one (Malhotra, 2004). This procedure produced factors that were difficult to interpret. Varimax rotation (using Kaiser normalisation) was then applied in order to obtain a clearer factor structure. Varimax rotation was used in order to minimise the number of variables with high loadings on a factor, thereby enhancing the interpretability of the extracted factorial model (Malhotra & Birks, 2003). Varimax rotation was also used in similar studies (Bahia & Nantel, 2000; Avkiran, 1994; Papadidmitriou & Karteroliotis, 2000). Eleven factors were initially extracted with reliability values ranging from 0.919 to 0.538 with four factors lower than the benchmark level of 0.70 as recommended by Nunnally (1978: 230). Similar to the studies conducted by Parasuraman *et al*. (1988), Kim and Kim (1995) and Papadimitriou and Karteroliotis (2000), the first factorial structure extracted contained cross-loadings of variables. Moreover, this structure was difficult to interpret, as only four of the eleven extracted factors shared a common core and independent meaning.

Item reduction and scale purification was then undertaken whereby items with low factor loadings, communalities and low-item-to-total correlations were investigated (Chandon *et al*., 1997; Aldlaigan & Buttle, 2002). The iterative process was re-run several times until a clear factor structure emerged. The determination of the number of factors to be extracted were homogeneously and conceptually accomplished by applying a combination of statistical approaches, namely, % of variance explained, the eigenvalue criterion, the scree plot, and taking into account the interpretability of factors (Nunnally, 1978; Malhotra, 2004). This resulted in an eight factor solution consisting of thirty nine variables. The final factor structure and the respective coefficient alphas (Cronbach α) are reflected in Table 2.

Factors were not constrained (*i.e.* not determined *a priori)* since this was an exploratory study and more specifically, the study was designed to measure service quality within a South African context. Relative importance of service quality dimensions and its ability to explain satisfaction may vary in different countries due to cultural variations. Such cultural differences may include consumers' perceptions of issues of lifestyle, wellness, economic, and socio-cultural factors (Malhotra *et al*., 1994).

DISCUSSION OF RESULTS

The measure of central tendency, dispersion and normality is reflected in Table 1. The lowest means turned out to be 1.962 for safety and support, and 1.963 for the facility attraction dimension, indicating that respondents agree that these dimensions are important in health and fitness service quality evaluation. The highest mean recorded was 2.838 for the programming

and medical dimension indicating that respondents were in moderate agreement to its contribution to service quality. The largest standard deviation was 0.999 and the smallest being 0.696. The standard deviations across all dimensions were <1 inferring that the sample

was relatively homogeneous. All dimensions reflect positively skewed distributions, indicating that the distribution is relatively symmetrical. The kurtosis values obtained from all the variables indicate that all the dimensions differed from zero, indicating that the distributions were either flat or more peaked than normal.

TABLE 1. **DESCRIPTIVE STATISTICS FOR AN EIGHT FACTOR SOLUTION**

Subscale	Mean	SD	Skewness	Kurtosis	No. of items
Personnel	2.487	0.843	0.881	1.144	12
Programming and medical	2.838	0.906	0.906	0.760	7
Convenience and information dissemination	2.630	0.999	0.999	0.592	4
Functionality and layout	2.131	0.801	0.801	1.070	3
Ambience and accessibility	2.111	0.784	0.784	0.865	3
Facility attraction	1.963	0.777	0.777	0.992	5
Safety and support	1.962	0.696	0.696	1.192	3
Membership	2.162	0.947	0.947	1.255	2

The internal consistency reliability of the eight factor solution was assessed by computing the alpha coefficients (Cronbach α). These results are reported in table 2. The alpha coefficients obtained on factors one to eight were 0.919; 0.825; 0.730; 0.729; 0.670; 0.717; 0.609 and 0.673 respectively. The reliability for factors one, two, three, four, and six were considered adequate *ie.* 0.70 and above (Nunnally, 1978) whereas for factors five, seven and eight indicates marginal internal consistency. These values of internal consistency are deemed acceptable as McKay and Crompton (1991); Chandon *et al*. (1997); Papadimitriou and Karteroliotis (2000) also reported similar values in their health and recreational studies. In addition, the very high coefficient alpha values of the total service quality scale construct ($\alpha=0.941$) supported the inclusion of these three dimensions.

Factor 1, labelled personnel consists of twelve variables and accounted for 32.4% of the variance. This dimension incorporates the responsiveness and assurance dimensions of the SERVQUAL scale and the employee attitude dimension of the QUESC scale. This factor demonstrated the important role that personnel play in delivering quality of service. The second factor, labelled programming and medical consist of seven variables and explained 7.3% of the variance. This dimension conceptually emphasises the significance of program availability and medical support in sport and fitness centres. It is evident that this factor combines the tangibles aspects of the SERVQUAL, the facility attraction and operation aspects of the QUESC, and the programme offered dimensions of the FITSSQ scales. The fact that this factor of the subscale explained the second highest % of variance indicates that patrons of health and fitness centres do form judgements of service quality based on programs and facility related attributes. The third factor extracted from the study, labelled convenience and information dissemination consists of four variables, accounted for 5.5% of the variance. This dimension relates to the information and convenience aspects of service quality. Issues such as space availability and information dissemination are essential to enhance service

delivery. Factor four, labelled functionality and layout consists of three items and accounted for 4.2% of the variance. This factor captures in essence some of the tangible variables of the SERVQUAL model. Bitner (1993) reaffirms that the centre atmosphere and appearance are important in global evaluations of a service. Further insights from environmental psychology

(Donovan *et al*., 1994) support the notion that an environment influences the attitude as well as the behaviour of consumers. It is apparent that due to the intangible nature of services and that service quality is difficult to evaluate, health and fitness patrons rely on this tangible evidence that surrounds the service to assist them in their evaluation of service quality (Hoffman & Bateson, 2002). Factor five, labelled ambience and accessibility consists of three items and accounted for 3.8% of the variance. This factor combines some of the variables of the tangible dimension of the SERVQUAL scale and the ambience dimension of the QUESC scale. Factor six, labelled facility attraction consists of five items and accounted for 3.3% of the variance. Facilities such as mirrors in training areas, proper aerobic studios and dressing facilities are essential to patrons in service quality evaluation. Factor seven, labelled safety and support consists of three items and accounted for 3.1% of the variance. Finally, factor eight labelled membership also consists of two items and accounted for 2.6% of the variance. In sum all eight factors accounted for 62.3% of the total variance explained, which according (Malhotra, 2004) is satisfactory. Whilst one would expect that the prime reason for a health and fitness centre's existence is to provide variety in terms of facilities and programs, it was not the case in this empirical study. These findings resonates similar views of other studies in this field (Papadimitriou & Karteroliotis, 2000: 162). These findings suggest that the human element (behaviour of facility personnel) is more important in service quality evaluation. This is also in line with some earlier studies that have highlighted the importance of "soft issues" such as trust, politeness, assistance and personal attention in improving service quality (Powell, 1995; Sureshchander *et al*., 2002; Dhurup, 2003).

TABLE 2. **ROTATED FACTOR LOADING MATRIX**

ITEM	F1	F2	F3	F4	F5	F6	F7	F8
Staff provides consistent services	0.746							
Staff shows interest in progress	0.727							
Staff are adequately trained	0.717							
Staff responds to your request	0.678							
Adequate supervision	0.665							
Instructors are adequately qualified	0.649							
Staff assistance	0.611							
Staff assistance in use of facilities	0.593							
Staff give you personal attention	0.542							
Staff conduct is ethical	0.521							
Staff instils a sense of confidence	0.511							
Remedy complaints immediately	0.484							
Adequate medical services		0.771						
Variety of fitness and health programs		0.714						
First aid available		0.678						
Pre-participation assessment		0.659						
Goal-differentiated programs		0.620						
Facilities for disabled persons		0.523						
Emergency evacuation		0.496						
Space for relaxation			0.645					
Updated notice boards			0.580					

ITEM	F1	F2	F3	F4	F5	F6	F7	F8
Space for warm-up and cool-down activities			0.534					
Suggestion box			0.517					
Modern fixtures and equipment				0.778				

	F1	F2	F3	F4	F5	F6	F7	F8
Adequate signage				0.718				
Centre layout				0.642				
Interaction with members					0.758			
Pleasant ambience					0.542			
Conveniently located					0.537			
Sufficient mirrors						0.811		
Wooden sprung floors for aerobic studios						0.611		
Dressing facilities						0.479		
Access to water						0.475		
Shower facilities are hygienic						0.401		
Safe in using facilities							0.711	
Staff politeness							0.609	
Equipment can be used with ease							0.410	
Membership easily purchased								0.745
Membership good value for money								0.627
Eigenvalue	12.64	2.89	2.12	1.64	1.50	1.28	1.22	1.02
% of variance explained	32.42	7.30	5.45	4.21	3.87	3.28	3.13	2.62
Cumulative %	32.42	39.72	45.18	49.39	53.26	56.55	59.68	62.31
Reliability (Cronbach alpha)	0.919	0.825	0.730	0.729	0.670	0.717	0.609	0.673

Extraction method: Principal Component Analysis Rotation method: Varimax with Kaiser Normalisation.

Variables with loading 0.40 excluded from analysis

To ensure that the health and fitness service quality scale satisfies content validity, a mixed methodology research process was followed. Initially a qualitative data collection process, namely, focus group interviews was undertaken to ascertain consumer perceptions of health and fitness service quality. Content validity was also ascertained by pre-testing the questionnaire and a review of the questionnaire by academics and practitioners in the field. The instrument was further purified during the various stages in the iterative process.

The scale's convergent validity was assessed for statistical significance by using Kendall's tau b correlation coefficient. The eight dimensions of health and fitness service quality were correlated with C1 of the questionnaire (i.e." Overall, I am satisfied with the quality of service provided by this centre"). Kendall's tau b correlation coefficient supports the notion behind convergent validity that the observed results are not an artefact of the instrument i.e. that there is high correlation with the results from the instrument designed to measure the same construct (Avkiran, 1994). Thus the following hypothesis was formulated:

H_1 *There is no association between health and fitness service (as measured by the eight dimensions of service quality) and overall service quality (as measured by C1 of the questionnaire).*

Table 3 reflects that the marked correlations are all significant at $p < 0.01$. Hypothesis H_1 is therefore rejected. This implies that the eight dimensions of service quality do in fact converge with the measure of overall service quality. Furthermore, the reliability of a scale as measured

by coefficient alpha (0.941) reflects the degree of cohesiveness among scale items and is an indirect indicator of convergent validity.

TABLE 3. **CORRELATION: DIMENSIONS OF SERVICE QUALITY WITH OVERALL SATISFACTION**

Dimensions	n	Significance (2 tailed)	Correlation coefficient/ Overall satisfaction
Personnel	235	0.000	0.505 (**)
Programming and medical	242	0.000	0.343 (**)
Convenience and information dissemination	237	0.000	0.363 (**)
Functionality and layout	244	0.000	0.245 (**)
Ambience and accessibility	243	0.000	0.352 (**)
Facility attraction	237	0.000	0.478 (**)
Safety and support	245	0.000	0.444 (**)
Membership	243	0.000	0.334 (**)

** Correlation is significant at the 0.01 level (2 - tailed)

CONCLUSION, RECOMMENDATIONS AND IMPLICATIONS FOR FUTURE RESEARCH

The study adopted a conceptual framework for identifying dimensions of health and fitness service quality. The findings of this preliminary factorial analysis do provide support that there are potentially eight dimensions of health and fitness service quality: namely, personnel, programming and medical, convenience and information dissemination, functionality and layout, ambience and accessibility, facility attraction, safety and support, and membership. These findings concur with results from earlier studies that service quality is indeed a multidimensional construct (Papadimitriou & Karteroliotis, 2000) which requires multiple item measures. Whereas the Parasuraman *et al*. (1988) SERVQUAL model is in part encapsulated in this scale, the number and types of dimensions lends support to Carman (1990), Buttle (1996) and Williams (1998) comments that the service quality construct much depends on the service industry under investigation, its service settings and its related service attributes. Hence it was not surprising that substantial differences emerged as only a few of the items of the SERVQUAL scale were found to be efficacious within the context of health and fitness centre service quality. The results also indicate that the SERVQUAL authors were optimistic in their claim that "the instrument has been designed to be applicable across a broad spectrum of services" which " can be adapted or supplemented to fit the characteristics of the specific needs of a particular organisation (Parasuraman *et al*., 1988: 31). Notwithstanding such criticism, the SERVQUAL model does provide valuable conceptual and operational insights in the measurement of service quality.

Within the eight dimensions, the personnel dimension was found by patrons as most pertinent. Issues such as consistency in service, interest in progress of patrons, proper training and supervision, qualified instructors, staff assistance, ethical conduct, confidence and complaints

handling are high on the agenda of patrons in service quality perceptions of a health and fitness centre.

The dimensions of health and fitness service quality were operationalised by a series of statements that provide managers with an evaluation tool which can translate the abstract

construct of service quality into meaningful actions. In practical terms, the eight factor structure can provide an invaluable assessment tool for service quality in health and fitness centres in South Africa. The scale might serve as a diagnostic methodology to uncover broad areas of health and fitness service quality, shortfalls and strengths. The instrument can also be used to measure both overall service quality achieved by health and fitness centres and a dimension-based estimate of service quality (Crompton *et al*., 1991). The instrument may also be useful for gathering data that can be utilised to benchmark current levels of service quality among health and fitness centres belonging to the same chain or with competitors.

This study, undertaken within the health and fitness setting, adds to the growing literature, which calls for the re-examination of how to measure and manage service quality. The results of this study cannot be accepted as being completely relevant and applicable to all health and fitness centres because of the limited sample size and the sampling procedure. There is a possibility that perceptions may vary from customers among other developed countries (Dhurup *et al*., 2005). However, there may be differences in the manner in which profit and non-profited oriented health and fitness centres operate in South Africa which may necessitate differences in the operationalisation of the service quality construct. Further research initiatives are encouraged to test the reliability and stability of the health and fitness service quality scale in commercial health and fitness centres.

This study has certain practical implications for practitioners in the Health and Fitness industry. Firstly, the human resources engaged in producing their experiences as services should be specifically trained with regard to identifying the components of customer service quality. Secondly, they should also be trained in techniques to enhance customer satisfaction. Lastly, marketing managers in this sector of the industry should be trained in utilising current but locally relevant and reliable measurement instruments in order to monitor customer satisfaction. Future researchers may also build on the knowledge of service attributes developed in this study by developing measures of patron satisfaction using similar methods. Advancing the measurement of service quality and satisfaction in sport and recreational setting will lead to further research investigating the relationships among other constructs such as facility loyalty. Although this study included a number of ambience (atmospheric) variables, the authors did not manipulate any of these variables and explore the effect on consumer's perception of the environment.

Finally, a comprehensive framework has been proposed reflecting both its practical application and statistical reliability which can be used to measure and understand customer perceptions of service quality in a health and fitness context. It is hoped that the findings of the study (which might be referred to as (HAFSQ) will help to advance an archetype of health and fitness service quality in order to comprehend better the concept of service quality and its constituents.

REFERENCES

ALDLAIGAN, A.H. & BUTTLE, F.A. (2002). SYSTRA-SQ: a new measure of bank service quality. *Industrial Journal of Service Industry Management*, 13(3): 362-381.

AVKIRAN, N.K. (1994). Developing an instrument to measure Customer Service Quality in Branch Banking. *International Journal of Bank Marketing,* 12(6): 10-18.

BABAKUS, E. & BOLLER, G.W. (1992). An empirical assessment of the SERVQUAL scale. *Journal of Business Research*, 24: 253-268.

BAHIA, K. & NANTEL, J. (2000). A reliable and valid measurement scale for perceived service quality in banks. *The International Journal of Bank Management*, 12(2): 38-48.

BERRY, L.L. (1986). Retail businesses are service businesses. *Journal of Retailing,* 62: 3-6.

BITNER, M.J. (1993). SERVICESCAPES: The impact of physical surroundings on customers and employees*. Journal of Marketing*, 56: 57-71.

BOSHOFF, H.C. (1990). Perceptions of services quality in three selected service industries. Unpublished Doctor of Commerce dissertation. Pretoria: University of Pretoria.

BUTTLE, F. (1996). SERVQUAL: review, critique, research agenda. *European Journal of Marketing*, 30(1): 8-32.

CAMERON, K. & WHETTEN, D. (1983). Organisational effectiveness: A comparison of multiple models. New York, NY: Academic Press.

CARMAN, J.M. (1990). Consumer perceptions of service quality: an assessment of the SERVQUAL dimensions. *Journal of Retailing*, 66: 33-55.

CHAD, R. (1995. Health clubs add convenience services to place busy patrons. *Marketing News*, 29(6): 1-3.

CHANDON, L.; LEO, L. & PHILIPPE, J. (1997). Services encounter dimensions - a dyadic perspective: measuring the dimensions of service encounters as perceived by customers and personnel. *International Journal of Service and Industry Management*, 8(1): 65-86.

CHANG, C.M.; CHEN, C.T. & HSU, C.H. (2002). A review of service quality in corporate and recreational sports/fitness programs. *The Sports Journal*, 5(3): 1-10.

CHELLADURAI, P. & CHANG, K. (2000). Targets and standards of quality in sports services. *Sports Management Review*, 3:1-22.

CHELLADURAI, P.; SCOTT, F.L. & HAYWOOD-FARMER, J. (1987). Dimensions of fitness services: Development of a model. *Journal of Sport Management*, 1: 159-172.

CHISNALL, P. (2005). *Marketing research* (7th ed.). London: McGraw-Hill.

CHURCHILL, G.A. (Jr). (2001). *Basic marketing research* (4th ed.). Cincinnati, OH: Thomson Learning.

CROMPTON, J.; MACKAY, K.J. & FESENMAIER, D. (1991). Identifying dimensions of service quality in public recreation. *Journal of Park and Recreation Administration,* 9(3): 15-27.

CROMPTON, J.L & MACKAY, K.J. (1989). Users perception of the relative importance of service quality dimensions in public recreation programs. *Leisure Services*, 11: 367-375.

CRONIN, J.J. & TAYLOR, S.A. (1992). Measuring service quality: a re-examination and extension. *Journal of Marketing*, 56: 55-68.

DABHOLKAR, A.; THORPE, I.D. & RENTZ, O.J. (1996). A measure of retail service quality: scale development and validation. *Journal of the Academy of Marketing Science*, 24(1): 3-16.

DHURUP, M. (2003). Customer perceptions of supermarket service quality: scale development, measurement and validation. Unpublished PhD dissertation. Potchefstroom: PU for CHE.

DHURUP, M.; VENTER, P. & OOSTHUYZEN, A. (2005). A factor analytical service quality measurement scale for supermarkets in South Africa. *South African Journal of Economic and Management Science,* 8(2): 140-153.

DONOVAN, R.J.; ROSSITTER, J.R.; MARCOOLYN, G. & NESDALE, A. (1994). Store atmosphere and purchasing behaviour. *Journal of Retailing*, 70(3): 283-294**.**

DU PLESSIS, F.; ROUSSEAU, D. & BLEM, N. (1995). *Buying behaviour: strategic marketing applications*. Halfway House: Southern Book Publishers.

ENNEW, C.T.; REED, G.V. & BRINKS, M.R. (1993). Importance-performance analysis and measurement of service quality. *European Journal of Marketing,* 27(2): 59-70.

ESPINOZA, M.M. (1999). Assessing the cross-cultural applicability of a service quality measure: a comparative study between Quebec and Peru. *International Journal of Service Industry Management*, 10(5): 449-468.

GRÖNROOS, C. (1984). A service quality model and its marketing implications. *European Journal of Marketing*, 18(4): 36-44.

GUMMESSON, E. & GRÖNROOS, C. (1987). Quality in the service sector: Lessons from the product sector. In C. Suprenant (Ed.), *Add value to your services: the key to success. Proceeding series*, (35-39). Chicago, IL: American Marketing Association.

HARRIS, M. & HARRINGTON, H.J. (2000). Service quality in the knowledge gap: Huge opportunities for the twenty first century. *Measuring Business Excellence,* 4(4): 31-36.

HAYWOOD-FARMER, J. (1988). A conceptual model of service quality. *International Journal of Operations and Production Management*, 8(6): 19-27.

HOFFMAN, K.D. & BATESON, J.E.G. (2002). *Essentials of services marketing: concepts, strategies and cases* (2nd ed.). Fort Worth, TX: Harcourt College Publishers.

HOWAT, G.; GRILLEY, G.; ABSHER, J. & MILNE, L. (1996). Measuring service quality in sport and leisure centres. *Managing Leisure*, 1(2): 77-89.

HOWAT, G.; MURRAY, D. & CRILLEY, G. (1999). The relationship between service problems and perceptions of service quality, satisfaction, and behavioural intentions of Australian public sport and leisure customers. *Journal of Park and Recreation Administration*, 17(2): 42-64.

JOHNSON, R.L.; TSIROS, M. & LANCIONI, R.A. (1995). Measuring service quality: a systems approach. *Journal of Services Marketing,* 9(5): 6-19.

KAISER, H.F. (1974). An index of factorial simplicity. *Psychometrika*, 29(1): 31-36.

KELLY, S.W. & TURLEY, L.W. (2001). Customer perceptions of service quality attributes at sporting events. *Journal of Business Research*, 54: 161-166.

KIM, D. & KIM, S.Y. (1995). QUESC: An instrument for assessing the service quality of sports centres in Korea. *Journal of Sport Management,* 9: 208-220.

KLAUS, P.G. (1985). Quality epiphenomenon: the conceptual understanding of quality in face-to-face service encounters. In J. Czepiel; M.R. Solomon & C.F. Suprenant (Eds.), *The service encounter: managing employee-customer interactions in service businesses* (17-33). Lexington, MA: Lexington Books.

KOTLER, P. (2000). *Marketing management: the Millennium edition*. New Jersey, NJ: Prentice-Hall.

LENTELL, R. (2000). Untangling the tangibles: physical evidence and customer satisfaction in local authority leisure centres. *Managing Leisure*, 5: 1-16.

MALHOTRA, N.K. (2004). *Marketing research: an applied orientation* (4th ed.). New Jersey, NJ: Prentice-Hall.

MALHOTRA, N.K. & BIRKS, D.F. (2003). *Marketing research: an applied approach* (2nd ed.). London: Prentice-Hall.

MALHOTRA, N.K.; ULGADO, F.M.; AGARWAL, I. & BAALBAKI, I.B. (1994). International service marketing: a comparative evaluation of the dimensions of service quality between developed and developing countries. *International Marketing Review*, 11(2): 91-127.

McDONALD, M.; SUTTON, W. & MILNE, G. (1995). Measuring service quality in professional team sports. *Sports Marketing Quartely*, 4(2): 9-16.

MEIDAN, A. (1996). *Marketing financial services*. London: Macmillan.

METHA, C.; LALWANI, A.K. & LI HAN, S. (2000). Service quality in retailing: relative efficiency of alternative measurement scales for different product-service environments. *International Journal of Retail & Distribution Management,* 28(2): 62-72.

NUNNALLY, J.C. (1978). *Psychometric theory* (2nd ed.). New York, NY: McGraw-Hill.

PAPADIMITRIOU, D.A. & KARTEROLIOTIS, K. (2000). The service quality expectations in private sport and fitness centres: A re-examination of factor structure. *Sport Marketing Quartely*, 9(3): 15-27.

PARASURAMAN, A.; ZEITHAML, V. & BERRY, L.L. (1985). A conceptual model of service quality and its implications for future research. *Journal of Marketing*, 49: 41-50, Fall.

PARASURAMAN, A.; ZEITHAML, V. & BERRY, L.L. (1988). SERVQUAL: a multiple-item scale for assessing consumer perceptions of service quality. *Journal of Retailing*, 64(1): 12-35, Spring.

PARASURAMAN, A.; ZEITHAML, V. & BERRY, L.L. (1991). Refinement and re-assessment of the SERVQUAL scale. *Journal of Retailing*, 67(4): 420-450.

PARASURAMAN, A.; ZEITHAML, V. & BERRY, L.L. (1994). Alternative scales for measuring service quality: a comparative assessment based on psychometric and diagnostic criteria. *Journal of Retailing*, 70(3): 201-231.

PARKHOUSE, B.L. (2005). *The management of sport: its foundation and application* (4th ed.). New York, NY: McGraw-Hill.

PORTER, M.A. (2005). Wellness at Work. *Management Association*, April: 49-54.

POWELL, C.T. (1995). Total quality management as competitive advantage: a review and empirical study. *Strategic Management Journal*, 16: 15-37.

REICHHELD, F. & SASSER, W.E. (1990). Zero defections: quality comes to service. *Harvard Business Review,* 68(5): 105-111.

REYNOSO, J. & MOORES, B. (1995). Towards the measurement of internal service quality. *International Journal of Service Industry Management*, 6(3): 64-83.

SIVADAS, E. & BAKER, J.L. (2000). An examination of the relationships between service quality, customer satisfaction and store loyalty. *International Journal of Retail and Distribution* Management, 28(2): 1-13.

SMITH, A.M. (1990). Quality aspects of services marketing. *Journal of Marketing Intelligence & Planning*, 8(6): 25-32.

SURESHCHANDER, G.S.; RAJENDRAN, C. & ANANTHARAMAN, R.N. (2002). Determinants of customer-perceived service quality: a confirmatory factor analyis approach. *Journal of Services Marketing*, 16(1): 9-34.

TAYLOR, S.A.; SHARLAND, A.; CRONIN, J. & BULLARD, W. (1993). Recreational service quality in the international setting. *International Journal of Service Industry Management*, 4(4): 68-86.

TEAS, K.R. (1993). Expectations, performance evaluation, and consumers' perceptions of quality. *Journal of Marketing,* 57: 18:34.

TERBLANCHE, N.S. (1998). *Retail management*. Johannesburg: Thomson Publishing.

THEODORAKIS, N.; KAMBITSIS, C.; LAIOS, A. & KOUSTELIOUS, A. (2001). Relationship between measures of service quality and satisfaction of spectators in professional sports. *Managing Service Quality*, 11(6): 431-438.

VAZQUEZ, R.; IGNACIO, A.; DEL-BOSTIQUE, R.; DIAZ, A.M. & RUIZ, A.V. (2001). Service quality in supermarket retailing: identifying critical service experiences. *Journal of Retailing and Consumer Services,* 8: 1-14.

WAGER, J.A. (1966). Quality in outdoor recreation. *Trends in Park and Recreation*, 3(3): 9-12.

WILLIAMS, C. (1998). Is SERVQUAL model an appropriate management tool for measuring service delivery quality in the UK leisure industry? *Managing Leisure*, 3: 98-110.

ZEITHAML, V.A. & BITNER, M.J. (2000). *Services marketing: integrating customer focus across the firm* (2nd ed.). Boston, MA: McGraw Hill.

ZIKMUND, W.G. (2000). *Exploring marketing research* (7th ed.). FortWorth, TX: Harcourt College Publishers.

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THE EFFECT OF A PHYSICAL ACTIVITY PROGRAMME ON THE SELF-ESTEEM OF PRE-PRIMARY HIV-DIRECTLY AFFECTED LEARNERS

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ABSTRACT

Literature shows that HIV/AIDS greatly affects the self-esteem of HIV/AIDS affected learners (these affected learners are either directly infected, or one or both parents are or had been infected). Studies also show that developmentally appropriate

physical activities can have a positive influence on a child's self-esteem. The purpose of this study was to determine the effect of a developmentally appropriate physical activity programme on the gross motor and perceptual motor skills and the self-esteem of HIV/AIDS-affected learners. Eight gross motor and perceptual motor skills, as well as self-esteem was evaluated among 30 directly-affected learners in a pre-primary school for terminally sick children in Potchefstroom. Evaluation took place before and after the implementation of a 12-week long developmentally appropriate physical activity programme. The motor scores as well as the self-esteem scores of the experimental group showed statistically significant ($p \leq 0.05$) improvements after the completion of the programme, in contrast with the scores of the control group which showed no significant improvements. These improvements entailed certain fundamental locomotor and balance skills, and self-perceived competence with reference to certain movement skills, as well as peer acceptance. The results imply that by improving the gross motor and perceptual motor skills of HIV/AIDS-affected learners by means of a developmentally appropriate physical activity programme, the self-esteem and related aspects of these learners may be enhanced.

Key words: Developmentally appropriate physical activity; Gross motor; Perceptual motor; HIV/AIDS; Pre-primary; Self-esteem.

INTRODUCTION

HIV-infected and affected children have received increased attention during the past few years, due to their rising numbers in South Africa and around the world (Wiener *et al.*, 1999; Lwin & Melvin, 2001; Human Sciences Research Council, 2004). The prevalence of HIV among the 2-9 year age group is currently estimated to be 6.7% (Human Sciences Research Council, 2004).

The extent of children not necessarily infected, but also directly affected by HIV (having lost one or both parents due to AIDS), can be seen in the number of AIDS-orphans in South Africa which in 2001 was estimated to be between 190 000 (Vass, 2003) and 420 000 (Bradshaw *et al.*, 2002) and predicted to rise to over 1.5 million in 2010 (Bradshaw *et al.*, 2002; Vass, 2003; Frederiksen & Kanabus, 2004). Of the total population of AIDS-orphans, an estimated 4% to 12% are orphaned when they are between 2 and 7 years old (Johnson & Dorrington, 2001).

With continuing research and progress in the treatment of HIV/Aids, HIV-positive children are, however, living longer and fuller lives (Wiener *et al*, 1994; Bacha *et al.*, 1999). According to Brown *et al.* (2000), international advances in therapies have led to more than 65% of children with HIV living past five years of age. In the USA, it is estimated that over 49.5% of HIV-positive children receiving basic medication, survives their ninth year (Wiener *et al.*, 1994). According to the Milennuim HIV/Aids Project (GNMTCP, 2000), 25% of South African children who are HIV-positive live past five years of age. According to Lwin and Melvin (2001), the picture of paediatric HIV is increasingly one of living long term with the virus rather than dying from its effects.

Due to both the higher life expectancy of HIV-positive children and the increasing number of Aids-orphans, intervention and social programmes aimed at improving quality of life are increasingly emphasizing the psychological needs and issues of these children (Bacha *et al.*, 1999; Brown *et al.*, 2000; GNMTCP, 2000; Lwin & Melvin, 2001; Bicego *et al.*, 2003). Studies have shown that children infected and/or affected by HIV experience higher levels of

anxiety and lower levels of self-esteem than their unaffected peers, independent of their knowledge of their HIV-status (Havens *et al.*, 1994, Wiener *et al*., 1994). In an extensive review of studies which address HIV infection and its psychological and social implications, Brown *et al.* (2000) point out reasons for anxiety and low self-esteem in HIV-infected children such as the disclosure of HIV-infection, social ostracism, fears of death, family conflict and family instability.

The above review supports the view that support and intervention programmes should be encompassing, addressing not only the medical and physical but also their psychological needs in order to improve the quality of life of HIV-directly affected children. According to Bacha *et al*. (1999), Brown *et al.* (1999) and Lwin and Melvin (2001), the ideal treatment model for children affected by HIV would involve pediatricians, social workers, psychologists, psychiatrists, occupational therapists, physical therapists and language therapists. Many such programmes already exist in the USA (Bacha *et al.*, 1999; Brown *et al.*, 1999) and in Europe (Lwin & Melvin, 2001).

In South Africa, however, circumstances are very much different from those in the USA and other countries due to higher prevalence rates of HIV. In the absence of such complete multidisciplinary intervention programmes, the person who often plays the most important role in supporting the HIV-infected and affected child in the ways described above, is the teacher in school.

In the current South African educational system, and in the Foundation phase especially, one developmental aspect that is currently emphasized more in the Foundation phase than in the other phases, is physical and motor development. The reason for this is that the age period of 2-7 years is considered to be the critical years of a child's motor development, as, through play and physical activities, the fundamental gross motor skills develop during this period (Gabbard, 1998; Gallahue & Ozmun, 1998). Children living with HIV often show delays in achieving motor milestones and experience perceptual-motor delays (Wiener *et al.*, 1994; Melvin, 1996; Brown *et al.*, 1999).

Several studies pertaining to the improvement of motor skills and self-esteem among young children focus on the improvement of motor skills through physical activity, and the

relationship there-of to self-esteem (Corbin, 2002; Rose & Larkin, 2002; James & Collier, 2004; Miyahara & Wafer, 2004). According to Bunker (1991), there is a dynamic interaction between motor skill competency and self-esteem in the young child (2 to 10 years), and the results of several studies support this statement (Thomas, 1999; Miyahara, 2004; Rose & Larkin, 2004).

No studies could be found pertaining to the self-esteem of pre-primary learners affected by HIV in South Africa, and no studies could be found on the effect of physical activity on the self-esteem of pre-primary learners directly affected by HIV in South Africa.

In the light of the psychosocial problems developed by HIV-infected and directly affected children and the need for more holistic intervention programmes in South Africa, the question arises whether a physical activity programme in the form of gross motor and perceptual motor activities will improve the levels of self-esteem of pre-primary HIV-directly affected (infected or having lost one or both parents due do HIV/AIDS) children. The answer to this question could confirm the value of a well-structured physical activity programme for Foundation

phase teachers in enhancing the quality of life for HIV-infected and affected children.

The objective of this study involved a developmentally appropriate physical activity programme in the form of gross motor and perceptual motor activities for HIV-affected pre-primary children. The focus was twofold: firstly, to determine whether the programme would improve the gross motor and perceptual motor skills of the participants, and secondly, to determine whether the programme would improve the self-esteem of the participants.

METHOD

Participants

The original sample consisted of 28 pre-primary children of the ages four (N=12, seven male and five female), five (N=8, three male and five female) and six years (N=7, two male and five female), from a school which accommodates terminally-ill children in Promosa, a suburb of Potchefstroom in South Africa. Age was defined by the participant's birthday in the year of the study. Of these 28 participants, 18 had been tested HIV-positive and the remaining 10 were tested negative but were directly affected, having lost one or both parents due to AIDS. All the participants were from a lower socio-economic status or previously disadvantaged background.

The participants were paired according to their ages and HIV-status (whether the participant was infected or affected) and the pairs were randomly assigned to an experimental (N=14) and control group (N=14), resulting in two groups with the same number of HIV-infected and HIV-affected learners and an even distribution of ages. Two participants from the experimental group died during the course of the study due to AIDS, resulting in a number of 12 participants in this group. The mean age of the final experimental group was 5.00 years ($\pm$0.74) and the age of the control group 4.71 years ($\pm$0.99).

Assessment procedures

All the participants were tested before and directly after the implementation of the programme. Testing was done on the school premises, and assistants and translators were used for this purpose. The assistants were Movement Education students in their final year, and had been extensively trained in the assessment of motor skills and self-esteem of learners in the Foundation phase. The participants were tested by the same test administrator before and after the programme. The translators went through an in-depth training session before the assessments started, and assisted during the self-esteem assessment in translating the instructions or questions of the test administrator to the participant, as English was not the first language of many of the participants.

Gross motor and perceptual motor assessment

Standing long jump, hopping, skipping, one leg balance, balance walk, catching and throwing-for-distance were selected as the gross and perceptual motor skills to be tested. These skills were selected for three reasons:

1) They represent the three categories of movement, namely basic locomotion (standing long jump, hopping and skipping), balance (one leg balance and hopping), and manipulation (throwing and catching) (Gallahue & Ozmun, 1998);

2) they are used extensively in established motor test batteries for children of these age groups (Bruininks, 1978; Folio & Fewell, 1983; Frankenburg, 1990; Henderson & Sugden, 1992; Pyfer, 1990; Ulrich, 1985); and

3) they are suitable to use in the form of a screening test in a physical activity programme consisting of gross and perceptual motor activities because of their simplicity and compatibility with the type of activities used in the programme.

The skills were evaluated based on the following procedures:

Standing long jump (Bruininks, 1978; Ulrich, 1985). The test measured how far the child could jump horizontally, using a two-foot takeoff and landing. The score was the highest of three trials.

Hopping (Frankenburg, 1990; Mutti *et al.*, 1998). The test entailed two trials of hopping forward on each leg as many times as possible, up to a maximum of 12 hops. The higher score was taken.

Skipping (Mutti *et al.*, 1998; Pyfer, 1990). The skipping pattern (step, hop, step, hop) was demonstrated by the researcher and then the participant was asked to skip across the room. According to Gallahue and Ozmun (1998), 20% of five year olds and nearly all six year olds can skip proficiently. Therefore, skipping was only evaluated among the five and six year olds. The number of skipping steps done correctly, to a maximum of four, was taken as the score.

One leg balance (Henderson & Sugden, 1992; Mutti *et al.,* 1998). The test entailed two trials of balancing on one foot, with the arms hanging at the sides, for as long as possible up to a maximum of 12 seconds. The participant was instructed to stand with the free leg bent backwards at the knee and kept off the floor. Swaying was allowed, and the arms were allowed to move to maintain balance. Balancing was tested on both legs, and the better of the two trials taken as the score.

Throwing (Folio & Fewell, 1983; Haubenstricker & Seeveldt, 1986). The test entailed throwing a tennisball as far as possible, using the overhand technique. The longer distance of two throws was scored.

Catching (Bruininks, 1978; Folio & Fewell, 1983; Pyfer, 1990). The test measured the ability to catch an aerial, underhand thrown 20 cm ball with two hands. The thrower was positioned 2 meters from the participants and aimed the ball at the participant's chest. The score was the number of successful catches off five throws.

Assessment of self-esteem

The Pictorial Scale of Perceived Competence and Social Acceptance for Young Children (PSPCSA) (Harter & Pike, 1984a) was used to evaluate the self-perceived competence and social acceptance of the participants. This standardized scale is designed for assessing the self-esteem of children of the ages 4-7 and has four separate subscales: Cognitive Competence, Physical Competence, Peer Acceptance and Maternal Acceptance. Each of these subscales is comprised of six items constituting a total of 24 items. The items are bound as a booklet of pictures depicting children. The participant is asked to choose between paired pictures, and indicate which one is more like him or her, for example a boy or girl surrounded by several friends, or a child with only one friend. The test contains separate picture plates for male and female participants, depicting boys or girls in the pictures with the aim of enhancing the

identification of the participant with the picture. Each item is scored on a scale of 1 to 4 where a score of 1 indicates low perceived competence and a score of 4 indicates high perceived competence. The test was presented individually to the participants, by the tester and the translator according to the instructions in the test manual. Acceptable validity and reliability is reported for the scale (Harter & Pike, 1984b).

As many of the participants were maternal orphans, before the assessment started the participant was asked whom he or she lived with, and where applicable the word "mother" was replaced with the title of the gaurdian of the participant in the test items of the Maternal Acceptance subscale. Therefore, this subscale in fact measured gaurdian acceptance. One item, where the picture plate depicts a child getting stars on his or her papers, was excluded due to the fact that the participants in this study were not familiar with this method of rewarding papers in school as the school didn't apply it. The score of the cognitive subscale was therefore calculated on the basis of 5 items, according to the guidelines of Harter and Pike (1984a).

The physical activity programme

The physical activity programme was presented in the form of gross and perceptual motor activities, by trained fourth year Movement Education students and consisted of 12 lessons of 30 minutes each. Each lesson consisted of six to eight activities addressing the main gross motor and perceptual motor components of total body co-ordination, static and dynamic balance, hand-eye co-ordination, foot-eye co-ordination, spatial orientation and body awareness. Activities addressing these components varied across lessons and different apparatus were used in every lesson. The lessons and activities were compiled according to the guidelines of Gallahue (2003) and were adapted to fit the developmental level and ages of each group.

The control group stayed in the class room during each physical activity session, watching age-appropriate, fictional videos provided by the researchers.

For each lesson, the apparatus to be used in the next lesson was manufactured by the learners and the teachers during classes, with the purpose of motivating learners to be proud and excited and to look forward to use the apparatus during the physical activity lesson. The self-made apparatus made it possible for the learners to take it home and practise the skills after the lesson. An example lesson from the programme as well as instructions on making such apparatus for the lesson are included in Appendix A.

Statistical analysis

All calculations of means (*M*), standard deviations (*SD*), degrees of freedom (df), p-values and t-values were done using the Statistica for Windows (6.0) computer programme (Statsoft, 1995). A dependent sample t-test was used to determine pre and posttest score differences for each item of the motor skill tests, the PSPCSA as well as the four subscales and the total score of the PSPCSA. The Wilcoxon Sign Rank Test, a nonparametric statistic test appropriate for small range scores, was also administered to confirm the results of the dependent t-tests pertaining to the PSPCSA. Statistical significance was set at $p \leq .05$.

RESULTS

Motor skill assessment

Descriptive statistics for the motor assessment for both control and experimental conditions are presented in Table 1. Independent sample t-test of pretest scores indicated no significant differences between the control and experimental groups in any of the motor skill or PSPCSA scores before the implementation of the movement programme.

TABLE 1: **MEAN SCORES AND STANDARD DEVIATIONS OF MOTOR TESTS IN AFFECTED CHILDREN (*N=26*) BEFORE AND AFTER THE PHYSICAL ACTIVITY PROGRAMME**

	Experimental group (*N=12*)				Control group (*N=14*)			
	Before		After		Before		After	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Long jump	48.17	21.36	65.58	25.29	47.14	29.09	55.21	36.36
Hop L leg	5.75	3.22	9.58	4.85	6.57	4.67	7.43	6.12
Hop R leg	8.00	3.81	9.42	5.25	8.00	5.25	6.64	5.60
Skip	3.50	1.17	3.33	2.45	3.42	1.16	3.20	1.69
One leg balance L	7.00	3.98	8.50	3.32	4.93	4.16	6.43	3.98
One leg balance R	6.67	3.73	9.17	2.04	5.00	4.21	7.21	3.93
Catching	4.33	0.98	4.67	0.65	4.21	1.37	4.43	0.76
Throwing distance	6.73	3.16	7.56	4.18	6.59	3.38	6.70	4.42

Note: L = left; R = right, SD = standard deviation.

As indicated in Table 2 which shows the statistical analysis of the differences between the scores of the first and second motor skill evaluation, statistically significant differences were found with reference to the standing long jump, hopping on the left leg, and balancing on the left and the right leg in the experimental group. The scores of the motor tests of the control group showed no significant differences ($p \leq 0.05$) in any of the motor skill tests.

TABLE 2: **RESULTS OF THE DEPENDENT T-TESTS IN THE MOTOR SKILL TESTS: T-VALUES, DEGREES OF FREEDOM AND P-VALUES DEPICTING DIFFERENCES BETWEEN THE BEFORE AND AFTER SCORES OF AFFECTED CHILDREN (*N=26*)**

	Experimental group (*N=12*)			Control group (*N=14*)		
	t	df	p	t	df	p
Long jump	-2.427	11	0.034*	-1.132	13	0.278
Hop L leg	-2.972	11	0.013*	-0.882	13	0.394
Hop R leg	-1.028	11	0.326	1.133	13	0.278
Skip	0.408	8	0.694	1.481	9	0.173
One leg balance L	-2.721	11	0.020*	-1.902	13	0.080
One leg balance R	-2.307	11	0.042*	-2.136	13	0.052
Catching	-1.483	11	0.166	-0.467	13	0.648
Throwing distance	-1.568	11	0.145	-0.221	13	0.829

*Note: * = statistically significant at $p \leq 0.05$; df = degrees of freedom.*

Self-esteem assessment

Descriptive statistics for the individual items of the self-esteem assessment for both control and experimental conditions are presented in Table 3. As indicated in Table 4 which shows the dependent t-tests and the Wilcoxon Sign Rank test, both the experimental group and the control group showed significant differences between the scores of the pretests and posttests in the cognitive subscale item "Knows names of colours" and in the experimental group, the physical competence subscale item "Good at skipping".

TABLE 3: **MEAN SCORES AND STANDARD DEVIATIONS OF ITEMS IN THE PSPCSA ASSESSMENT OF AFFECTED CHILDREN (*N=26*) BEFORE AND AFTER THE PHYSICAL ACTIVITY PROGRAMME**

	Experimental group (*N=12*)				Control group (*N=14*)			
	Before		After		Before		After	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Good at puzzles	3.33	0.98	3.75	0.45	3.14	1.10	2.64	1.15
Has lots of friends	3.08	1.08	3.42	0.79	2.71	1.38	3.14	1.23
Good at swinging	3.67	0.65	3.75	0.45	3.57	0.76	3.86	0.37
Mom smiles at you often	3.75	0.62	3.25	0.97	3.36	1.08	3.50	0.94

	Experimental group (*N=12*)				Control group (*N=14*)			
	Before		After		Before		After	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Stays overnight at friends	2.33	1.23	3.00	1.13	1.86	1.41	1.86	1.10
Good at climbing	3.33	0.98	3.50	1.00	3.21	1.19	3.71	0.61
Mom takes you places	3.25	1.06	2.75	1.42	3.29	1.14	3.14	1.29
Knows names of colours	2.83	1.19	3.67	0.49	2.29	1.33	3.21	0.89
Has friends to play with	2.92	1.24	3.83	0.39	2.64	1.45	3.50	1.09
Can tie shoes	3.08	1.31	3.75	0.45	2.86	1.23	3.29	1.14
Mom cooks favourite foods	3.17	1.27	3.25	1.06	3.21	1.12	3.50	0.94
Good at counting	3.25	1.06	3.50	0.80	2.29	1.33	2.93	1.14
Has friends on playground	3.17	1.34	3.92	0.29	3.14	1.41	3.50	0.76
Good at skipping	3.08	1.38	3.92	0.29	3.00	1.18	3.50	0.94
Mom reads to you	3.33	0.98	3.25	1.22	3.21	1.12	2.93	1.14
Knows alphabet	2.25	1.42	3.17	1.19	1.86	1.41	2.64	1.51

Gets asked to play by others	3.08	1.31	3.00	1.35	3.14	1.29	3.57	0.76
Good at running	3.08	1.00	3.17	1.03	3.14	1.23	3.29	0.99
Mom plays with you	2.58	1.31	3.08	1.24	2.14	1.23	2.50	1.29
Knows first letter of name	2.42	1.44	2.58	1.38	1.57	0.85	1.93	1.14
Eats dinner at friends' houses	2.58	1.08	3.08	1.24	2.57	1.45	2.21	1.19
Good at hopping	3.33	0.98	3.58	1.00	3.43	0.85	3.43	1.09
Mom talks to you often	2.83	1.19	3.42	1.00	2.43	1.34	2.64	1.22

TABLE 4: **RESULTS OF THE DEPENDENT T-TESTS AND THE WILCOXON SIGN RANK TEST OF INDIVIDUAL ITEMS IN THE PSPCSA ASSESSMENT OF AFFECTED CHILDREN(*N=26*)**

	Experimental group (*N*=12)				Control group (*N*=14)			
	Dependent t-test		Wilcoxon test		Dependent t-test		Wilcoxon test	
	t	**df**	**p**	**p**	**t**	**df**	**p**	**p**
Good at puzzles	-1.332	11	0.210	0.237	1.836	13	0.089	0.093
Has lots of friends	-1.483	11	0.166	0.178	-1.144	13	0.396	0.484
Good at swinging	-1.000	11	0.339	0.412	-1.472	13	0.165	0.178
Mom smiles at you often	2.171	11	0.053	0.076	-0.563	13	0.583	0.715
Stays overnight at friends	-1.146	11	0.276	0.285	-0.493	13	1.000	1.000
Good at climbing	-0.484	11	0.638	0.686	-1.612	13	0.131	0.138
Mom takes you places	1.198	11	0.256	0.272	0.618	13	0.547	0.584
Knows names of colours	-2.419	11	0.034*	0.043*	-2.687	13	0.037*	0.050*
Has friends to play with	-2.200	11	0.051	0.060	-1.472	13	0.165	0.203
Can tie shoes	-1.773	11	0.104	0.106	-1.031	13	0.321	0.286
Mom cooks favourite foods	-0.200	11	0.845	0.834	-0.773	13	0.453	0.499
Good at counting	-0.672	11	0.515	0.612	-2.590	13	0.069	0.139
Has friends on playground	-1.827	11	0.095	0.106	-0.924	13	0.373	0.353
Good at skipping	-2.278	11	0.044*	0.048*	-1.336	13	0.205	0.205
Mom reads to you	0.185	11	0.857	0.834	0.773	13	0.453	0.441
Knows alphabet	-1.608	11	0.136	0.173	-2.242	13	0.119	0.069
Gets asked to play by others	0.192	11	0.851	0.917	-1.195	13	0.254	0.208
Good at running	-0.172	11	0.866	0.859	-0.458	13	0.655	0.735

Mom plays with you	-0.920	11	0.377	0.374	-1.000	13	0.336	0.327
Knows first letter of name	-0.321	11	0.754	0.675	-1.046	13	0.315	0.273
Eats dinner at friends' houses	-2.345	11	0.309	0.056	0.812	13	0.431	0.441
Good at hopping	-0.540	11	0.600	0.612	0.000	13	1.000	0.893
Mom talks to you often	-1.103	11	0.294	0.327	-0.543	13	0.596	0.594

Note: * = statistically significant at p≤0.05.

Table 5 shows the descriptive statistics of the four subscales as well as the total scale scores of the PSPCSA. As the results of the dependent t-tests pertaining to these scores show (Table 6), no significant differences were found between the total scores of any of the four subscales from the first and second evaluation of either groups, but statistically significant differences were found between the total scale scores of the experimental group in contrast with those of the control group.

TABLE 5: **MEAN SCORES AND STANDARD DEVIATIONS OF THE FOUR SUBSCALES AND THE TOTAL SCALE SCORE OF THE PSPCSA IN AFFECTED CHILDREN (*N=26*) BEFORE AND AFTER THE PHYSICAL ACTIVITY PROGRAMME**

	Experimental group (*N=12*)				Control group (*N=14*)			
	Before		**After**		**Before**		**After**	
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Cognitive	14.08	4.29	16.67	2.74	11.64	3.77	13.43	4.26
Peer	17.17	2.98	20.75	2.56	16.07	5.47	18.14	2.25
Physical	19.58	4.29	21.67	2.46	19.21	2.83	21.07	3.12
Maternal	18.92	4.01	19.00	4.67	17.64	3.61	18.21	3.75
Total score	69.33	11.42	78.67	10.93	68.79	11.02	71.07	8.53

TABLE 6: **RESULTS OF THE DEPENDENT T-TEST IN THE FOUR SUBSCALES AND THE TOTAL SCALE SCORES OF THE PSPCSA**

	Experimental group (*N=12*)			Control group (*N=14*)		
	t	**df**	**p**	**t**	**df**	**p**
Cognitive	-1.845	11	0.092	-2.033	13	0.063
Peer	-3.654	11	0.141	-1.331	13	0.206
Physical	-1.428	11	0.181	-1.958	13	0.072
Maternal	-0.049	11	0.962	-0.540	13	0.598
Total scale score	-2.578	11	0.026*	-2.141	13	0.052

Note: * = statistically significant at p<0.05.

DISCUSSION

The standing long jump is a skill which represents the gross motor component of total body coordination, but is also a skill which involves specific technique which can be improved with practice (Gallahue & Ozman, 1998). The physical activity programme involved a variation of jumping from two legs in every session which possibly contributed to the improvement of this skill in the experimental group. The improvements in the scores of the items of hopping on the left leg and one leg balance are encouraging, as these are balance skills which are the basis for the development of all gross motor skills (Auxter *et al.*, 1997; Gallahue & Ozmun, 1998) and therefore can have a positive influence on the development of other gross motor skills.

Pertaining to the results of the PSPCSA, a possible explanation for the significant differences in both groups found with reference to the "Knows names of colours"-item could be the fact that the use of colours formed part of the predetermined work schedule of the specific age groups during the period of the intervention programme. The significant difference in the item "Good at skipping" in the experimental group indicates that this group felt that their skipping ability had improved, possibly because skipping formed a major part of the physical activity programme and was practised often in the programme. According to Mahoney *et al.* (2004), the improvement of motor skills and other aspects by means of a physical activity programme in the form of gross motor and perceptual motor activities is a long term process, and the success of such a programme depends on the individual child and the status of his or her motor skill levels (Sugden & Chambers, 2003; Mahoney *et al.*, 2004). In studies involving the effects of motor skill programmes on several aspects of children including motor skills and self-esteem, it is suggested that such a programme should entail at least three sessions per week to be effective (Pless & Carlsson, 2000; Sugden & Chambers, 2003; Mahoney *et al.*, 2004). While the results of the motor tests in this study indicate that the gross and perceptual motor programme had an effect on some gross and perceptual motor skills and the total self-esteem of the experimental group, it is possible that the effect of the programme might have been greater had the programme been longer and had it been involved more sessions per week.

CONCLUSION

The results obtained with this study should be evaluated in the light of the following limitations, lessening the measure of generalizability. Firstly, a comparatively small, and a selected, group of participants was used due to the law preventing the revelation of HIV-status of children in mainstream schools. Secondly, due to circumstances in the school no third assessment was done to test the measure of retention, and thirdly the gross motor and perceptual motor programme could be presented only once a week and for only 12 weeks whereas more sessions per week for a longer period of time could have yielded clearer results. Additionally, the PSPCSA has not been adapted for children of a different culture with reference to the suitability of the picture plates.

Bearing these limitations in mind, but also the significant differences found in this study, it is suggested that future research should be conducted to further examine the question, but that they should make use of larger, and if possible randomly selected populations. Furthermore, it is recommended that a third assessment is done to determine the measure of retention and also that the intervention programme is presented at more frequent intervals for longer than twelve weeks.

If using the PSPCSA as a testing tool for South African children from a different culture, the picture plates should be adapted to reflect children similar to the participants' own culture.

Therefore, it is recommended that the scale be standardized for South African children from different cultures, as to enhance the generalizability of results when using this instrument in a South African context.

In light of the relatively high scores in the PSPCSA test in this study, further investigation of the self-esteem of HIV-infected pre-primary children is recommended.

From the statistically significant improvement in the total PSPCSA score of the experimental group, the tentative conclusion can be made that the interventon programme had an effect on the self-esteem of this group. On the grounds of this conclusion and also judging by the positive reception of the programme by the teachers in the school, in principle the programme does seem to have been suitable to have addressed the aims of this study.

To summarise, the results of this study suggest that a developmentally appropriate physical activity progamme can contribute to the improvement of gross and perceptual motor skills, as well as the self-esteem in HIV-infected and affected children in the pre-primary phase. Additionally, the programme used in this study can be recommended for use in pre-primary schools and programmes for HIV- infected and affected children with the aim of improving their quality of life, and also in mainstream schools where the numbers of HIV-infected and affected children are increasing.

REFERENCES

AUXTER, D.; PYFER, J. & HUETTIG, C. (1997). *Principals and methods of Adapted Physical Education and Recreation* (8th ed.). St. Louis, MO: Mosby.

BACHA, T.; POMEROY, E.C. & GILBERT, D. (1999). A psychoeducational group intervention for HIV-positive children: a pilot study. *Health and Social Work*, 24(4): 303-307.

BICEGO, G.; RUTSTEIN, S. & JOHNSON, K. (2003). Dimensions of the emerging orphan crisis in sub-Saharan Africa. *Social Science and Medicine,* 56: 1235-1247.

BRADSHAW, D.; JOHNSON, L.; SCHNEIDER, H.; BOURNE, D. & DORRINGTON, R. (2002). Orphans of the HIV/AIDS epidemic. MRC Policy Brief, 2 May. [http://www.mrc.ac.za/policybriefs/2policy2002.pdf]. Retrieved 26 November 2004.

BROWN, L.K.; LOURIE, K. & PAO, M. (2000). Children and adolescents living with HIV and AIDS: a review. *Journal of Child Psychology and Psychiatrics*, 41(1): 81-96.

BRUININKS, R.H. (1978). *Bruininks-Oseretsky Test of Motor Proficiency.* Los Angeles, CA: American Guidance Service.

BUNKER, L.K. (1991). The role of play and motor skill development in building children's self-confidence and self-esteem. *The Elementary School Journal*, 91(5): 467-471.

CORBIN, C.B. (2002). Physical activity for everyone: what every educator should know about promoting lifelong physical activity. *Journal of Teaching in Physical Education*, 21(2): 128-145.

FOLIO, R. & FEWELL, R. (1983). *Peabody Developmental Motor Scales and Activity Cards.* Chicago, IL: The Riverside Publishing.

FRANKENBURG, W.K. (1990). The Denver Approach to early case finding: a review of the Denver Developmental Screening Test and a brief training program in developmental diagnosis. In W.K. Frankenburg; R.N. Emde & J.W. Sullivan (Eds.), *Early identification*

of children at risk. An international perspective (135-158). New York, NY: Plenum.

FREDERIKSEN, J. & KANABUS, A. (2004). Aids orphans in Africa. [http://www.avert.org/aidsorphans.htm]. Retrieved 20 October 2004.

GABBARD, C. (1998). Windows of opportunity for early brain development. *Journal of Physical Education, Recreation and Dance,* 69(4): 52-54, October.

GALLAHUE, D.L. & OZMUN, J.C. (1998). *Understanding motor development* (4th ed.). New York: NY: McGraw-Hill.

GALLAHUE, D.L. (2003). *Developmental physical education for today's children* (4th ed.). Dubuque, IA: Brown & Benchmark.

GNMTCP. *See the Greater Nelspruit Millennium Time Capsule Project.*

GREATER NELSPRUIT MILLENNIUM TIME CAPSULE PROJECT, THE (2000). Milennuim HIV/Aids Project. [http://www.timecapsule.co.za/charities/AidsFamily.htm]. Retrieved 19 October 2004.

HARTER, S. & PIKE, R. (1984a). The Pictorial Scale of Perceived Competence and Social Acceptance for Young Children. Denver, TX: University of Denver.

HARTER, S. & PIKE, R. (1984b). The Pictorial Scale of Perceived Competence and Social Acceptance for Young Children. *Child Development*, 55: 1969-1982.

HAUBENSTRICKER, J. & SEEFELDT, V. (1986). Acquisition of motor skills during childhood. In V. Seefeldt (Ed.), *Physical activity and well-being* (56-68). Reston, VA: AAHPERD.

HAVENS, J.F.; WHITAKER, A.H.; FELDMAN, J.F. & ERHARDT, A.A. (1994). Psychiatric morbidity in school-age children with congenital Human Immunodeficiency Virus infection: a pilot study. *Journal of Developmental and Behavioural Pediatrics*, 15(Suppl.): S18-S25.

HENDERSON, S.E. & SUGDEN, D.A. (1992). *Movement Assessment Battery for children.* New York, NY: The Psychological Corporation.

HUMAN SCIENCES RESEARCH COUNCIL (2004). SA's children and HIV/Aids. [http://www.health24.com/news/HIV_AIDS/1-920,27531.asp]. Retrieved 17 May, 2004.

JAMES, A. & COLLIER, D. (2004). Establishing the preschool learning environment. *Teaching Physical Education*, May: 38-40.

JOHNSON, L. & DORRINGTON, R. (2001). The impact of AIDS on orphanhood in South Africa: a qualitative analysis. Cape Town: Centre for Actuarial Research, University of Cape Town. Monograph No. 4. [http://www.care@commerce.uct.ac.za/care/]. Retrieved 19 October 2004.

LWIN, R. & MELVIN, D. (2001). Annotation: Paediatric HIV infection. *Journal of Child Psychology and Psychiatrics*, 42(4): 427-438.

MAHONEY, G.; ROBINSON, C. & PIRALES, F. (2004). Early motor intervention. the need for new treatment paradigms. *Infants and Young Children*, 17(4): 291-300.

MELVIN, D. (1996). Counselling issues for children and families living with HIV infection. In: J. Green & A. McGreaner (Eds.). *Counselling in HIV infection and AIDS* (136-146). Cambridge, MA: Blackwell Science.

MIYAHARA, M. & WAFER, A. (2004). Clinical intervention for children with developmental coordination disorder: a multiple case study. *Adapted Physical Activity Quarterly*, 21(3): 281-301.

MUTTI, M.; MARTIN, N.A.; STERLING, H.M. & SPALDING, N.V. (1998). *Quick Neurological Screening Test* (2nd ed.). Novato, CA: Academic Therapy Publications.

PLESS, M. & CARLSSON, M. (2000). Effects of motor skill intervention on Developmental Coordination Disorder: a meta-analysis. *Adapted Physical Activity Quarterly*, 17: 381-401.

POPULATION COUNCIL (2000). Making a difference for children affected by Aids. [http://www.popcouncil.org/horizons/resum/orphans.html]. Retrieved 24 June 2003.

PYFER, J.L. (1990). Motor Development evaluation. Unpublished manuscript. Denton, TX: Texas Woman's University:

ROSE, E. & LARKIN, D. (2002). Perceived competence, discrepancy scores, and global self-worth. *Adapted Physical Activity Quarterly*, 19(2): 127-141.

STATSOFT (1995). *Statistica for Windows. Release 5.5: General conversions and statistics*. Tulsa, OK: Statsoft.

SUGDEN, D. & CHAMBERS, M.E. (2003). Intervention in children with Developmental Coordination Disorder: The role of parents and teachers. *British Journal of Educational Psychology*, 73(4): 545–562.

THOMAS, J.R. (1999). McCloy research lecture: children's control, learning, and performance of motor skills. *Research Quarterly for Exercise and Sport,* 71(1): 1-9.

ULRICH, D.A. (1985). *Test of Gross Motor Development.* Austin, TX: Pro-ED.

VASS, J. (2003). The impact of HIV/Aids. In: Human Sciences Research Council. *Human Resources Development Review 2003. Education, employment and skills in South Africa* (187-205). Pretoria: HSRC.

WIENER, L.; BATTLES, H. & RIEKERT, K.A. (1999). Longitudinal study of psychological distress symptoms in HIV-infected, school-aged children. In: S. Taylor-Brown & A. Garcia (Eds.). *HIV Affected and Vulnerable Youth* (13-36). New York, NY: The Haworth Press.

WIENER, L.; THEUT, S.; STEINBERG, S.M.; RIEKERT, K.A. & PIZZO, P.A. (1994). The HIV-infected child: parental responses and psychosocial implications. *American Journal of Orthopsychiatrics*, 64(3): 485-492.

APPENDIX: **EXAMPLE OF ONE LESSON FROM THE PHYSICAL ACTIVITY PROGRAMME**

Lesson 1: Balls and bean bags (bb)
Outcome: Life orientation Learning outcome 4: Physical development
Assessment standard*:* Describes what own body can do; explores different ways to locomote, rotate, elevate and balance; performs expressive movements using different parts of the body
Homework: Throw and catch ball by himself – see how high he can throw and still catch it.
Instructions on the making of a ball: Cut out 2 "O"'s from a carton box, place against each other and thread wool through the middle. Cut the wool on the sides, remove carton.

COMPONENT	APPARATUS	ORGANISATION	ACTIVITY	What the leader says
Body awareness	Bb, balls	Each learner stands at a beanbag, holds	Roll ball over body parts and	"Who can roll the ball"
Warm-up, locomotor/total body coordination	Bb, cones	Each learner places his ball next to his bb and stands close to his bb. A cone is placed $\pm$ 10m. from each bb.	• Learners run to the cone and back • Learners gallop to the cone and back • Hop on one leg to the cone, back on other • Skip to the cone (young ones try in their own way) and back	"See the orange / yellow cones there? Let's see who can run really fast to your cone! And back!" etc.
Static balance	Paper balls, bb	Each learner stands close to his bb	• Stand with one foot on the ball, arms sideways and balance for 10 counts (everyone count together) L and R • Balance on one leg for 10 counts (L and R)	"Now we put our foot on the ball - who can stand like this without falling? Whoooa! Let's all count to 10! 1,2,3…."

Dynamic balance and spatial awareness, total body coordination	Bb, 1 skipping rope, 4 hoops, 3 mats	Learners stand in line at circuit:
		     bb
		rope
		
		ƎƎƎƎƎƎ-------------- O
		
		O hoops
		
		O
		
		     mats ɘ ɘ ɘ
		O
			• 1st 2 rounds: Walk tiptoe on bb, walk with feet straight on skipping rope, 2leg hop in hoops, walk on all fours over mats
			• 2nd 2 rounds: Walk all fours on bb, backward on skipping rope, 1 leg hop in hoops,
				"These are stones in the river, we have to step only on the stones so that we don't fall in the river (there are crocodiles / monsters in the river). Now we walk across the bridge (don't fall off,

COMPONENT	APPARATUS	ORGANISATION	ACTIVITY	What the leader says
Body awareness	Bb, balls	Each learner stands at a beanbag, holds	Roll ball over body parts and crabwalk over mats	"Who can roll the ball" the crocodiles will eat you). Now we have to jump in the rabbits' holes like this, and then walk like a monkey on the mats"
Hand-eye- and foot-eye co-ordination	Bb, paper balls	Each learner stands at his own bb, holds his ball	• Throw and catch ball by himself, keep ayes on the ball ($\pm$ 10-15 times, then higher) • Drop ball, kick it ($\pm$ 10-15 times, then try to kick ball before it hits floor)	"Who can do this? See how I watch the ball all the time? Etc…)
Closing activity: Attention focus andhomework	Bb, paper balls	Learners stand at their bb and hold the ball between their knees while watching the leader	• Hold the ball between the knees and turn around without it falling • Demonstrate and give homework	"Who can turn around like this without dropping the ball?" Now you must go and practise this at home - see how high you can throw and catch. Next time I will look to see who've practised it." "Did you enjoy the

COMPONENT	APPARATUS	ORGANISATION	ACTIVITY	What the leader says
Body awareness	Bb, balls	Each learner stands at a beanbag, holds	Roll ball over body parts and	"Who can roll the ball"
				exercise? Good –bye-bye!"

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PHYSICAL INACTIVITY AS ONE OF THE CHRONIC DISEASE RISK FACTORS AMONG HIGH SCHOOL LEARNERS IN PUBLIC SCHOOLS IN A LOCAL COMMUNITY IN SOUTH AFRICA

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ABSTRACT

This study aimed to determine the physical activity levels and existence of risk factors associated with chronic diseases of lifestyle among high school learners. A cross-sectional research design was used to obtain information about physical activity levels from 951 learners from two high schools in a local community in the Western Province of South Africa. Physical activity levels were obtained using the KUOPIO Ischaemic Heart Disease 24-hour physical activity record over a seven-day period. Anthropometrical and blood pressure measurements as well as behaviours including cigarette smoking and alcohol use were recorded as risk factors for chronic diseases of lifestyle. Statistical analyses were performed using the Statistical Package for Social Science (2000). Risk factors were identified as obesity, physical inactivity, smoking and hypertension. Variance of analysis (ANOVA) was used to statistically determine differences in groups. The results indicated that 32% of the learners were classified as being physically inactive and that 21% engaged in health risk behaviours. In addition, 35% of the learners had more than one risk factor for chronic diseases of lifestyle present. Since cardiovascular risk factors have been shown to persist into adulthood, health professionals should assume some responsibility for the prevention, detection, and intervention relevant to cardiovascular risk factors in adolescents.

Key words: Physical inactivity; Learners; Disease; Obesity; Risk factors; Lifestyle.

INTRODUCTION

The burden of chronic diseases of lifestyle is a key impediment to social and economic progress as these diseases have become the leading cause of death and disability worldwide (Alberti, 2001). The World Health Report (2000) estimated that chronic diseases of lifestyle accounted for 60% of global mortality and 43% of the global burden of disease. In order to prevent the epidemic of chronic diseases of lifestyle, both the immediate and the root causes of these diseases must be identified (Canon, 2001). Physical inactivity is one of the immediate causes of chronic diseases and one that is modifiable. In Canada, approximately 3% of the total direct health care costs, i.e. over $2 billion, can be attributed to physical inactivity (Katzmarzyk *et al.*,1998).

The World Health Organisation (WHO) identified physical inactivity as a threatening public health issue worldwide and subsequently introduced the STEPwise approach to monitor the emergence of non-communicable diseases (WHO, 2003). The STEPS approach is based on sequential levels of surveillance of different aspects of non-communicable disease. Within this

approach the most common non-communicable diseases and their established behavioural and physiological risk factors that meet criteria for surveillance are identified. The modifiable behavioural risk factors include smoking, drinking alcohol, and physical inactivity. In addition, the physiological risk factors include excess body fat (obesity), high blood pressure, abnormal blood glucose and abnormal blood lipids.

Prevention through risk factor focused intervention requires population specific data on risk factors so that priorities can be appropriately set. Insufficient physical activity data in children and adolescents has also been identified as a concern. According to Lambert *et al.* (2001), South African data on the prevalence of physical inactivity, especially among the youth, is limited. The Birth to Twenty Study (Birth to Twenty, 2002) and the THUSA BANA study (Underhay *et al.*, 2003) are two of the main studies relating to physical inactivity in South Africa that report on South African youth. These studies reported that more than 40% of young people do not participate in regular physical activity. This information was part of a bigger study of which a section focused on physical activity levels. In addition, a study by Coetzee and Underhay (2003) reported that adolescents from as early as 13 years of age take part in health risk behaviours which include cigarette smoking, alcohol and drugs, unsafe sexual behaviour and physical inactivity. An underlying premise for the promotion of physical activity in youth is that it may persist through adulthood and lead to a healthy lifestyle (Brunton *et al.*, 2003). Physical activity levels among young people have raised cause for concern. In America, the 1995 school-based youth risk behaviour study indicated a 10.4% prevalence of inactivity (Centre for Disease Control and Prevention, 1996). In Australia, it was found that among the young people 10% were inactive (Baumann & Campbell, 2001). According to Bouchard *et al.* (1990) the general model underlying most research on the relationships among physical activity, physical fitness and health is that physical fitness is one of the mediators of the effects of physical activity on health outcomes. Thus, to develop effective interventions to assist positive health outcomes, one needs to evaluate the physical activity patterns and health habits of the youth, as evidence indicates that these associations track into adulthood.

The study population for the current study included all young people who attended high school in a particular local community in South Africa. This community was chosen based on its representivity of the previously disadvantaged group in the Western Cape, South Africa. The sample included two of the high schools in the community. The objectives of the study were to describe the physical activity levels of youth aged 13 to 18 years and to examine the association between physical activity levels and other risk factors for chronic diseases of lifestyle.

METHODS

Research design

The research described in this article forms part of a larger doctoral study conducted in a local community in the Western Province. A cross-sectional research design was used. Nine hundred and fifty-one (951) high school learners aged 13 to 18 years selected from the secondary schools in the selected community were included in the sample. Data were collected over a period of 12 months.

Subjects

The learners were conveniently selected and following informed consent from the school, parents and the learners, only two of the four high schools decided to participate in the study. The 951 learners in the study consisted of 477 males and 474 females. The mean age for these learners was 15.2 years (SD=1.5).

Test materials

Data were obtained using a questionnaire that contained three sections. Information obtained from the questionnaire included (1) socio-demographic characteristics of the participants (age, family income, parents' educational level and occupation); (2) self-reported daily habitual activity level over seven days and (3) objective measurement of health related physical fitness levels (Fitnessgram). The KIHD 24 hours physical activity record was adapted and used in the study as it was found to be reliable in measuring activities in a short period of recall (Baranowski, 1988). The daily physical activity report was divided into 13 activities which included sitting, grooming, walking for 15 minutes, studying, gardening, household chores and sporting activities. For analysis it was further classified into four categories as reported by the Surgeon General Report (1996). These included sedentary activities, light intensity activities, moderate intensity activities and vigorous intensity activities. Information regarding current smoking and drinking of alcohol habits for the previous week was also recorded. The instrument was pre-tested on 20 learners for content validity and to ensure that the learners understood what was expected of them. The instrument was also tested one week apart on this group to check for test-retest reliability and yielded a Chronbachs alpha of .82. These learners did not form part of the final study sample.

Anthropometrical and blood pressure measurements that were included from the battery of physical fitness tests for this study are briefly discussed below. The anthropometrical measurements taken included body height and weight. The Body Mass Index (BMI) was calculated by dividing the weight by the square root of the height. Individuals were classified as obese if they had a BMI above the age and gender specific 85th percentile. The BMI was dichotomized at the 85th percentile because the researchers were interested in discovering what proportion of the learners was overweight. Systolic blood pressure (SBP) and diastolic blood pressure (DBP) were measured at rest in the sitting position with an electronic sphygmomanometer, which automatically recorded the pulse rate of the participant.

Statistical analyses

Statistical analyses were performed using SPSS 2000. Descriptive statistics of all the children were calculated for the relevant variables in the study. Risk factors were defined as obesity (BMI>26), physical inactivity (< three and a half hours per week), smoking (current use in the past seven days), and hypertension (SBP>130; DBP>85). Variance of analysis (ANOVA) was used to statistically determine differences in groups. A p-value of <0.05 was accepted as a statistical difference between groups.

RESULTS AND DISCUSSION

From the total number of learners (951), at least 21% were identified as engaging in health risk behaviours that could become risk factors for chronic diseases of lifestyle. Of the 951

participants, 32% did not meet the requirement of participating in physical activity for three

and a half hours per week (3.5h/week) to be classified as being active. The mean time of participants who participated in moderate and vigorous activity was 2.8 h/week and 4.16 h/week respectively. Table 1 indicates the overall prevalence of cigarette use and alcohol drinking among the learners who were classified as being physically active and those classified as being physically inactive.

TABLE 1: **HEALTH PROFILE OF THE HEALTH RISK BEHAVIOURS OF THE LEARNERS**

Variable		Active learners (N=644)	Inactive learners (N=307)
Gender	Male	342 (53%)	135 (44%)
	Female	302 (47%)	172 (56%)
Age	13	83 (13%)	45 (15%)
	14	194 (30%)	68 (22%)
	15	146 (23%)	47 (15%)
	16	97 (15%)	65 (21%)
	17	69 (10%)	50 (16%)
	18	55 (9%)	32 (10%)
Smoking	Yes	201 (31%)	126 (41%)
	No	443 (69%)	181 (59%)
Drinking	Yes	138 (21%)	137 (45%)
	No	506 (79%)	170 (55%)

Various studies have indicated that smoking is associated with less physical activity and regular physical activity with non-smoking (Yang *et al*., 1999). In addition, smoking is responsible for about two million deaths a year (Peto *et al*., 1994). In some calculations it is estimated that smoking reduces the life expectancy of a 20-year-old person by 4.3 years (Manning *et al*., 1991). It is also well documented that cigarette smoking substantially increases the risk of cardiovascular disease, including stroke, heart attack, peripheral vascular disease and aortic aneurysm (USDHHS, 1996; Bartecchi *et al.*, 1994).

One hundred and thirty-seven of the physically inactive high school learners reported that they had drunk alcohol in the previous week. Further analysis found that 21% of the physically inactive learners both smoked cigarettes and drank alcohol. Pearson's Chi-Square showed that the older learners were more likely to participate in smoking and drinking ($p < 0.05$). A similar study by De Bourdeaudhuij and Oost (1999) found a high correlation with physical activity in the over 16 year age group for smoking and alcohol consumption.

It can thus be seen that a large number of the learners in this community were at risk of developing chronic diseases of lifestyle, as 31% of them were physically inactive and of these physically inactive learners, 21% were engaging in health risk behaviours such as smoking and drinking alcohol.

Anthropometric measurements and physical activity participation

The average BMI for the participants was 20.8. The average BMI at the 95th percentile for being overweight was 26.2. Approximately 23% of the participants fell into this category and were thus classified as being overweight. Of the overweight participants, 18% were male in comparison to the 27% females. Cross-tabulations and ANOVA tables indicated that the

relationship between BMI and gender (df=1; F=28.43; p<0.00) and the relationship between BMI and age (df=5; F=5.32; p<0.00) were statistically significant.

The overall prevalence of hypertension was 15%, with males accounting for 14% and females accounting for 15%. Table 2 presents an overall picture of the learners' physiological measurements with regard to obesity and high blood pressure.

TABLE 2: **DESCRIPTION OF LEARNERS' PHYSIOLOGICAL MEASUREMENTS WITH REGARD TO OBESITY AND INCREASED BLOOD PRESSURE**

Variable		Active learners (n=644)	Inactive learners (n=307)
BMI	Normal	510 (79%)	220 (72%)
	Underweight	31 (5%)	14 (4%)
	Overweight	103 (16%)	73 (24%)
SBP	Normal	547 (85%)	234 (76%)
	Stage1 hypertension	58 (9%)	37 (12%)
	Stage 2 hypertension	39 (6%)	36 (12%)
DBP	Normal	526 (82%)	224 (73%)
	Stage1 hypertension	65 (10%)	50 (16%)
	Stage 2 hypertension	53 (8%)	33 (11%)

The clinical significance of overweight and obesity in adolescent populations is a public health concern. Adolescents who are overweight have increased average blood pressures, heart rates and cardiac outputs compared to their non-overweight peers (Moran, 1999).

Of the 307 (32%) physically inactive high school learners, 73 (23.8%) were overweight and 126 (41%) smoked. In addition, 83 (27%) of the physically inactive high school learners were hypertensive. Risk appraisals have been developed to quantify an individual's susceptibility to chronic heart disease. The following risk factors for chronic heart disease are commonly recognised: cigarette smoking (> 10 per day), physical inactivity, hypertension and obesity as well as hyper-cholesterolaemia. According to McArdle *et al*. (1996), the interaction of three or more of these risk factors in an individual magnifies their effects. Table 3 gives a profile of risk factors of learners in the study. Of the learners who participated in the study, 21% had two or more risk factors, 10% had three or more risk factors and 4% had four risk factors.

TABLE 3: **MULTIPLE MODIFIABLE RISK FACTOR PROFILE (N=951)**

Number of risk factors present	% of learners
Physical inactivity	32
Physical inactivity and smoking	21
Physical inactivity, smoking and obesity	10
Physical inactivity, smoking, obesity and hypertension	4

From the current study it can be seen that a substantial number of these learners are at risk of

developing chronic diseases of lifestyle. The risk factors identified in the literature have been identified in these learners, namely obesity, high blood pressure and inadequate fitness levels. It is important to accumulate evidence regarding adolescent health-related physical fitness, as it assists health professionals in identifying young people at risk, thus allowing for early intervention.

CONCLUSION

More than one risk factor was present in 21% of the learners in this study, thus predisposing them to an early development of certain chronic diseases. Baranowski *et al.*, (1992) indicated that most children tend to have at least one risk factor for cardiovascular disease which has practical implications for health promotion programmes. Since cardiovascular risk factors have been shown to persist into adulthood, this may translate into an epidemic of cardiovascular disease in the adults in this community in the future. The conclusion that can be made from the results is that physical inactivity in association with other health risk behaviours such as smoking, drinking alcohol, obesity and hypertension should be considered a public health concern in this community. Thus it is concluded that primary prevention and intervention through risk factor modification can be effective in childhood. Health professionals should thus assume some responsibility for the prevention, detection, and intervention relevant to cardiovascular risk factors in adolescents. Promotion of a healthy lifestyle, including regular physical activity and avoidance of risky behaviours, should be incorporated into health maintenance encounters. Adolescents should be empowered through education and skills development to assume increasing responsibility for their own health behaviours. Although the expense and the duration of follow-up studies prohibit longitudinal studies to document that altering cardiovascular risk factors in childhood will reduce morbidity and mortality from this disease in adulthood, it is intuitive to suppose that risk factor modification early in life will have a positive impact.

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REFERENCES

ALBERTI, G. (2001). Noncommunicable diseases: tomorrow's pandemics. Editorial. *Bulletin of the World Health Organisation,* 79(10): 907.

BARANOWSKI, T. (1988). Validity and reliability of self-report measures of physical activity: an information-processing perspective. *Research Quarterly for Exercise and Sport,* 59: 314-327.

BARANOWSKI, T.; BOUCHARD, C.; BAR-OR, O.; BRICKER, T.; HEATH, G.; KIMM, S.; MALINA, R.; OBARZANEK, E.; PATE, R.; STRONG, W.; TRUMAN, B. & WASHINGTON, R. (1992). Assessment, prevalence and cardiovascular benefits of physical activity and fitness in youth. *Medicine and Science in Sports and Exercise,* 24(suppl): S237-S247.

BARTECCHI, C.E.; MACKENZIE, T.D. & SCHRIER, R.W. (1994). The human costs of tobacco use. *New England Journal of Medicine,* 330: 907-912.

BAUMAN, A. & CAMPBELL, T. (2001). Heart Week 2001: Get Active! A call to action. *Medical Journal of Australia,* 174: 381-382.

BIRTH TO TWENTY STUDY (2002). Physical activity and South African children – some shocking findings. March 2002. Study Updates.

BOUCHARD, C.; SHEPHARD, R.; STEPHENS, T. & McPHERSON, B. (1990). Exercise, fitness and

health: the consensus statement. In C. Bouchard; R. Shephard; T. Stephens & B.D. McPherson (Eds.). *Exercise, fitness and health: a consensus of current knowledge* (3-28). Champaign, IL: Human Kinetics.

BRUNTON, G.; HARDEN, A.; REES, R.; KAVANAGH, J.; OLIVER**,** S. & OAKLEY, A. (2003). *Children and physical activity: a systematic review of barriers and facilitators*. London. EPPI-Centre, Social Science Research Unit, Institute of Education, University of London.

CANON, G. (2001). Health and nutrition emerging and re-emerging issues in developing countries. *International Food Policy Research Institute,* Focus 5, Brief 8(11): 1-4.

CENTER FOR DISEASE CONTROL AND PREVENTION (1996). Report for the Surgeon General. Physical Activity and Health. Atlanta, GA: US Department of Health and Human Services.

COETZEE, M. & UNDERHAY, C. (2003). Gesondheidsrisikogedrag by adolessente van verskillende ouderdomme. *Suid-Afrikaanse Tydskrif vir Navorsing in Sport, Liggaamlike Opvoedkunde en Ontspanning,* 25(2): 27-36.

DE BOURDEAUDHUIJ, I. & OOST, P. (1999). A cluster-analytical approach toward physical activity and other health related behaviours. *Medicine and Science in Sports and Exercise,* 31: 605-612.

KATZMARZYK, P.; MALINA, R.; SONG, T. & BOUCHARD, C. (1998). Physical activity and health-related fitness in youth: a multivariate analysis. *Medicine and Science in Sport and Exercise,* 30(5): 709-714.

LAMBERT, E.V.; BOHLMANN, I. & KOLBE-ALEXANDER, T. (2001). "Be active" – physical activity for health in South Africa. *South African Journal of Clinical Nutrition,* 14(3): S12-S16.

MANNING, W.; KEELER, E.B.; NEWHOUSE, J.P.; SLOSS, E.M. & WASSERMAN, J. (1991). *The costs of poor health habits*. Cambridge, MA: Harvard University Press.

McARDLE, D.; KATCH, F. & KATCH, V. (1996). *Exercise Physiology* (3rd ed.). Philadelphia, PA: Lea and Febiger.

MORAN, R. (1999). Evaluation and treatment of childhood obesity. *American Family Physician,* 59(4): 861-877.

PETO, R.; LOPEZ, A.D.; BOREHAM, J.; THUN, M. & HEATH, C. (1994). *Mortality from smoking in developed countries 1950-2000. Indirect estimates from national vital statistics.* New York, NY: Oxford University Press.

SURGEON GENERAL REPORT (1996). *Physical activity and health: a report of the Surgeon General.* Atlanta, GA: US Department of Health and Human Services, Centres for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion.

UNDERHAY, C.; DE RIDDER, J.H.; VAN ROOYEN, J.H. & KRUGER, H.S. (2003). The effect of urbanization on the relationship between physical activity and obesity in 10-15 year old males in the North West province of South Africa: Thusa Bana study. *South African Journal for Research in Sport, Physical Education and Recreation Social Sciences,* 25(2): 77-92.

UNITED STATES DEPARTMENT OF HEALTH AND HUMAN SERVICES (USDHHS) (1996). *Physical activity and health: a report of the Surgeon General.* Atlanta, GA: US Department of Health and Human Services, Centres for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion.

WORLD HEALTH ORGANISATION (2003). *Surveillance of risk factors for noncommunicable diseases. The WHO STEPwise approach*. Geneva: World Health Organisation.

WORLD HEALTH REPORT (2000). *Health Systems: Improving performance*. Geneva: World Health Organisation.

YANG, X.; TELAMA, R. & LEINO, M. (1999). Factors explaining the physical activity of young adults: the importance of early socialization. *Scandanavian Journal of Medicine and Science in Sports,* 9: 371-378.

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SELECTING A LIMITED OVERS CRICKET SQUAD USING AN INTEGER PROGRAMMING MODEL

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ABSTRACT

An integer programming model was developed to select an one day international (ODI) cricket squad of 15 players. To develop the method, batting, bowling and fielding ability, which are measured differently, had to be placed onto the same scale,

so an ability-indexing technique was used. This paper describes the ability-indexing and integer programme used and discusses the results of an empirical study conducted using the statistics of 32 South African cricket players.

Key words: Cricket; Squad selection; Integer programme; Optimization.

INTRODUCTION

The game of cricket is no longer just a recreational pastime, the advent of the professional game has resulted in it becoming a career. Young, promising players commit many hours of their time to develop and hone the necessary skills to compete at the highest and thus most lucrative level. Cricketers spend considerable time and effort to develop their fitness, their mental ability (Slogrove *et al*., 2002) and their tactical strategic choices (Preston & Thomas, 2000), all skills necessary of a professional player.

Whether or not professional cricket players make a success of their chosen profession is all to often dependent on factors beyond their control. Considerations such as leadership roles within administration bodies can impact on the professionalism of the sport (Ristow *et al*., 1999), and hence on the success of a cricket player. Similarly, team selection is beyond a player's control, selection is a task assigned to a group of convenors who on occasion have to select teams based on conditions other than merit (Press Trust of India, 2005). This is an arduous and extremely difficult task, fraught with tangible subjectivity and open to criticism from media (Emslie, 2005), spectators and players alike. Preston and Thomas (2002) provide a simple description of limited overs cricket and those less familiar with the game are referred to their paper.

This study proposes an integer programming model, which can be used for team selection. The model removes subjectivity from the decision making process and reduces the likelihood of a player's failure due to influences beyond their control. The model was developed to select a squad of 15 players rather than an 11-person team, as this has become the norm for many international touring cricket sides.

METHODOLOGY

Background

A cricket team consists of 11 players with players specializing in batting, bowling, fielding, wicket keeping or a combination of these disciplines (all-rounders). A batsman is considered to be a valuable resource if the average number of runs scored per game, hereafter referred to as batting average, is relatively high. Similarly a bowler is considered to be a valuable resource if the average number of runs conceded per over, hereafter referred to as economy rate, is relatively low. In this study, fielding is considered as a specialist position and a fielder is considered as a valuable resource if the average number of dismissals per game, defined as dismissal rate, is relatively high. These statistics are the primary source of player ability.

There are alternative methods for determining the ability of a cricket player. Barr and Van den Honert (1998) propose that batsmen's ability be measured by an adjusted batting average, which includes a measure of consistency. Lemmer (2002, 2004) provides a ranking technique for batting and bowling ability. However this study consigned itself to the afore-mentioned batting average, economy rate and dismissal rate. Furthermore the frequently used statistic,

bowler's strike rate, defined as the number of balls bowled per wicket taken is ignored, as it was felt that this statistic is more applicable to the longer version of the game.

Requirements of the Integer Programming Model

To model team selection using an integer programme (IP) requires that all abilities, batting, bowling and fielding be measured on the same scale. To clarify this issue, consider the batting average and economy rate of players. The batting averages of cricketers (usually in the 30's or 40's), are measured as runs per innings (excluding not outs) whilst bowlers economy rates (preferably below 4.5) are measured as runs per over. These measurements are scaled differently and when optimizing an IP model, the objective function requires that the measurements are valued on the same scale. Considering these two abilities, the IP model would preferentially select the larger numerical values (assuming a maximization problem), over the smaller ones, thus batsmen would be chosen in preference to bowlers.

To address this, the IP model was developed in two stages. Initially ability-indexing techniques were used to calculate coefficients for cricketing abilities (batting, fielding or bowling) so that they would be comparable and thereafter the objective function and the constraints were developed.

Ability coefficients

The proposed indexing method requires that the coefficients used in the IP objective function only be calculated for those players that are considered as specialists in their ability, i.e. batting, bowling, fielding, keeping wicket or as all-rounders. The following indexing method was used to calculate the specialist ability coefficients:

Batting ability

$Bat\ index\ for\ player\ i =$ (

Batting average of batsman

$$\Big\rangle \times number\ of\ specialist\ batsmen$$

$$\Big\lfloor \overline{Sum\ of\ all\ the\ batting\ averages\ of\ all\ the\ batsmen} \Big\rfloor$$

This equation relates the batting average of one batsman to the mean batting average of all batsmen. The resulting index coefficient will be comparable with the other cricketing abilities.

Bowling ability

Integer optimization requires that the objective function either be maximized or minimized (Taha, 2003). To setup the objective function in a maximization form requires that all ability indices be comparable. In cricket an increasing batting average is fine for a maximization problem, whilst a decreasing economy rate is fine for a minimization problem. To model these abilities in a single maximization function requires that we multiply the bowling ability by –1. Thus we consider the negative of the bowling ability as shown below. Furthermore, since these coefficients are negative (economy rate has to be minimized), a constant, which is sufficiently large, is added to ensure all coefficients are positive.

$$Let \quad v = \Big\lceil k - \Big\lfloor$$

$$ \sum_i \left\lfloor \left(\frac{\textit{Economy rate of specialist bowler } i}{\textit{Sum of all the economy rates of all the specialist bowlers}} \right) \right\rfloor $$

The constant k, was chosen as the smallest positive integer such that $\left\lceil k - \right.$

Economy rate of specialist bowler i

$$> 0 \left\lfloor \left(\frac{}{\textit{Sum of all the economy rates of all the specialist bowlers}} \right) \right\rfloor$$

Then the same normalizing strategy that was used for batsmen is used to determine the bowling index for individual bowlers.

$$\textit{Bowl index for player } i = \left(\frac{v_i}{\textit{sum of all } v_i} \right) \times \textit{number of specialist bowlers}$$

Fielding ability

$$\textit{Field index for player } i = \Bigg($$

Dismissal rate of fielder

$$\Big) \times number\ of\ specialist\ fielders \over \Big\lfloor \overline{Sum\ of\ all\ the\ dismissal\ rates\ of\ all\ fielders}\ \Big\rfloor$$

This equation relates the dismissal rate of one fielder to the mean dismissal rate of all fielders. The resulting index coefficient will be comparable with the other cricketing abilities.

All-rounder ability

In developing the general model we have chosen to classify four classes of all-rounders. The first category is for players who can both bat and bowl. Category two includes players who can both bat and field, category three includes players who can both bowl and field and category four includes players who can bat, bowl and field. This is a generalization approach and some selection panels may classify all-rounders differently.

$$All-round\ index\ for\ player\ i = \left(\frac{sum\ of\ individual\ players\ index\ values}{sum\ of\ that\ category\ index\ values} \right) \times number\ of\ players\ in\ all-round\ category$$

For each of the four categories under consideration, the index values of individual abilities where summed and then normalized as per the method used for batting indices.

Keeping wicket ability

$$Wicket\ keep\ index\ for\ player\ i = \left($$

Dismissal rate of keeper

$$\left. \right) \times \textit{number of specialist keepers} \left(\frac{}{\textit{Sum of all the dismissal rates of all keepers}} \right)$$

This equation relates the dismissal rate of one wicketkeeper to the mean dismissal rate of all wicketkeepers. The resulting index coefficient will be comparable with the other cricketing abilities.

Model definition

To standardize, the IP model was treated as one of maximization. Convenors may have different interpretations of the necessary requirements for a squad. To allow for this flexibility the model was set up to consider *p* possible abilities, as illustrated in Table 1.

TABLE 1: **TWO-WAY REPRESENTATION MATRIX OF PLAYERS AND ABILITIES**

		Abilities						
		Bat	Bowl	Field	All Round 1	All Round 2			pth ability
		1	2	3	4	5			*p*
Player	1	$a_{1,1}$	$a_{1,2}$	…	…	…	…	$a_{1,p}$
	2	$a_{2,1}$						
	:							
	n	$a_{n,1}$						$a_{n,p}$

The decision variables are defined as

x_{ij}

$$\Big\}_0 \qquad\qquad\qquad\qquad = \begin{cases} 1 \\ \ \end{cases}$$

if player i is selected for ability j

if player i is not selected for ability j

The objective function is stated as maximize, $Z = z_1 + z_2 + z_3 + z_4 + ... + z_p$

Where the terms in the expression are

$$z_1 = \sum_i a_{i1} x_{i1}$$

$$z_2 = \sum_i a_{i2} x_{i2}$$

$$z_3 = \sum_i a_{i3} x_{i3}$$

$$z_4 = \sum_i a_{i4} x_{i4}$$

Maximizing ability index for the batsmen (ability 1). Maximizing

ability index for the bowlers (ability 2). Maximizing ability index for

the fielders (ability 3).

Maximizing ability index for the all-rounders in category 1 (ability 4).
:
$$z_p = \sum_i a_{ip} x_{ip}$$

Maximizing ability index for the ability *p*.

Constraints

The constraints are dependent on the objectives of the team selectors. If a convenor requires that five all-rounders be selected, then this constraint would be included in the model. The constraints were generalized for the model so that convenors have the flexibility to set their own requirements.

The following three constraints must be included in the model

$$\sum_i \sum_j x_{ij} = k \; ;$$ to ensure exactly *k* players are selected for the squad.

$$\sum_j x_{ij} = 1 \; for\; all\; i \; ;$$ to ensure that a player is only selected once.

$$x_{ij} = 0 \; or\; 1 ; $$ to satisfy the definition of the decision variable.

The following constraints or variations thereof may be included in the model

$$\sum_i x_{i1} \geq y_1 \; ;$$ to ensure sufficient batsmen (y_1) are selected.

$$\sum_i x_{i2} \geq y_2 \; ;$$ to ensure sufficient bowlers (y_2) are selected.

$$\sum_i x_{i3} \geq y_3 \; ;$$ to ensure sufficient fielders (y_3) are selected.

$$\sum_i x_{i4} \geq y_4 \; ;$$ to ensure sufficient category 1 all-rounders (y_4) are selected.

:

$$\sum_i x_{ip} \geq y_p \; ;$$ to ensure sufficient players (y_p) requiring ability *p* are selected.

Additional constraints may be added at the convenors discretion. One such case could be the inclusion of a captain who quite possibly may be unable to make the squad solely on ability but is required for their captaincy and strategic skills. There are several variations to these types of constraints and one such case is shown in the illustrated model.

ILLUSTRATION OF THE MODELLING PROCESS (SOUTH AFRICAN ODI SQUAD)

Data

The ability measures were calculated from player statistics available from the cricinfo website. The statistics economy rate, batting average and number of dismissals per game for 32 South African cricket players were obtained for the period up to and including September 2003. For players with less than 15 international games first class statistics were used whilst statistics obtained as a Protea were used for players with 15 or more international games. The ability indices calculated as discussed above are shown in Table 2. The rows of the table identify the

player i (i=1, 2, …, 32) and the columns of the table identify the ability j (j=1, 2, …, 9).

TABLE 2: **TWO-WAY REPRESENTATION MATRIX OF SOUTH AFRICAN ODI PLAYERS AND ABILITIES**

		Ability (j)								
		1	2	3	4	5	6	7	8	9
	Players (i)	**Bat**	**Bowl**	**Field**	**Bat/ Bowl**	**Bat/ Field**	**Bowl/ Field**	**B/B/F**	**Wick**	**Bat/W**
1	Abrahams, S.		1.02							
2	Adams, P.R.		0.99							
3	Bacher, A.M.	1.00								
4	Benkenstein, D.M.	0.52								
5	Boje, N.	0.81	0.98		0.94					
6	Boucher, M.V.	0.74							1.35	1.05
7	Dawson, A.C.		1.05							
8	Dippenaar, H.H.	1.23								
9	Donald, A.A.		1.02							
10	Elworthy, S.		0.99							
11	Gibbs, H.H.	1.05		0.95		0.98				
12	Hall, A.J.	0.69	1.00	0.96	0.88	0.81	0.97	0.92		
13	Kallis, J.H.	1.30	0.95	0.98	1.18	1.12	0.96	1.13		
14	Kemp, J.M.	0.78	0.97	0.98	0.92	0.86	0.97	0.95		
15	Kirsten, G.	1.20								
16	Klusener, L.	1.27	0.95		1.16					
17	Langeveldt, C.K.		1.02							
18	McKenzie, N.D.	1.13								
19	Nel, A.		1.05							
20	Ntini, M.		1.01							
21	Ontong, J.L.		1.02	1.17			1.09			
22	Peterson, R.J.		0.98							
23	Pollock, S.M.	0.70	1.06		0.92					
24	Prince, A.G.	0.78								
25	Rudolph, J.A.	1.48		0.79		1.12				
26	Smith, G.C.	1.10		1.17		1.11				
27	Stewart, E.L.R.								0.85	
28	Telemachus, R.		0.95							
29	Van Jaarsveld, M.	1.13								
30	Van Wyk, M.N.	1.09							0.80	0.95
31	Willoughby, C.M.		1.02							
32	Zondeki, M.		0.95							

Modelling a South African ODI squad

IP Model

To illustrate the flexibility of the model ten constraints were used. Three constraints were included as a matter of necessity, six constraints were included as a matter of choice and one constraint was included to illustrate model flexibility. The constraints were chosen for illustration purposes only and do not reflect policy of any organizing cricket associations. Several variations of these constraints are possible.

Objective function

Maximize, $Z = z_1 + z_2 + z_3 + z_4 + \ldots + z_9$

The following constraints were included as a matter of necessity

1. $\sum_i \sum_j x_{ij} = 15$;   to ensure exactly 15 players were selected for the squad.

2. $\sum_j x_{ij} = 1 \ for \ all \ i$;   to ensure that a player is only selected once.

3. $x_{ij} = 0 \ or \ 1$; to satisfy the definition of the decision variables.

The following constraints were included as a matter of choice

4. $\sum_i x_{i1} \geq 4$;   to ensure that there were at least four specialist batsmen.

5. $\sum_i x_{i2} \geq 4$;   to ensure that there were at least four specialist bowlers.

6. $\sum_i x_{i3} \geq 1$;   to ensure that there was at least one specialist fielder.

7. $\sum_i x_{i4} \geq 2$;   to ensure that there were at least two specialist batting/bowling all-rounders.

8. $\sum_i \sum_{j=4,5,6,7} x_{ij} \geq 3$;   to ensure that there were at least three specialist all-rounders (all categories).

9. $\sum_i \sum_{j=8,9} x_{ij} \geq 1$;   to ensure that there was at least one specialist wicketkeeper.

The following constraint was included to select a captain
10.

$\sum_j x_{26j} = 1$; to ensure that Graeme Smith was selected for the squad.

The choice constraints provide the squad with at least six batsmen (constraints 4 & 7), at least six bowlers (constraints 5 & 7), at least one specialist fielder and at least one wicketkeeper. The inclusion of a captaincy constraint ensures that the person chosen as captain elect was selected. The constraints were motivated by considering that for an 11-person ODI team at least five bowlers, at least four recognized batsmen and a specialist wicketkeeper are needed. Selection convenors may have alternative interpretations of what an ODI team requires and

thus may opt for variations of the chosen constraints. For example, a specialist spinner, a specialist opening batsmen and/or a specialist strike bowler constraints may be included in the model.

RESULTS

The IP model had 68 variables and 38 constraints. To determine the solution to the proposed model, *Solver*, a linear optimization "*Excel Add In*" package was used. To confirm the results, both authors independently of each other ran the same programme and obtained the same solution. The illustration model yielded a feasible optimal solution. This is not always the case, often an IP model is over constrained and no feasible solution is possible. Goal programming is an option that could be considered if this occurs.

The squad members selected by the IP model were:
Batsmen
H.H. Dippenaar, G. Kirsten, N.D. McKenzie, J.A. Rudolph, M. van Jaarsveld and M. van Wyk
Bowlers
A. Dawson, C.K. Langeveldt, A. Nel and S.M. Pollock
All-rounders
J.H. Kallis (batting and bowling), L. Klusener (batting and bowling) and G.C. Smith (batting and fielding)
Wicketkeeper
M.V. Boucher
Fielder
J.L. Ontong

DISCUSSION

Interestingly, in this example the captaincy constraint would not have influenced the squad selection, as Graeme Smith would have been selected solely on ability. The inclusion of a fielding constraint was perhaps unnecessary, as convenors may prefer to include an extra specialist bowler or all-rounder, however this constraint was used to illustrate how easy it is to include additional constraints in the optimization model.

Alternative criteria for selecting an ODI squad could be used. Team selection criteria like merit, development and transformation constraints could be included at the convening panels discretion and motivations for the use thereof provided. Squad selections in these cases may differ depending on the constraints included but the optimal squad for the constraints used will

still be obtained. As an example, the IP was recalculated after removing constraint 7 (at least two specialist batting/bowling all-rounders). The IP squad selection showed one player change and one ability change. This constraint change meant that the batsman, M. van Wyk was replaced by J.H. Kallis, and the all-rounder J.H. Kallis (bat/bowl) was replaced by H.H. Gibbs (bat/field).

The model does not make selection easy for a player who has performed poorly in the early years of their career. This model relies on long-term form and players who start their career off slowly, as measured by the ability index, may struggle for selection. There are two

solutions to this problem; additional constraints can be included in the model or short-term statistics rather than career statistics used to measure ability. Furthermore, if a player hasn't performed well after having played 15 games for the Protea's, it is difficult to be reselected. This is a drawback as newcomers to teams are often used in unconventional roles and their statistics can be adversely affected. Yet again there are two possible solutions to this problem; in exceptional cases additional constraints can be included in the model or the period (15 games) over which the statistics are determined be extended. These are considerations that bear further investigation.

The analysis of the SA ODI model was used for illustration purposes. To select the optimum National squad, selection convenors should include all players competing in the provincial limited overs format of the game. The methodology would remain the same, but a more sophisticated optimization solver, such as *LINDO*, would be required.

CONCLUSIONS AND FURTHER RESEARCH

The model removes the subjectivity of convenors so that ability is used to determine the optimum squad. Ability is measured by the player indices and will need to be updated at regular intervals. The model is relatively simple and alternative measures for determining the ability of a player could have been used. In particular, a bowler's strike rate, measured as the number of balls bowled relative to the number of wickets taken, is considered by some to be a crucial ability. This ability is useful, if, as some believe, that losing wickets reduces a team's ability to set or reach a demanding target. This is a consideration that bears further investigation, particularly in light of the new 20-over format of the game that has generated substantial spectator interest in the last two seasons.

The model was developed for squad selection of players competing in the limited overs format of the game; the same methodology could be used for selecting a Test squad. Different ability indices may be more preferable in this longer format of the game and this is also an area, which bears further investigation. Also, in this format of the game, the choice constraints as decided by the authors may be irrelevant. All-rounder constraints may be of less importance and this constraint can be amended accordingly. Similarly, opening specialist batsmen may be necessary in this scenario. In all these cases, the relevant coach and team selectors can decide the choice constraints.

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REFERENCES

BARR, G.D.I. & VAN DEN HONERT, R. (1998). Evaluating batsmen's scores in test cricket. *South African Statistical Journal*, 32: 169-183.

EMSLIE, N. (2005). Call for cricket fans to support SA at St George's. *The Herald*, Friday, 18 February.

LEMMER, H.H. (2002). The combined bowling rate as a measure of bowling performance in cricket. *South African Journal for Research in Sport, Physical Education and Recreation Social Sciences*, 24(2): 37-44.

LEMMER, H.H. (2004). A measure for the batting performance of cricket players. *South African Journal for Research in Sport, Physical Education and Recreation Social Sciences*, 26(1): 55-64.

PRESS TRUST OF INDIA (2005). "SA selection policy flawed, says Rhodes." Hyperlink [http://www.indianexpress.com/full_story.php?content_id=64759]. Retrieved 19 February 2005.

PRESTON, I. & THOMAS, J. (2000). Batting strategy in limited overs cricket. *The Statistician*, 49(1): 95-106.

PRESTON, I. & THOMAS, J. (2002). Rain rules for limited overs cricket and probabilities of victory. *The Statistician*, 51(2): 189-202.

RISTOW, A.M.; AMOS, T.L. & STAUDE, G.E. (1999). Transformational leadership and organizational effectiveness in the administration of cricket in South Africa. *South African Journal of Business Management*, 30(1): 1-5.

SLOGROVE, L.; POTGIETER, J.R. & FOXCROFT, C.D. (2002). Batting related experiences of South African universities cricketers. *South African Journal for Research in Sport, Physical Education and Recreation Social Sciences*, 24(1): 101-111.

TAHA, H.A. (2003). *Operations research, an introduction* (7th ed.). Upper Saddle River, NJ: Prentice Hall.

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A MEASURE OF THE CURRENT BOWLING PERFORMANCE IN CRICKET

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ABSTRACT

The combined bowling rate (CBR) defined in Lemmer (2002) for use in limited overs matches and the dynamic bowling rate (DBR) defined in Lemmer (2005) for unlimited overs matches are both measures of career bowling performances. There is, however, a need for measures that can be used to assess the current bowling performances of bowlers in conjunction with their career performances. In order to meet this need, the CBR and DBR measures will be modified to reflect current performances better. Secondly, due to the importance of selecting bowlers who have high probabilities of rendering good performances, the consistency of the bowler (which also reflects the present form of the bowler) should also form part of the measure. The CBP measure developed in this paper has been used to rank a selection of South African bowlers according to their one-day careers and also their test careers.

Key words: Combined bowling rate; Consistency of bowlers; Cricket; Dynamic bowling rate; One-day internationals (ODIs), Rating of bowlers, Test cricket.

INTRODUCTION

Researchers working on the development of performance measures in cricket seem to concentrate almost entirely on batting in one-day matches. This is apparently due to the stimulus given by the Duckworth-Lewis method proposed in Duckworth & Lewis (1998) and further explained in Duckworth & Lewis (2002) for use in ODIs. A very interesting paper, which covers both batting and bowling in ODIs, is that of Beaudoin & Swartz (2003). They defined a statistic, the runs per match for a cricketer, as RM=100*(total number of runs)/(total resources used) where the totals are taken over all of the cricketer's appearances in ODIs. The measure is calculated by using the Duckworth-Lewis method. Conceptually, it is a simple yet

very sensible measure. Unfortunately, as pointed out by the authors, its use is severely restricted by the enormous effort that is required to extract the necessary ODI data for analyses.

In this present paper the focus will be on measures of bowling performance in ODIs and tests alike. A comprehensive measure of bowling performance has been defined in Lemmer (2002) as:

$$CBR = 3R/(W + O + W*R/(6*O))$$

where O is the number of overs bowled, R the number of runs conceded and W the number of wickets taken. This measure is normally calculated for a bowler's one-day career, but it can

also be calculated for a specific innings, match or series of limited overs matches. In the case of unlimited overs matches, the dynamic bowling rate, DBR, which will be discussed later in this paper, is used.

The purpose of this study is to define a suitable measure of a bowler's current bowling performance. Following the approach used in Lemmer (2004a), CBR is modified in such a way that recent bowling performances carry higher weights than performances further back in the bowler's career. It is also necessary to define bowling consistency and show why this is important and necessary to be included as part of the current bowling performance measure.

BOWLING CONSISTENCY

The value of the CBR for the i-th innings will be indicated by CBR_i whereas the career CBR up to the i-th innings will be indicated by $CCBR_i$ for i = 1,2,…,n, where n indicates the number of ODI innings in which the bowler has bowled. There is no simple relationship between $CCBR_n$ and the individual CBR_i. Note that $CCBR_j$ is not equal to $ACBR_j$, the average of all the CBR_i up to the j-th innings. By plotting the $CCBR_j$ and the $ACBR_j$ it can be seen from Figure 1 that the figures have very similar patterns but $ACBR_j$ is larger than $CCBR_j$ for j>1 and more sensitive to exceptionally large (i.e. bad) CBR_i values.
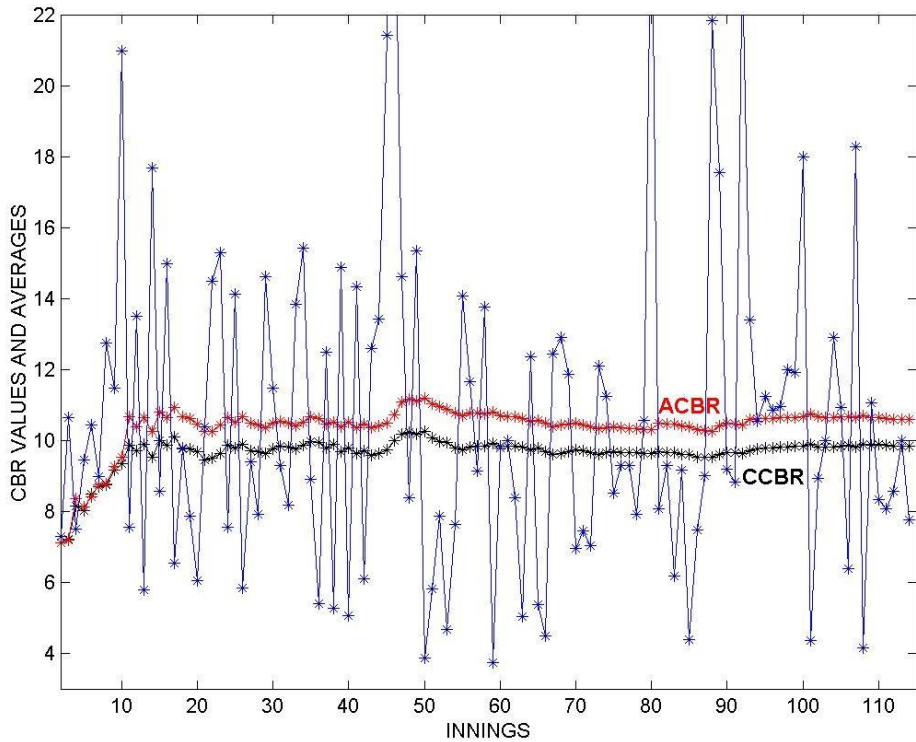
FIGURE 1. **CBR VALUES AND CURVES OF CCBR AND ACBR IN ODIs: M. NTINI**

From a statistical point of view a bowler's consistency can formally be defined as the coefficient of variation of the CBR values, i.e. the standard deviation of all the CBR values divided by their mean. After the j-th innings, this would be $B_{1j} = S_{1j}/ACBR_j$ where:

$$S_{1j}{}^2 = \sum{}^{j}$$

$i=1$

$(CBR_i - ACBR_j)^2/(j-1)$.

The use of ACBR is, however, not satisfactory because CCBR is the actual career performance measure. Note further that the CBR values are observed sequentially as in a time series, and at stage i it is logical to compare CBR_i with the career value $CCBR_i$. A better measure would thus be $B_{2j} = S_{2j}/CCBR_j$ where:

$$S_{2j}{}^2 = \sum^{j}_{i=1}$$

$(CBR_i - CCBR_i)^2/(j-1)$.

This measure is, however, still not satisfactory for the present study because a very small CBR value (i.e. a very good bowling performance) contributes to saying that the bowler is inconsistent. On the other hand, a bowler whose CBR values all lie close to the CCBR values will be called consistent, but such consistency only means more or less average performances.

This study prefers a non-symmetrical definition of consistency by saying that a bowler is consistent if he often obtains CBR values much smaller (better) than his CCBR value. This will happen if his CBR values are mostly below CCBR with some far below CCBR. The aim is to accentuate values far below CCBR but to allocate little or no weight to values above CCBR. This can be accomplished by defining $B_{3j} = S_{3j}/CCBR_j$ where:

$$S_{3j}{}^2 = \sum^{j}_{i=1}$$

$(CBR_i - CCBR_i)^2 \, Ind\{CBR_i < CCBR_i\}/(j-1)$

The indicator function is defined as follows: $Ind\{A\} = 1$ if the event A is true and $Ind\{A\} = 0$ if A is not true. In order to judge whether this measure works satisfactorily, consider a case study consisting of the bowling figures after 36 innings. A twofold graph is drawn in Figure 2 with CCBR and the individual CBR_i in the top figure and B_3 in the bottom figure.
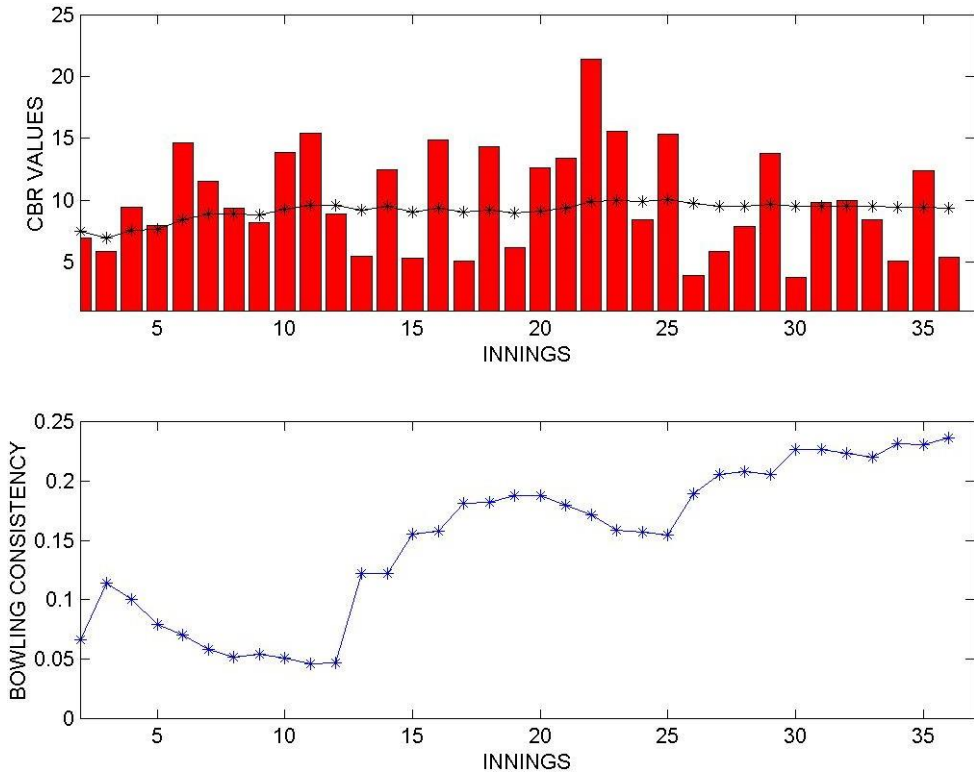
FIGURE 2. **TOP: CASE STUDY ODI VALUES: CBR AND CCBR**
BOTTOM: CASE STUDY ODI BOWLING CONSISTENCY

Since bad performances are not penalized, the curve does not respond to such cases. Careful examination reveals that in six cases the consistency curve of B_3 moves in the wrong direction. In the 14th match the performance was bad, but the curve shows a slight increase from the previous match. In match 33, a good performance is accompanied by a decrease in the curve. It is often difficult to judge whether the curve increases or decreases, i.e. whether it moves in the right direction. To quantify this, define the deviation $d(j)=CBR_j-CCBR_j$ and the increment of the consistency curve by $inc(j) = B_{3j} - B_{3,j-1}$. The signs of $d(j)$ and $inc(j)$ should differ. Define the product $pr(j) = d(j).inc(j)$ and m_1 = proportion of cases where the signs differ, i.e. where the product is negative. The value of m_1 should be close to 1. In the case of

Figure 2, $m_1 = 0.824$. Some of the increments are very small, so it is better to take the sizes of the deviations and increments into consideration too. Define npr as (-1) times the sum of the negative products and ppr as the sum of the positive products. Then let $m_2 = npr/(ppr + npr)$. In the case of Figure 2, $m_2 = 0.985$.

The measure B_3 can be improved by taking the positive deviations d(j) into account too. Let $BC_j = S_j / CCBR_j$ where:

$$S_j^2 = [\sum_{i=1}^{j} - \sum_{i=1}^{j}$$

$$(CBR_i - CCBR_i)^2 \, Ind\{CBR_i < CCBR_i\}$$

$$(CBR_i - CCBR_i)^d \, Ind\{CBR_i > CCBR_i\}]/(j-1)$$

with $S_j = 0$ if […] <0, and where $d = 1$. If a bowler performs very well in an innings, the value of BC_j will increase markedly, but if he performs very badly, the value of BC_j will decrease only moderately due to the choice of $d = 1$. Measures B_1, B_2, B_3, BC and various other versions have been considered. The choice of a value for d to be used in BC was based on extensive studies in which various values of d have been considered. The value of d determines how severely bad performances are penalized. If $d = 2$ (as for good scores), such scores could overshadow good ones because even for the best bowler, the distribution of CBR is skewed to the right. The value of d should thus be scaled down from 2 in relation to the length of the left tail relative to the right tail of the distribution. Thirteen experienced ODI bowlers have been selected from a data set mentioned below, all their CBR_i values have been calculated and a distribution has been fitted to these 1430 values. As expected, a gamma distribution yielded a very good fit. When examining the distances of certain percentiles from the overall CBR value for the whole set, the indications were that the value of d should be in the range from 1 to 1.2. By plotting the consistency curves of many bowlers, it was found that with $d = 1.2$ the drop in the consistency curve for bad performances appeared too severe compared to $d = 1$. Taking into account that even the best bowler can occasionally have bad match figures due to the bad fielding of his team and not because of his bad bowling, it was decided to use the value d=1. Details of this extensive process have been discussed in a conference lecture (Lemmer, 2004b).

For the case study, the BC measure worked well and yielded $m_1 = 0.971$ and $m_2 = 0.999$. The consistency curve is given in Figure 3.
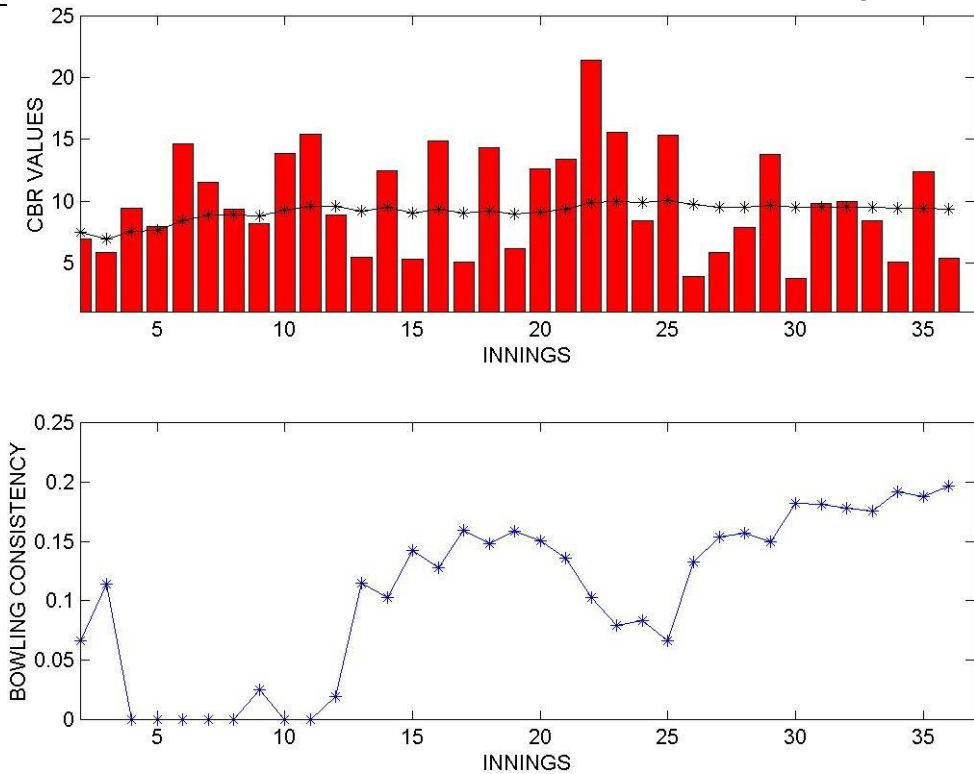
FIGURE 3. **TOP: CASE STUDY ODI VALUES: CBR AND CCBR**
BOTTOM: CASE STUDY ODI BOWLING CONSISTENCY

The curve is sensitive to very bad (high) CBR values and to very good (small) values. Initially, the curve may fluctuate a great deal, but it stabilizes as the number of innings played increases.

From the definition of bowling consistency, it is clear that consistency is a desirable characteristic. In order to learn more about bowling consistency, it is necessary to apply it to real data. Consider a data set consisting of the bowling figures of all the current bowlers of all ODI teams who have bowled at least one hundred overs each, taken on 02/02/2005 from Cricinfo (2005a). If the career consistency BC of each bowler is calculated, it is found that BC has an almost normal distribution with average 0.17333 and standard deviation 0.057138.

Consistency is an important requirement for a good bowler because it can be expected that a consistent bowler will normally bowl well with only occasional bad performances. In order to provide a further perspective on bowling consistency, it can be related to the probability of a good bowling performance. A bowler will be judged to have bowled very well if his CBR_i value in a match is smaller than $0.7CCBR_i$, i.e if his CBR_i value is at least 30% better than his

current $CCBR_i$ value. For the data set, the relationship between the consistency measure BC and the probability of a very good performance has been found as PROB = 0.042 + 0.813BC.

A very consistent bowler with BC = 0.30 has a 29% probability of a very good performance, whereas an inconsistent bowler with BC = 0.10 has only a 12% probability of a very good performance.

CBR is a formal measure based on all the bowling figures of the bowler, irrespective of the time span of his career. In the construction of a measure of current performance, it is important to attach more weight to recent performances compared to performances far back in time. One possibility is to calculate CBR for the last ten, twenty or thirty matches, indicated by CBR10, CBR20 and CBR30. Each of these, however, takes no account of any previous performances. A better approach is to use all the career figures, but to allocate high weights to recent figures and progressively lower weights to figures further back. The method proposed here is to use weights according to those of an exponentially weighted average (cf. Lemmer, 2004a). The weights are, however, not applied to the individual CBR_i, but to each of the consecutive match values of O, R and W separately. If the last (most recent) set of scores of O, R and W has a weight , the weight of the second-last set is β , the weight of the third last set is β^2 , etc., where β =1- with being a suitable value. The weighted sums of O, R and W are then used as in the CBR formula to calculate the value of the exponentially weighted CBR measure, WCBR. In Lemmer (2004a) the value used for was 0.04. In this study, the values 0.04, 0.06, 0.08 and 0.10 were considered. By calculating the correlation between each of CBR10, CBR20 and CBR30 on the one hand and WCBR with each of the values, it was found that CBR20 and WCBR with =0.06 had the highest correlation (r=0.96). The choice of was further facilitated by plotting $CCBR_i$ and $WCBR_i$ jointly on the same graph for each of the values considered. This has been done for a large number of bowlers and the choice of was confirmed. Note that CBR20 (which is based on only twenty CBR values) is much more sensitive to exceptionally good or bad performances than WCBR, which makes it unsuitable as a career performance measure. For illustration purposes, the graphs of English bowler Ashley Giles are given in Figure 4 for =0.06. The more stable curve ending at the top in the top figure is CCBR.
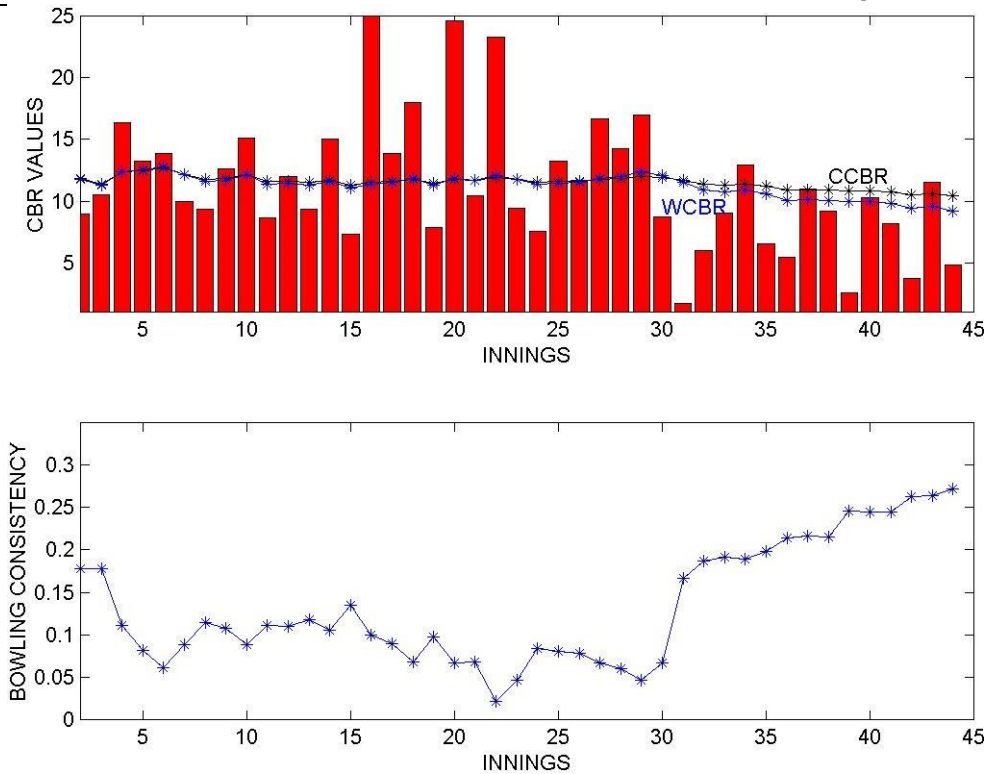
FIGURE 4. **TOP: GILES' CAREER ODI VALUES: CBR, CCBR AND WCBR**
           BOTTOM: GILES' CAREER ODI BOWLING CONSISTENCY

Up to his 30th match, Giles had a mixture of good and bad performances, resulting in low consistency, as can be seen on the bottom graph. From the 30th innings, he became much more consistent as shown on the graph and reflected by the increasing gap between the CCBR and WCBR curves. It is clear that the final value of WCBR quantifies the bowler's current performance better than the final value of CCBR. It was thus decided to use WCBR instead of CCBR as a basis for the new measure. This is similar to the use of EWA in the construction of BP for batting – cf. Lemmer (2004a). Note that the high percentage of good (lower than CCBR) CBR values in the latter part of Giles' career reflects his high consistency, despite the appearance of inconsistency in a normal statistical sense.

CURRENT BOWLING PERFORMANCE MEASURE

To have a measure that has a large (rather than small) value in the case of good performance, it is better to use the inverse of WCBR, namely 1/WCBR. In order to take consistency into account too, 1/WCBR must be scaled up or down by using $A = BC/\text{average}(BC) = BC/0.17333$ in a suitable way. For the data set it is found that the average of A is 1.0000 and

the standard deviation of A is 0.32965. In the construction of the batting performance measure BP in Lemmer (2004a) the consistency scale factor C had an average of 1.0000 and a standard

deviation of 0.0677. In order to obtain a similar scale factor here, consider $B = A^c$ with c such that the standard deviation of B is as close as possible to 0.0677. Using the same trick as in Lemmer (2004a), let c = 0.0677/0.32965 = 0.2054. Then the average of B is 0.9934 and its standard deviation is 0.0674. These statistics are very similar to the scaling factors C and RP in Table 3 in Lemmer (2004a), and are shown in Table 1.

TABLE 1. **STATISTICS OF ODI DATA SET**

	BC	A	B	C	RP
Average	0.1733	1.0000	0.9934	1.0000	0.9969
Standard deviation	0.0571	0.3297	0.0674	0.0677	0.0681

The measure of current bowling performance is defined as CBP = 100*B/WCBR where the factor 100 is conveniently used to avoid working with too many decimals. This can be used to rank bowlers in order to select the best ones. For comparison purposes it is useful to classify bowlers into ten classes according to their current bowling performances (see Table 1 in Lemmer, 2004a). The classification table is given in Table 2, which also includes the classes for the current bowling performance measure in the case of test matches (discussed below). A bowler with CBP >11.19 falls in class one, the best class.

TABLE 2. **A CLASSIFICATION SCHEME OF TEN CLASSES FOR CBP VALUES FOR TESTS AND ONE-DAY INTERNATIONALS**

Class number	Interval for tests	Interval for ODIs
1	7.26^+ - ∞	11.19^+ - ∞
2	6.86^+ - 7.26	10.06^+ - 11.19
3	6.50^+ - 6.86	9.62^+ - 10.06
4	6.15^+ - 6.50	9.21^+ - 9.62
5	5.94^+ - 6.15	8.81^+ - 9.21
6	5.74^+ - 5.94	8.33^+ - 8.81
7	5.51^+ - 5.74	7.97^+ - 8.33
8	5.20^+ - 5.51	7.61^+ - 7.97
9	4.77^+ - 5.20	6.91^+ - 7.61
10	0.00 - 4.77	0.00 - 6.91

The use of the current bowling performance measure (CBP) is now illustrated. In Table 3 the South African bowlers who had, at the end of the 2004/2005 season, bowled at least 100 overs and played at least 20 ODIs have been ranked according to the CBP.

TABLE 3. **RANKING OF SA ODI BOWLERS ACCORDING TO CBP**

Rank	Name	Average	CBR	WCBR	BC	PROB	CBP	Class
1	A. Hall	28.92	10.53	10.35	0.264	0.214	10.53	2
2	S. Pollock	24.15	9.04	10.19	0.211	0.238	10.22	2
3	M. Ntini	22.86	9.83	9.87	0.162	0.175	9.99	3
4	N. Boje	35.41	11.10	11.13	0.139	0.154	8.59	6

5	L. Klusener	29.95	11.04	11.73	0.177	0.165	8.56	6
6	J. Kemp	32.56	11.15	11.58	0.161	0.217	8.51	6
7	A. Nel	30.49	11.21	11.47	0.103	0.091	7.84	8
8	J. Kallis	31.90	11.31	12.79	0.156	0.198	7.65	8
9	R. Peterson	69.56	12.84	12.82	0.146	0.150	7.53	9

Much useful information can be obtained from this table. According to the traditionally used average, Ntini should be in the first place. The better, more comprehensive, combined bowling rate (CBR) would place Pollock first. Note that both CBR and WCBR should be as small as possible. A comparison between the values of CBR and WCBR is very informative because the latter places more weight on recent performances. In Hall's case WCBR = 10.35 is smaller (better) than CBR = 10.53, indicating that he was improving his bowling performances. Except for Peterson, all the other bowlers were going the opposite way round – Ntini and Boje only slightly, but Pollock and Kallis quite drastically. Looking at bowling consistency (BC), Hall stands out as much more consistent than all the others, with Pollock in second place. The probability of a good bowling performance, which is, according to previous discussion, related to BC, is highest in the case of Pollock, Kemp and Hall. All these considerations are jointly accommodated in the CBP measure, which places Hall in the top position as the best South African ODI bowler at the end of the 2004/2005 season. In comparison with all the current ODI bowlers (according to the classification scheme in Table 2), Hall and Pollock were in class 2, Ntini in class 3 and the rest below average.

TEST MATCHES

The measure proposed in Lemmer (2005) for bowling performance in the case of unlimited overs matches is the dynamic bowling rate:

$$DBR = 7R/(4W + O + 2W*R/(6*O)).$$

The steps that are required for the construction of a measure of current bowling performance are the same as for the CBP above and can thus be presented much more concisely. Data is recorded per innings and not per match.

The value of DBR for the i-th innings is indicated by DBR_i and the career DBR value up to the i-th innings by $CDBR_i$, i = 1,2,…,n. The bowling consistency coefficient after j innings is defined as $BC_j = S_j/CDBR_j$ where:

$$S_j^2 = [\sum_{i=1}^{j} \quad - \sum_{i=1}^{j}$$

$(DBR_i - CDBR_i)^2 \, Ind\{DBR_i < CDBR_i\}$

$(DBR_i - CDBR_i)^d \, Ind\{DBR_i > CDBR_i\}]/(j-1)$

with $S_j = 0$ if [...] <0, and d = 1. The choice of the most appropriate value of d has again been confirmed by examining the consistency curves of test bowlers.

For further developments, a data set consisting of the bowling figures of all the current test bowlers who have bowled at least one hundred overs each, was taken from Cricinfo (2005b) on 02/02/2005. The career consistencies of all of these 87 bowlers have been calculated and it was found that the distribution of BC is approximately normal with average 0.19809 and standard deviation 0.08642.

It is well known that in the case of test matches bowlers are less restricted than in ODIs and can therefore perform better, as can be seen from the ordinary bowling measures (the average, the economy rate and the strike rate). The requirement for a very good bowling performance will thus be slightly stricter than in the case of ODIs, namely if the bowler's DBR_i value is at least 33% better than his $CDBR_i$ value, i.e. if $DBR_i < 0.67CDBR_i$ he has bowled very well. For the data set it was found that the probability of a very good performance is given by PROB = 0.06 + 0.757BC. For an inconsistent bowler with BC = 0.10 the probability of a very good performance is 8.2% and for a very consistent bowler with BC = 0.35 the probability of a very good performance is 27.1%. This confirms the importance of bowling consistency and motivates its utilization in the construction of a measure of bowling performance.

To obtain a measure reflecting current performances, one can start by calculating DBR for the last ten, twenty or thirty innings and indicate these by DBR10, DBR20 and DBR30. Much better, however, is an exponentially weighted measure WDBR constructed similarly to WCBR. Again the values 0.04, 0.06, 0.08 and 0.10 were considered and it was found that the highest correlation (r = 0.96) existed between DBR20 and WDBR with = 0.06. The measure of the current bowling performance is now constructed by using 1/WDBR and scaling it up or down by using an appropriate power of A = BC/0.19809. For the data set the average of A is 1.0000 and its standard deviation is 0.43627. Using the same downscaling technique as in the case of the batting performance measure of test batsmen in Lemmer (2004a), calculate c = 0.0718/0.43627 = 0.1646. Let $B = A^c = A^{0.1646}$, then the average of B is 0.9890 and its standard deviation is 0.0732. These statistics are summarized in Table 4. By comparing them with the statistics of BP from Table 6 of Lemmer (2004a) it is clear that the scaling is very satisfactory.

TABLE 4. **STATISTICS OF TEST DATA SET**

	BC	**A**	**B**	**C**	**RP**
Average	0.1981	1.0000	0.9890	1.0000	0.9937
Standard deviation	0.0864	0.4363	0.0732	0.0718	0.0729

For tests and other unlimited overs matches, the measure of current bowling performance is defined as CBP=100*B/WDBR. By calculating the CBP for each bowler in the data set and estimating the deciles of the distribution of the CBP, the classification scheme is as given in Table 2.

A ranking of the current SA bowlers who had, at the end of the 2004/2005 season, bowled at least 100 overs and played at least 15 test matches is given in Table 5.

TABLE 5. **RANKING OF SA TEST BOWLERS ACCORDING TO CBP**

Rank	Name	Average	DBR	WDBR	BC	PROB	CBP	CLASS
1	A. Nel	25.45	14.02	13.13	0.189	0.071	7.56	1
2	S. Pollock	22.09	11.92	13.20	0.189	0.184	7.51	1
3	L. Klusener	37.91	14.66	14.59	0.263	0.274	7.18	2
4	M. Ntini	29.22	15.27	14.91	0.176	0.155	6.58	3
5	A. Hall	37.19	16.41	17.23	0.288	0.259	6.17	4
6	J. Kallis	31.60	14.49	15.87	0.162	0.180	6.10	5
7	N. Boje	37.49	15.47	17.16	0.138	0.138	5.49	8
8	M. Hayward	29.80	16.07	16.90	0.096	0.103	5.26	8
9	G. Smith	87.29	20.34	20.83	0.137	0.115	4.52	10

According to the career dynamic bowling rate (DBR), Pollock should have been in the top position, but the large increase from DBR = 11.92 to WDBR = 13.20 clearly indicates that towards the end he was out of form. This gave Nel the opportunity to shift into the first place. That this was justified can be seen by observing that he showed great improvement towards the end with WDBR = 13.13, much smaller than DBR = 14.02. Ntini also showed marked improvement and Klusener to some extent, but all the others fell back. Hall and Klusener were very consistent with relatively high probabilities of good bowling performances. Measured against the total group of current test bowlers used to draw up the classification Table 2, Nel and Pollock were in class 1, Klusener in 2, Ntini in 3, Hall in 4 and Kallis in 5.

CONCLUSION

Bowling consistency was defined and a suitable measure (BC) developed to quantify it. A bowler's consistency is important in its own right because it gives an indication of the present form of a bowler and the likelihood that the bowler will perform well.

A bowler's present form can also be judged by comparing WCBR and CBR in the case of one-day matches and WDBR and DBR in unlimited overs matches.

The current bowling performance measure (CBP) defined in this study is a joint measure that takes into account all the important measures of bowling performance. It is completely objective and thus not subject to personal prejudices. Its calculation is by means of an easily programmable algorithm using only the bowler's career values of O, R and W per innings played.

Measures like the CBP and others discussed here and in previous publications indicate that selectors often do not succeed in selecting the best players. The challenge is to convince cricket statisticians, coaches and selectors to use these measures in order to select the best players, measure their performances on a regular basis and train them to reach and maintain their optimal performance levels.

The following comments by one of the referees are very valid: "Research in virtually all disciplines has become increasingly dependent on the application of statistical techniques. If

civilization is to progress, our knowledge must be increased at all levels and statistics is an

essential link in this process because it entails the development and application of techniques for interpreting cricket data".

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REFERENCES

BEAUDOIN, D. & SWARTZ, T. (2003). The best batsmen and bowlers in one-day cricket. *South African Statistical Journal*, 37(2): 203-222.

CRICINFO (2005a). ODI career bowling averages [http://rsa.cricinfo.com/link_to_database/STATS/]. Retrieved on 2 February 2005.

CRICINFO (2005b). Test career bowling averages [http://rsa.cricinfo.com/link_to_database/STATS/]. Retrieved on 2 February 2005.

DUCKWORTH, F.C. & LEWIS, A.J. (1998). A fair method for resetting the target in interrupted one-day cricket matches. *Journal of the Operational Research Society,* 49: 220-227.

DUCKWORTH, F.C. & LEWIS, A.J. (2002). Review of the application of the Duckworth/Lewis method of target resetting in one-day cricket. In G. Cohen & T. Langtry (Eds.), *Mathematics and computers in sport* (127-140). Gold Coast: Bond University, Queensland.

LEMMER, H.H. (2002). The combined bowling rate as a measure of bowling performance in cricket. *South African Journal for Research in Sport, Physical Education and Recreation Social Sciences,* 24(2): 37-44.

LEMMER, H.H. (2004a). A measure for the batting performance of cricket players. *South African Journal for Research in Sport, Physical Education and Recreation Social Sciences,* 26(1): 55-64.

LEMMER, H.H. (2004b). 'n Maatstaf vir die meting van die bestendigheid van boulers in krieket. Unpublished paper presented at the Annual Conference of the South African Statistical Association on 3 November 2004.

LEMMER, H.H. (2005). A method for the comparison of the bowling performances of bowlers in a match or a series of matches. *South African Journal for Research in Sport, Physical Education and Recreation Social Sciences,* 27(1): 91-103.

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JOB SATISFACTION OF SELF EMPLOYED TRAINERS AND PERSONAL TRAINERS EMPLOYED AT COMMERCIAL GYMNASIUMS: A COMPARATIVE STUDY

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ABSTRACT

Personal trainers are responsible for the effective delivery of health and fitness programmes. Their roles are of importance to the fitness industry and therefore, the degree of job satisfaction they experience is of prime importance. The purpose of this paper is to identify the various factors that play a role in determining the job satisfaction levels of personal fitness trainers employed at commercial gymnasiums and self employed trainers. A total of 353 personal trainers from South Africa formed the target population for the survey. A structured questionnaire was sent to the entire population. A response rate of 85% (n=300) was received using the mail survey method. Key results revealed that the majority of the trainers at the commercial gymnasiums expressed low levels of satisfaction with their salary, opportunities for promotion and growth, commission structure, ranking system and working conditions. More importantly, a major finding was that self employed trainers experienced greater levels of satisfaction than commercially employed trainers.

Key words: Job satisfaction; Personal trainer; Commercial; Self employed.

INTRODUCTION

Personal training is a profession that is practised worldwide (Lumpkin, 2004). It is a highly skilled profession and requires a great deal of expertise in areas such as marketing, human relations, communication, service delivery and knowledge in the field itself. Personal trainers are responsible for the effective delivery and promotion of health and fitness programmes. They play a key role in the fitness industry and therefore the degrees of job satisfaction they experience are of prime importance (Koehler, 1998). Personal trainers are different from a regular fitness trainer as they train clients on an individual basis.

After completing their studies, two employment options are available to personal trainers. They may work in a commercial gymnasium, or practice as a freelance personal trainer in a number of health clubs.

The key theories of job satisfaction, namely Maslow's (1954) hierarchy of needs theory,

Herzberg's motivation theory (Herzberg, *et al*.,1959), Lawler's (1973) facet model of satisfaction and Locke's (1976) value-based theory of satisfaction were used for this study. Maslow's (1954) self actualisation model is based on the work of existential philosophers who postulate that man has the innate drive to achieve his full potential, but that it is the conditions

of everyday life that place constraints on this "instinct for self actualisation" and cause him to perform sub optimally. Herzberg *et al*. (1959) found that five work related factors, namely achievement, recognition, work itself, responsibility and advancement, tended to affect job attitudes in a positive direction. The presence of these factors tended to contribute to increases in performance. On the other hand he found eleven work environment related factors such as salary, possibility of growth, interpersonal relations (sub-ordinates), interpersonal relations (superiors), interpersonal relations (peers), supervision technical, company policy, working conditions, personal life, status and job security that contribute to job satisfaction. These 11 factors of Herzberg (1959) are of prime importance as contributors to job satisfaction of personal trainers or any worker. In most of these eleven factors, if the factor was not present it led to low degrees of job satisfaction.

Lawler's (1973) facet model of satisfaction argues that job satisfaction is a function of the extent to which what one receives from a job matches what one thinks he or she should receive from the job. If personal trainers feel they are higher qualified and have more experience they would expect to receive more from the job in terms of compensation.

Locke (1976) argued that individuals place more or less value on each of all possible outcomes from their jobs. The outcomes may be salary, prestige, or working conditions. His theory is applicable to personal trainers as some may prefer working for the prestige and status associated with the job while others may place more emphasis on salary.

There are three important dimensions of job satisfaction (Lumpkin, 2004): firstly, job satisfaction is an emotional response to a job situation; secondly, job satisfaction is determined by how well outcomes meet or exceed expectations. For example, if commercial personal trainers feel that they are working much harder in the gymnasiums but are receiving fewer rewards they could have a negative attitude towards the job, the employer and co-workers. These employees would experience lower degrees of job satisfaction. On the other end of the continuum if they are treated well and are being paid equitably, they are likely to have a positive attitude towards their job (Robbins, 2003). They would be satisfied (Luthans, 2002). Thirdly, job satisfaction represents several related attitudes such as the work itself, pay, promotion opportunities, supervision and co-workers that an individual has towards the job.

Smucker & Kent (2004) analysed job satisfaction and referent comparisons of administrators in three different segments of the sport industry. The results of the study showed a relationship between promotion and job satisfaction. If employees were not promoted when they considered themselves worthy of promotion low degrees of job satisfaction arose. Respondents indicated low degrees of job satisfaction with regard to low pay, promotion and negative working conditions.

Koehler (1998) researched corporate fitness managers who directed fitness programs or facilities in Californian gymnasiums. This group of managers experienced satisfaction with their overall employment, social services, moral values, and achievement and lower satisfaction with supervision, lack of opportunities for advancement and compensation. Commercial personal trainers in South Africa experienced high and low levels of job

satisfaction with similar contributors.

A study conducted by Howell and Higgins (2005) of the job satisfaction of sport administrators employed in American and Canadian recreation programs found that males reported higher degrees of job satisfaction than females. They also concluded that respondents showed low levels of job satisfaction with salary and promotional opportunities which contributed to their feeling dissatisfied about their jobs. Personal trainers also reported that salary and lack of promotional opportunities led them to experience low levels of satisfaction about their jobs.

PROBLEM STATEMENT

The liquidation of the Health and Racquet Club in 2000 and the subsequent take over by Virgin Active had a profound effect on the personal training profession (Salgado, 2001). Trainers were unsure regarding several issues such as the renewal of contracts, uncertainty regarding retrenchments, rental increases, budget constraints and uniform issues. Changes of this nature have had an effect on the attitude, morale and performance of personal trainers which caused them to express low degrees of satisfaction with their jobs (Khan, 2001). This created a high degree of uncertainty and anxiety that prevailed in the personal training profession and this has had an influence on their level of job satisfaction.

Changes in employment conditions coupled with massive rent increases led to a high turnover of personal trainers, as many of them could not afford the new rentals (Salgado, 2001). Former personal trainers of company employed gymnasiums became private trainers. The private practicing fitness trainers' levels of job satisfaction therefore need investigation and a comparison would be made with trainers who are currently employed at commercial gymnasiums. An important reason for investigating job satisfaction is the belief that increased job satisfaction will result in increased productivity and hence profitability of health clubs. It will assist personal trainers to work in a more stable environment, and provide greater efficiency in service delivery to their clients.

PURPOSE OF THE STUDY

The purpose of the study was to investigate the job satisfaction of self employed trainers and personal trainers employed in commercial gymnasiums. It attempted to identify the problems experienced by personal trainers, the solutions they proposed and to make future personal trainers aware of the levels of satisfaction involved in personal training in general. This paper attempts to seek answers to the following critical questions:

1) What are the levels of job satisfaction experienced by commercial trainers and self employed trainers?
2) Is it fair to constantly fluctuate commission structures of commercial trainers?
3) Should a personal trainer who has a higher qualification and longer years of service be given the same ranking as a newly qualified personal trainer?

METHODOLOGY

The target population for the investigations comprised 353 personal trainers who belonged to the former South African Registered Personal Trainer Association and represented all the provinces in South Africa. A structured questionnaire was sent to the entire target population

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using a mail survey. A return rate of 85% was received. Of these 53% (n=160) were employed at health clubs and 47% (n=140) were self employed.

The secondary sources that were used for a review of literature were textbooks, journals, Internet sources, media articles and other dissertations.

A pilot study was conducted in KwaZulu-Natal with a total of 50 personal trainers to reflect the homogeneity of the target population. These 50 personal trainers were also used in the final sample. The pilot study enabled the researcher to pre-test and validate research instruments and research procedures prior to the initiation of the empirical investigation. The pilot study revealed that two questions appeared to be ambiguous. This was subsequently remedied to fine tune the final questionnaire. The reliability of the questionnaire was established by the test retest responses. In addition, a preliminary analysis revealed the same consistent responses justifying the reliability of the instrument.

The questionnaire consisted of a number of close-ended questions, using the yes/no and the Likert scale. The Likert scale consisted of a rating scale of 1 -4 where respondents were asked to indicate their level of satisfaction towards their job. The rating for the likert scale was 4 - very satisfied, 3 - moderately satisfied, 2 - moderately dissatisfied, 1 - very dissatisfied. Provision was also made for open ended questions. The questionnaire was divided into four sections: Section One: Biographical data, Section Two: Occupational choice and motivation, Section Three: Job satisfaction and Section Four: Job security.

Once the questionnaires were received they were coded, and captured on the computer. The Statistical Programme for Social Sciences (SPSS) version 11 for Windows was used to conduct the statistical tests. Means, frequencies and test of significance were also applied on the data.

RESULTS AND DISCUSSION

The purpose of this study was to investigate the job satisfaction of self employed trainers and personal trainers employed in commercial gymnasiums. As a relatively recent phenomenon, the position of personal trainers and individuals filling those positions represent an area fraught with issues and questions for educators, researchers and fitness professionals alike. Not the least among these are the feelings and perceptions that personal trainers hold about their own job situation.

The respondents were all South African. A total of 60% of the respondents had between 10-15 years of experience in personal training, while 32% of the respondents had between 5-10 years of experience in personal training. Only 8% had relatively little experience of less than four years. Such high levels of experience in the personal training profession could be indicative of a high standard and quality of personal training in South Africa. With regard to job satisfaction of personal trainers it would appear that, overall, self-employed trainers experienced greater levels of job satisfaction than commercial trainers. That is, their overall job satisfaction was reported to be an average of 78.67%. The possible reasons for this include greater autonomy and compensation. Commercial trainers had an overall job satisfaction of

55.5%. However, certain aspects of the job seemed more pronounced than others such as salary, promotion and supervision. Specifically, the factors shown to be more satisfying than

all other factors were social service, or the chance to do some things for other people, and moral values, or not going against one's conscience.

Conversely, those factors that were less satisfying for commercial trainers were lack of advancement, opportunities for promotion and growth, commission structures constantly changing and compensation. A South African study conducted by Surujlal (2004) on the human resource management of professional sport coaches in South Africa yielded similar results in terms of coaches' job satisfaction. These findings are consistent with the findings of Herrera and Lim (2003) who conducted a study on job satisfaction among Athletic trainers in National College Athletic Association Division One institutions and concluded that athletic trainers experienced lower levels of job satisfaction with issues such as lack of opportunities for promotion and growth, salary and lack of skills development workshops. Howell and Higgins (2005) also concluded that compensation and lack of opportunity for upward mobility was the key determinant of job satisfaction in his study of job satisfaction of sport administrators employed in American and Canadian university recreation programmes. These studies evaluated similar elements as the present study in terms of job satisfaction.

Results of the present study showed that male personal trainers had a mean of 2.79, while female personal trainers had a mean of 2.27 in terms of their levels of satisfaction. Therefore, the research revealed that female personal trainers showed lower levels of job satisfaction than their male counterparts. The possible reasons for female trainers reporting lower degrees of job satisfaction were discrimination at work and lack of upward mobility. These findings are consistent with the findings of Koehler's (1998) study on the job satisfaction of corporate fitness managers in America which revealed that female fitness managers reported lower degrees of job satisfaction than their male counterparts with regard to upward mobility.

Commercial personal trainers 48% were within the age groups 18-25 years, and 57% of self-employed trainers were within the age group 25-35 years. The main reason cited for this is that most self-employed trainers start off their careers as commercial trainers when they are younger and then decide to pursue their own business venture, as they gain more knowledge and experience. When one starts off a career greater degrees of job satisfaction are experienced initially. Luthans (2002) states that during the early years of one's career an urgent need is felt for the reviewing of career plans to enhance job satisfaction. If a job an individual is involved in fails to provide challenges it may force the individual to start looking for alternative employment which might lead to greater job satisfaction.

Commercial personal trainers with one to five years of experience in the field had a mean rating of 2.95, and subjects of five years and more had a mean rating of 2.00 indicating that the longer the company employed personal trainer was in the profession the lower the levels of job satisfaction. A major cause of the low levels of job satisfaction was the constant changing of commission structures, and the absence of a ranking system. All commercial personal trainers, irrespective of their years of service and qualifications, were graded and ranked in the same manner, which impacts negatively on job satisfaction.

All of the respondents (100%) indicated that they did not belong to any professional fitness association and trade union. This was due to the absence of such an organisation in the country at the time. The absence of such an association could negatively affect the development of personal trainers aspiring to higher levels as they have no one to represent

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them. The reason as to why there was no such body was due to the South African Registered Personal Trainer Association being disbanded. All the respondents (100%) were in favour of the establishment of a National Personal Trainer or Sport Science Association to enhance job satisfaction. It would also suggest that for the advancement of a professional personal training body in South Africa, there is a need for personal trainers to take the initiative and to facilitate the formation of such a body.

TABLE 1. **SKILL DEVELOPMENT WORKSHOPS**

Skills development workshops presented	Company employed n=160	Self employed n=140
Yes	39%	0%
No	61%	100%

A concerning factor, as indicated in Table 1 was that 61% of commercial personal trainers indicated that skills development workshops were not presented to them by their employers, which contributed to a lack of job satisfaction as they did not have the opportunity to enhance existing skills. Skills development workshops are related to job satisfaction in terms of upward mobility (promotion opportunities).

Courses attended by personal trainers averaged from two to three courses during a three to five year period. An average of two to three courses for a three to five year period is too few for continuing education in the field of personal training. The industry average for health and fitness professionals is four refresher courses a year (Herrera & Lim, 2003). Providing valuable skills and improving their ability provide workers with a sense of self pride, a sense of competence, and a sense of self confidence (Gerber *et al*., 2002). The skilled worker will feel more confident in carrying out his or her tasks. This ultimately contributes positively to job satisfaction.

Most commercial personal trainers 67% were dissatisfied with the salary and compensation they received, which contributed to low levels of job satisfaction. It appears that a perceived low salary, which leads to job dissatisfaction, is a main contributor to employee turnover (Parkhouse, 2001). Salary is a key determinant of satisfaction because it serves as a symbol of achievement and a source of recognition (Merriman, 2004). These results are consistent with the findings of Surujlal (2004) that suggest job satisfaction and job retention is largely dependent on compensation. Chelladurai (1999) also agreed with these findings and maintains that salary is a key determinant of job satisfaction. Self-employed trainers were satisfied with the pay they received as they decide how much they get as a salary. A study conducted by Smucker (2003) on job satisfaction of female sport journalists concluded that the female sport

journalist expressed low degrees of job satisfaction with regard to salary which is also prevalent in the present study.

Career paths in terms of upward mobility (promotion) opportunities seem to have a varying effect on job satisfaction as they take on different forms. A lack of promotion opportunity leads to negative feelings of satisfaction as frustrated ambition can give rise to particularly intense feelings of low job satisfaction (George & Jones, 2000). The majority of the

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respondents from the commercial gymnasiums 67% experienced low levels of job satisfaction with their opportunities for promotion and growth. In the commercial gymnasium environment personal training is not a career that lends itself to promotion and growth as different levels of managers exist with various portfolios. Smucker (2003) concluded in his study of job satisfaction of female sport journalists that 50% of the survey respondents listed lack of career advancement as a very important factor in their decision to leave.

Self-employed trainers were moderately satisfied with their opportunities for promotion and growth. A positive work environment and opportunities to grow intellectually for many has become more important than promotional opportunities (Luthans, 2002).

Commercial and self-employed trainers reported that they experienced high degrees of stress, which led to low levels of job satisfaction. Although self employed trainers experienced greater degrees of job satisfaction, personal training was still a stressful occupation for them. This suggests that the facets influencing job satisfaction had a profound influence on the levels of stress experienced by personal trainers. Herrera and Lim (2003) support these findings and concluded that stress could have a negative effect on job satisfaction, organisational behaviour and on an individual's health. The main reason cited by personal trainers for their high levels of stress was the unrealistic expectations that clients had of them with regard to achieving their training goals.

CONCLUSIONS AND RECOMMENDATIONS

The results show that self employed trainers experienced greater levels of satisfaction than commercially employed trainers. Male personal trainers experienced greater levels of job satisfaction than female personal trainers. Personal training is a very stressful profession. It was noted that the stress levels of both commercial and self-employed trainers were high, and contributed to lower levels of job satisfaction.

Is it fair for commercial gymnasiums to constantly change the commission structures of personal trainers? This ultimately results in lower degrees of job satisfaction leading to uncertainty in the profession. Finally, most personal trainers felt strongly that they should not be paid the same salary and that they should be graded according to their qualifications and years of service.

The following recommendations with respect to job satisfaction should be considered:

• Service providers should organise more continuing education workshops to enhance existing skills and keep personal trainers abreast of the latest trends in the fitness industry.

- A National Fitness Association should be established. This would afford an opportunity to personal trainers to protect their specialised skills, establish guidelines that would regulate the personal training industry and establish codes of ethical behaviour.

- There should be a clear attempt to strike a balance between qualifications and remuneration.

- Companies can improve working conditions by making personal trainers feel part of the staff contingent, including them in decision making processes, creating a safe and hazard free environment and supplying personal trainers with consulting rooms for consultations.

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In the fitness industry personal trainers are assets to the overall success of health clubs. It is highly recommended that employers of these trainers follow the recommendations proposed by this study to enhance job satisfaction in commercial gymnasium environments.

REFERENCES

CHELLADURAI, P. (1999). *Human resource management in sport and recreation.* Champaign, IL: Human Kinetics.

GEORGE, J.M. & JONES, R.J. (2000). *Essentials of managing organizational behaviour*. New York, NY: Prentice Hall.

GERBER, P.B.; NEL, P.S. & VAN DYK, P.S. (2002). *Human resource management.* Halfway House: Southern Publishers.

HERRERA, R. & LIM, J. (2003). Job satisfaction among athletic trainers in NCAA division one institutions. *The Sport Journal*, 27(2): 1-7.

HERZBERG, F.; MAUSNER, B. & SYNDERMAN, B.B. (1959). *The motivation to work.* New York, NY: John Wiley.

HOWELL, J.M. & HIGGINS, C.A. (2005). Job satisfaction and security of sport administrators employed in American and Canadian recreation programs. *The Sport Journal,* 29(1): 24-29.

KHAN, F. (2001). Lawsuit undertaken by personal trainers. *The Independent on Saturday*, 6 October: 21.

KOEHLER, L.S. (1998). Job satisfaction and corporate fitness managers. *Journal of Sport Management,* 22(1): 100-105.

LAWLER, E. (1973). The effects of performance on job satisfaction. *Industrial Relations*, 22(1): 20-28.

LOCKE, A. (1976). *The nature and causes of job satisfaction*. New York, NY: McGraw-Hill.

LUMPKIN, A. (2004). *Physical education and sport*. St Louis, MO: Mosby Publishing.

LUTHANS, F. (2002). *Organizational behaviour*. New York, NY: McGraw-Hill.

MASLOW, A.H. (1954). *Motivation and personality*. New York, NY: Harper.

MERRIMAN, J. (2004). Ethics law and sport. *Journal of Legal Aspects of Sport*, 20(2): 56-63.

PARKHOUSE, B.L. (2001). *The management of sport*. New York, NY: McGraw-Hill.

ROBBINS, S. (2003). *Organizational behaviour*. Philadelphia, NJ: Prentice Hall.

SALGADO, I. (2001). Female personal trainers take on Virgin Active. *The Natal Mercury*, 8 October: 1.

SMUCKER, M.K. (2003). An investigation of job satisfaction and female sports journalists. *The Sports Journal*, 27(2): 1-12.

SMUCKER, M.K. & KENT, A. (2004). The influence of referent selection on pay, promotion, supervision, work and co-worker satisfaction across three distinct sport industry segments. *International Sports Journal*, 30(2): 11-16.

SURUJLAL, J. (2004*). Human resources management of professional sport coaches in South Africa. Unpublished D. Litt et Phil dissertation. Johannesburg: Rand Afrikaans University.

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ROLE OF SELF-EFFICACY BELIEFS IN GOAL COMMITMENT: A CASE STUDY OF THE 20th NIGERIAN UNIVERSITY GAMES CHESS EVENT

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ABSTRACT

The study examined the role of self-efficacy beliefs in goal commitment among 118 Nigerian University students who represented universities that qualified from a preliminary zonal arrangement in the chess event of the 20th Nigerian University Games. Hierarchical regression analysis results revealed that, in the second step, self-efficacy beliefs account for a significant proportion of the variance (β=.82, P<.01) in goal commitment. The significant positive impact of self-efficacy beliefs on goal commitment implies that chess players who exhibit high levels of self-efficacy beliefs are more committed to reaching a goal than those who exhibit low levels of self-efficacy. When self-efficacy beliefs was entered in the second step, R^2 increased to .87 (p=.01) indicative of a significant change in R^2(ΔR^2=.42, P<.01). This finding underscores the need for further research to provide a holistic empirical framework on goal commitment and performance.

Key words: Self-efficacy; Goal Commitment; Nigerian Case Study; Chess.

INTRODUCTION

Individuals who compete in sporting events often aspire to achieve distinguished performance. The goal of chess players in important competitions is, almost always, to win medals in their individual and team events. They either set goals or goals are set for them. Goals are desired ends (Locke, 1996) that regulate behaviour (Bandura, 1988) and clarify the task at hand (Campbell *et al*., 1970). Goal setting theorists argue that there is a motivational response to goal setting (Schunk, 1982; Mento *et al*., 1987) that gingers self-determination (Sands & Doll, 2000) and makes it central to motivated behaviour (Austin & Vancouver, 1996; Klein *et al*., 2001). Studies have shown that goal setting is strongly related to performance (Locke & Latham, 1990; Theodorakis, 1996).

A critical factor that ensures the esteemed link between goal setting and performance is goal commitment (Klein *et al*., 2001). Defined as an individual's determination to reach a goal (Locke & Latham, 1990), goal commitment is a critical condition to the extent that goals have no motivational effect if commitment is lacking (Locke *et al*., 1988). It implies an unwillingness to abandon or lower a goal (Campion & Lord, 1982). Thus, when individuals are committed to a goal, they make persistent attempts to attain that goal (Hollenbeck & Klein, 1987). This explains the significant relationship between goal commitment and persistent behaviour (Allen & Nora, 1995) and achievement (Wofford *et al*., 1992). The reasoned importance of goal commitment in motivated behaviour requires that great empirical attention be paid to it (Klein *et al*., 1999).

An investigation of the relevance of goal commitment in organized sports is therefore warranted because of its role in distinguished performance. Indeed, any attempt to enhance the performance of Nigerian athletes, as a matter of necessity, will have to start from an empirical database. However, there appears to be little or no research on this key factor in understanding the motivational base for high performance in the African setting. Besides, empirical investigations of goal-related variables are hardly transferred to organized sports in the African setting. Since, proffering solutions based on inspired guesses may not yield desired results; there is a need for an empirically based assistance. This study, therefore, extends research on goal commitment in an African setting, especially in a game that is gradually gaining acceptance. There is a need for empirical assistance for coaches who groom players to challenge veterans in international competitions. By understanding the underlying factors in the goal commitment of chess players, stakeholders will be able to assist them in attaining their goals. Findings from this study will provide empirical assistance to coaches and athletes in the area of motivated goal-directed behaviour.

Social cognitive theory provides a guide to understanding the process of getting committed to a course of behaviour. It suggests that human beings are capable of reflecting on and regulating their behaviour. In doing these, they interpret the outcome of their earlier actions. This cognitive process determines what they choose to do. A core argument of the theory is that unless an individual believes a desired result can be attained, sufficient inspiration to act or persevere will be lacking (Bandura, 2001). Self-efficacy or belief in ones ability to attain a goal determines what individuals think and the actions they take (Bandura, 1997). Indeed, empirical information suggests that self-efficacy beliefs lay the foundation for human functioning (Multon *et al*., 1991; Stajkovic & Luthans, 1998) even in the face of difficulties. On the basis of self-efficacy beliefs, people choose how much effort to expend in goal-directed behaviour and how long they will be committed in the face of obstacles (Bandura, 2001). Self-efficacy, a belief of being able to control environmental demands (Schwarzer & Scholz, 2000), predicts exercise adherence (Malherbe *et al*., 2003) and keeps people committed to a course of action especially when it involves failures or obstacles (Bandura, 1986, 1988). A low perception of self-efficacy is equated with a low self-esteem and pessimism about accomplishment (Schwarzer & Scholz, 2000). Self-doubts about one's capacity to accomplish a task hinders the use of previously established skills (Salomon, 1984) while anxiety and self-preoccupation discourages the individual (Bandura & Cervone, 1983) and reduces persistent effort towards the task at hand. It makes them think of failure and obstacles as formidable (Sarason, 1975; Meichenbaum, 1977). Individuals with high self-efficacy perform more challenging tasks (Bandura, 1997) and are more likely to extend their effort towards goal attainment. They persist in the face of setbacks (Schwarzer & Scholz, 2000).

Self-efficacy belief is not necessarily hinged on the actual abilities which individuals possess but on what is believed. Beliefs about one's ability and reality hardly tally (Pajares, 2002). Thus, persons with actual capabilities could express a low self-efficacy belief which in turn determines what they do with their knowledge and skills. For example, a chess player may realize that tactical skills and ability to spot combinations are essential for winning a chess game, but a lack of confidence in these skills which he or she possess would reduce commitment to the task of winning the game. The belief in one's ability to execute successfully a certain course of behaviour (Bandura, 1986) therefore should result in a commitment to that goal since self-efficacy affects the amount of effort invested in an activity

and the length of duration of perseverance if a desired result is not attained (Bandura & Schunk, 1981; Brown *et al.*, 1989; Bouffard-Bouchard, 1990). Since self-efficacy beliefs serve as a motivational base for performance, it should affect goal commitment.

Indeed, research shows that when individuals believe that they have the capability to attain a goal; it results in high goal commitment (Locke & Latham, 1990; Locke, 1996; Wu, 2002), motivation and performance (Taylor *et al.*, 1984; Brown *et al.*, 1989; Bouffard-Bouchard, 1990; Robertson & Sari, 1993; Moritz *et al.*, 2000). This study, therefore, examines goal commitment, an important aspect of goal-setting behaviour. It is hypothesized in this study that self-efficacy beliefs would account for a significant variance of the goal commitment of chess players.

METHOD

Participants

Data for the study was collected in a survey of 118 Nigerian university chess players who represented universities that qualified from a preliminary zonal arrangement in the chess event of the 20th Nigerian University Games. Seventy-eight were males from 13 universities (six players per university) while 40 were females representing 10 universities (four players per university). Sex was coded as 1 for female and 2 for male in statistical analysis. The age of the total sample range from 19 to 31 (M=22.7 years, SD=2.7) while their average years of experience in competitive chess was 3.8 years, ranging from 1 to 8 years.

MEASURES

Demographic Data: The first section of the questionnaire contained screening questions that tapped demographic information such as age, sex and years of experience in competitive chess. Effects of these variables were controlled for in the regression analysis that examined the role of self-efficacy beliefs in goal commitment.

Self-efficacy Beliefs: This variable was measured by an English version of the perceived self-efficacy belief scale developed by Schwarzer & Jerusalem (2000). The 10-item scale measures the extent to which an individual believes he or she can perform difficult tasks, cope with adversities and come up with favourable results. Responses were made on a 4-point likert scale ranging from not at all true (1) to exactly true (4). A coefficient alpha of between .75 and .90 is typical of the scale in numerous studies (Schwarzer & Jerusalem, 2000). In the present study, items were slightly modified (e.g. (1) 'I can always manage to solve difficult problems in my games in this competition if I try hard enough', (2) 'I have the tactical and combinative

moves to subdue my opponents and get the results I want in my games') to make them relevant to the domain of psychological functioning being investigated. Respondents indicated the degree of agreement with scale items on a 4-point scale ranging from 'not at all' to 'exactly true'. In the present study, item-total correlation range from .65 to .80 with a coefficient alpha of .93. The average score of participants on the scale was 27.9 (SD=8.1).

Goal Commitment: This variable was measured by a 5-item uni-dimensional measure of goal commitment by Klein *et al.* (2001). The items measure an individual's determination to reach a goal and was rated on a 5-point likert scale ranging from strongly agree (5) to strongly

disagree (1). The scale is psychometrically sound, construct relevant and most appropriate measure of goal commitment (Klein *et al*., 2001). The authors reported an alpha coefficient of .74 for the scale. In the present study, an alpha coefficient of .88 and an item-total correlation ranging from .61 to .83 was obtained. The average score of participants on the scale was 17.7 (SD=4.8).

RESULTS

Result of preliminary statistical analysis presented in Table 1 showed that sex differences do not exist in the scores of male and female participants for self-efficacy beliefs and goal commitment. This provides justification for collapsing female and male scores into one group in analysis.

TABLE 1: **SUMMARY OF T-TEST ANALYSIS SHOWING DIFFERENCES BETWEEN MALES AND FEMALES ON SELF-EFFICACY AND GOAL COMMITMENT**

Variable	Sex	N	Mean	SD	DF	t	P
Self-efficacy	Female	40	27.2	7.9	116	0.731	>.05
	Male	78	28.3	8.2			
Goal commitment	Female	40	17.1	4.5	116	0.968	>.05
	Male	78	18.0	4.9			

An inter-correlation analysis examined relationships among all the variables used in the study. The result is presented in Table 2. The table indicated that self-efficacy was significantly and positively related to goal commitment (r=.92, p<.01).

TABLE 2: **MEANS, STANDARD DEVIATIONS AND INTER-CORRELATION OF ALL VARIABLES OF STUDY.**

	Variables	Mean	S.D.	Inter-correlation				
				1	2	3	4	5
1	Age	22.7	2.7	-	.21*	.15*	.16*	.14
2	Sex	-	-		-	.15*	.07	.09
3	Experience	3.8	1.6			-	.61**	.67**
4	Self-efficacy	27.9	8.1				-	.92**
5	Goal commitment	17.7	4.8					-

n=118. *P<.05.**P<.01.

This result provides preliminary support for the hypothesis that self-efficacy plays a

significant role in goal commitment. Results in Table 2 also showed that years of experience in competitive chess was significantly related to goal commitment (r=.67, p<.01) while years of experience in competitive chess (r=.61, p<.01) and age (r=.16, p<.05) were significantly related to self-efficacy. Further analysis to establish the unique contribution of self-efficacy beliefs to goal commitment was carried out using the hierarchical regression analysis. In this analysis, goal commitment served as dependent variable while self-efficacy beliefs and control variables such as age, sex and years of experience in competitive chess were independent variables. The results of the analysis are presented in Table 3.

TABLE 3: **SUMMARY OF HIERARCHICAL REGRESSION ANALYSIS PREDICTING GOAL COMMITMENT**

Predictor/step	β		ΔR^2	R^2
	At step	Final		
1. Age	.05	.02		
Sex	.02	.01		
Experience	.66**	.17*		.45**
2. Self-efficacy	.82**	.82**	.42**	.87**

*P<.05.   **P<.01.

The first step of hierarchical regression analysis examined the effects of demographic factors such as age, sex and years of experience in competitive chess on goal commitment with a view of controlling for them. Results in Table 3 showed that experience is the only control variable which significantly account for part of the variance in goal commitment (β=.66, p<.01). In the first step, control variables jointly account for a significant variance in goal commitment (R^2=.45, p<.01). When self-efficacy beliefs was entered in the second step, R^2 increased to .87 (p=.01) indicative of a significant change in R^2(ΔR^2=.42, P<.01). Thus, self-efficacy beliefs account for a significant proportion of variance (β=.82, p<.01) in goal commitment of chess players. The results showed that when self-efficacy was introduced in the second step, the amount of variance accounted for by experience decreased from .66 (p<.01) to .17 (p<.01).

DISCUSSION

The present study examined the role of self-efficacy beliefs in the goal commitment of chess players at the 20th Nigerian University Games. Results of the regression analysis supported the hypothesized relationship between self-efficacy beliefs and goal commitment. Results also showed that years of experience in competitive chess accounted for a significant variance in goal commitment when self-efficacy belief was excluded. The finding that self-efficacy belief is linked to goal commitment lends credence to previous empirical results (e.g. Locke & Latham, 1990; Locke, 1996; Wu, 2002). The significant positive impact of self-efficacy beliefs on goal commitment implies that chess players who exhibit high levels of self-efficacy beliefs are likely to be more determined to reach a goal than those who exhibit low levels of self-efficacy. A probable explanation for the link between these variables can be found in the argument that high self-efficacy persons are more resilient when they are faced with difficult and complex tasks (Ford *et al*., 1998).

The finding supports the need to examine self-efficacy as a factor for distinguished performance among chess players. The practical implication of the finding is that the self-

efficacy beliefs of chess players can predict their being committed to set goals in important competitions. In the same vein, an intervention can be floated to help players increase their commitment to set goals for distinguished performance. This principle should be effective because social cognitive theory argues that when individuals believe in their capabilities, they are committed to a course of action even in the face of obstacles. Similarly, goal-setting theory states that when individuals are committed to a goal, distinguished performance results. Indeed, the postulations of these theories have found robust empirical support (Taylor *et al.*, 1984; Brown *et al.*, 1989; Bouffard-Bouchard, 1990; Locke & Latham, 1990; Robertson &

Sari, 1993; Locke, 1996; Moritz *et al.*, 2000; Wu, 2002). Thus, in addition to other forms of high performance-training, intervention programmes should be designed to boost self-efficacy beliefs among chess players. An argument is being made for an intervention programme because, though training in tactics and practice could enhance the skills of chess players; such skills hardly match their perception of self-efficacy (Pajares, 2002). Training and practice alone may therefore not be enough. Specific self-efficacy enhancement and management events should be introduced by trainers and coaches for players to remain committed to set goals in competitive chess even in the face of real or imagined difficulties. Self-efficacy beliefs can be enhanced by improving the physical and emotional well-being of the players and by reducing their negative emotional states (Pajares, 2002).

Stakeholders would need to pay some attention to the finding that years of experience in competitive chess plays a significant role in goal commitment when the influence of self-efficacy belief is excluded. A probable explanation for this is that experience provides a reasonably proficient chess player skill to deal with particular situations and an idea about possible outcomes. This is particularly true of players who had successful experiences in previous competitions. Past experience prepares an individual for even more complex tasks in competitive chess. When faced with difficulties experienced in previous competitions, such individuals are likely to remain committed to set goals. Experience makes it possible for them to easily recognize what is to be done in a given situation within a game of chess. Since experience counts in goal commitment of chess players, it is recommended that chess players are made to go through practice trials and enough competitive chess before attending important games. However, this should not be a replacement of specific programmes to enhance self-efficacy. This is because the benefits of experience could become insignificant if not complimented by a high level of self-efficacy belief. For instance, when a successful experience is discounted or its re-enactment doubted, there will be a low self-efficacy belief and a subsequent decrease in goal commitment. Since chess players have different experiences and background, self-efficacy interventions should be tailored to meet their specific needs.

The present study is not without its limitations. The study examined the role of self-efficacy beliefs in the goal commitment of chess players at the 20th Nigerian University Games and controlled for age, sex and years of experience in competitive chess. It does not suggest that the variance in goal commitment has been exhaustively accounted for. Indeed, all the variables examined in the study accounted for .87 of the variance in goal commitment, indicating that .13 is yet to be ascertained. Besides, there might be interacting effects of variables examined on goal commitment. Further study which incorporates other relevant individual differences variables that could predict or interact to affect goal commitment is, therefore, recommended. Also the present study examined the impact of self-efficacy beliefs on goal commitment but did not relate these measures to the actual performance of participants at the games. Future studies should address this shortcoming. This will provide a holistic empirical framework on the goal setting process and its impact on goal commitment

and performance. The foregoing limitations, however, does not obliterate the empirical contributions and the practical relevance of the findings for goal commitment enhancement and subsequent distinguished performance by chess players in Nigeria.

REFERENCES

ALLEN, D. & NORA, A. (1995). An empirical examination of the construct validity of goal commitment in the persistence process. *Research in Higher Education*, 26: 509–533.

AUSTIN, J.T. & VANCOUVER, J.B. (1996). Goal constructs in psychology: process and content. *Psychological Bulletin*, 120: 338–375.

BANDURA, A. & SCHUNK, D.H. (1981). Cultivating competence, self-efficacy and intrinsic interest through self-motivation. *Journal of Personality and Social Psychology*, 41: 586-598.

BANDURA, A. & CERVONE, D. (1983). Self-evaluative and self-efficacy mechanisms governing the motivational effects of goal systems. *Journal of Personality and Social Psychology*, 45: 1017–1028.

BANDURA, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Englewood Cliffs, NJ: Prentice Hall.

BANDURA, A. (1988). Self-regulation of motivation and action through goal systems. In V. Hamilton; G. Bower & N. Frijda (Eds.), *Cognitive perspectives on emotion and motivation* (37–61). Dordrecht (Netherlands): Kluwer Academic.

BANDURA, A. (1997). *Self-efficacy: The exercise of control*. New York, NY: Freeman.

BANDURA, A. (2001). Social cognitive theory: An agentive perspective. *A Review of Psychology*, 52: 1-26.

BOUFFARD-BOUCHARD, T. (1990). Influence of self-efficacy on performance in a cognitive task. *Journal of Social Psychology*, 130: 353–363.

BROWN, S.D.; LENT, R.W. & LARKIN, K.C. (1989). Self-efficacy as a moderator of scholastic aptitude-academic performance relationships. *Journal of Vocational Behaviour*, 35: 64–75.

CAMPBELL, J.; DUNNETTE, M.; LAWLER, E. & WEICK, K. (1970). *Managerial behaviour, performance and effectiveness*. New York, NY: McGraw-Hill.

CAMPION, M. & LORD, R. (1982). A control systems conceptualization of the goal-setting and change process. *Organizational Behaviour and Human Performance*, 30: 265–287.

FORD, J.K.; SMITH, E.M.; WEISSBEIN, D.A. & GULLY, S.M. (1998). Relationships of goal orientation, metacognitive activity, and practice strategies with learning outcomes and transfer. *Journal of Applied Psychology*, 83 (2): 218–233.

HOLLENBECK, J.R. & KLEIN, H.J. (1987). Goal commitment and the goal setting process: problems, prospects and proposals for future research. *Journal of Applied Psychology*, 72: 212–220.

KLEIN, H.J.; WESSON, M.J.; HOLLENBECK, J.R. & ALGE, B.J. (1999). Goal commitment and the goal setting process: conceptual clarification and empirical synthesis. *Journal of Applied Psychology*, 84: 885–896.

KLEIN, H.J.; WESSON, M.J.; HOLLENBECK, J.R.; WRIGHT, P.M. & DESHON, R.P. (2001). The assessment of goal commitment: A measurement model meta-analysis. *Organisational Behaviour and Human Decision Processes*, 85(1): 32-55.

LOCKE, E.; LATHAM, G.P. & EREZ, M. (1988). The determinants of goal commitment. *Academy of Management Review*, 13: 23–39.

LOCKE, E. & LATHAM, G.P. (1990). *A theory of goal setting and task performance*. Englewood Cliffs, NJ: Prentice Hall.

LOCKE, E. (1996). Motivation through conscious goal setting. *Applied Preventive Psychology*, 5: 117–124.

MALHERBE, D.G.; STEEL, H.R. & THERON, W.H. (2003). The contribution of self-eficacy and outcome expectations in the prediction of exercise adherence. *South African Journal for Research*

in Sport, Physical Education and Recreation Social Sciences, 25(1): 71–82.

MEICHENBAUM, D. (1977). *Cognitive-behaviour modification: an integrative approach*. New York, NY: Plenum.

MENTO, A.J.; STEEL, R.P. & KARREN, R.J. (1987). A meta-analytic study of the effects of goal setting on task performance: 1966–1984. *Organizational Behaviour and Human Decision Process*, 39: 52–83.

MORITZ, S.E.; FELTZ, D.I.; FAHRBACH, K.R. & MACK, D.E. (2000). The relation of self-efficacy measures to sport performance: A meta-analytic review. *Review Quarterly for Exercise and Sport*, 71: 280–294.

MULTON, K.D.; BROWN, S.D.; LENT, R.W. (1991). Relation of self-efficacy beliefs to academic outcomes: A meta-analytic investigation. *Journal of Counselling Psychology*, 38: 30–38.

PAJARES, F. (2002). "Overview of social cognitive theory and of self-efficacy." [http://www.emory.edu.EDUCATION/mfp/eff.html]. Retrieved 26 December 2004.

ROBERTSON, I.T. & SADRI, G. (1993). Managerial self-efficacy and managerial performance. *British Journal of Management*, 4: 37–45.

SALOMON, G. (1984). Television is easy and print is tough: the differential investment of mental effort in learning as a function of perceptions and attributions. *Journal of Educational Psychology*, 76: 647-658.

SANDS, D. & DOLL, B. (2000). Teaching goal-setting and educational decision-making in children and youth with developmental disabilities. *Innovations: Research for practice series*. Washington, DC: American Association for Mental Retardation.

SARASON, I.G. (1975). Anxiety and self-preoccupation. In I.G. Sarason & D.C. Spielberger (Eds.), *Stress and anxiety* (vol. 5, 27–44). Washington, DC: Hemisphere.

SCHUNK, D.H. (1982). Effects of effort attributional feedback on children's perceived self-efficacy and achievement. *Journal of Educational Psychology*, 74: 548–556.

SCHWARZER, R. & JERUSALEM, M. (2000). General perceived self-efficacy. [http://www.fu-berlin.de/gesund/skalen/langu.../hauptteil_general_perceived_self-efficac.ht]. Retrieved 16 March 2005.

SCHWARZER, R. & SCHOLZ, U. (2000). Cross-Cultural assessment of coping resources: The general perceived self-efficacy scale. *Paper presented at the First Asian Congress of Health Psychology: Health Psychology and Culture, August 28–29, Tokyo, Japan.* In A.D. Stajkovic & F. Luthans (1998). Self-efficacy and work-related performances: A meta-analysis. *Psychological Bulletin*, 124: 240-261.

TAYLOR, M.S.; LOCKE, E.A.; LEE, C. & GIST, M.E. (1984). Type A behaviour and faculty research productivity: What are the mechanisms? *Organisational Behaviour and Human Decision Processes*, 34: 402–418.

THEODORAKIS, Y. (1996). The influence of goals, commitment, self-efficacy and self-satisfaction on motor performance. *Journal of Applied Sport Psychology*, 8: 171–182.

WU, W. (2002). An empirical study of past performance, goal commitment, computer self-efficacy, computer performance of computer skill learner-an integration of social cognitive theory and goal-setting theory. [http://www.ntnu.edu.tw/acad/epub/j47/se471-3.htm]. Retrieved 16 February 2005.

WOFFORD, J.; GOODWIN, V. & PREMACK, S. (1992). Meta-analysis of the antecedents of personal goal level and of the antecedents and consequences of goal commitment. *Journal of Management*, 18: 595–615.

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ATHLETE SATISFACTION AT UNIVERSITIES IN GAUTENG

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ABSTRACT

One of the most frequently studied sectors of sport management is university sport which, in the South African context, includes the overall experiences of student-athletes of higher education institutions in relation to the sport department/ bureau, their personnel, activity programmes and offerings. In countries outside South Africa the issue of athlete satisfaction has been studied from several research perspectives such as coach behaviour, athletic trainer and medical cover, leadership behaviour, role ambiguity, holistic university experience and stakeholder satisfaction with selected goals and processes. One of the conclusions reached was that critical to athlete satisfaction was the sport department's emphasis on student development over the performance of the sport department. The purpose of this study was to determine what contributed to the satisfaction of athletes at universities in South Africa. The participants in this study consisted of 400 student-athletes at universities in the Gauteng province of South Africa. The instrument that was used in the study was a validated athlete satisfaction questionnaire (ASQ) developed by Riemer and Chelladurai (1998). The present study has identified support, individual performance, personal treatment by the coach, team task contribution and strategy as important indicators of athlete satisfaction. The findings of the study have important implications for universities as a whole as it can influence the reputation and image of the institution, the financial and other resources being made available for the institution, the number of quality athletes that can be attracted to the institution and the culture of the institution.

Key words: Athlete; Satisfaction; Universities; Coach.

INTRODUCTION

One of the most frequently studied sectors of sport management is university or collegiate sport (Chelladurai & Riemer, 1997). University sport in the South African context includes the overall experiences of student-athletes - the heart and soul of every participating organization (Bebetsos & Theodorakis, 2003) - of Higher Education Institutions in relation to the sport department/bureau, their personnel, activity programmes and offerings, as well as the sport related support services provided by their institutions.

Traditionally, numerous researchers have expounded on the personal and cultural benefits accruing to students from participation in university sport, particularly personal fitness, character building, sportsmanship and fair play, improved academic achievement, and

entertainment (Beyer & Hannah, 2000). More recently, however, researchers have also

proposed arguments regarding university-wide benefits of student participation in sport. These range from providing a positive influence on the general welfare of a university, institutional loyalty and unity, increasing revenues, increasing prestige to the institution's reputation, and in turn, to enhanced student applications, enrolment, fundraising and sponsorship (Beyer & Hannah, 2000; Smart & Wolfe, 2000).

Higher education institutions in South Africa have undergone major changes in terms of their structure and functioning as they have been subjected to the demands and competition of the market in which they function. There has been a steady increase in the level of competitiveness of the higher education sector because of factors such as increased globalization, internationalization, technological innovation and integration, and commercialization. Quality service and customer care have assumed heightened importance not only in commercial organizations, but also in the higher education sector. In order to retain and expand their market share, a high quality service must be offered by all organizations (Liebenberg, 2005). Liebenberg observed a relationship between corporate culture of a university and learner satisfaction. From this observation he deduced that a positive corporate culture could contribute to learner satisfaction (Liebenberg, 2005). This view supports the work of Smart & Wolfe (2000), who conducted an exploratory case study of the Pennsylvania State University (PSU) Football programme to examine the sources of their inter-university sport programme successes and to determine what gave them a sustainable competitive advantage. They reviewed the Resource-Based View (RBV), a recent development in strategic management literature and addressed appropriate success criteria for inter-university sport programmes. The resources they identified responsible for success included the university's history, relationships, trust, and organisational culture developed within their coaching staff. They added that an organisation with such resources may sustain competitive advantage by exploiting its human and physical resources more completely than other institutions. They concluded that PSU's competitive advantage was tied to the organisational resources of its coaching staff.

The issue of athlete satisfaction has been studied from several research perspectives, predominantly in the US, and to a lesser extent in Canada and Europe. Some of these studies focussed on athlete satisfaction with regard to: coach behaviour (Amorose & Horn, 2000; Baker *et al.*, 2003); athletic trainer and medical cover (Unruh, 1998); leadership behaviour (Riemer & Toon, 2001; Bebetsos & Theodorakis, 2003); role ambiguity (Eys *et al.*, 2003); holistic university experience (Berty *et al.*, 2002); and stakeholder satisfaction with selected goals and processes (Trail & Chelladurai, 2000). Trail & Chelladurai (2000) concluded that critical to athlete satisfaction was the sport department's emphasis on student development over the performance of the sport department.

PROBLEM STATEMENT

It is thus clear that for institutions to offer quality services in the modern higher education environment, it is essential for them to ascertain the level of satisfaction of their primary clients, namely the students. In the context of university sport, these primary clients would be the student-athletes. There has been a vacuum in the South African sport management literature regarding student-athlete satisfaction with services offered to them. In the past there has been a reliance on theoretical extrapolation from the more general literature on job

satisfaction, rather than research related to athlete satisfaction in particular. It was against this

background that the present study was undertaken to ascertain the satisfaction levels of student-athletes with their overall experience of university sport. The findings may prove beneficial not only to the sport departments/bureaus at universities, but also to student-affairs departments, marketing and recruitment departments, as well as academic departments of sport.

METHODOLOGY

Participants

The participants in this study comprised a convenient sample of 400 student-athletes from four Universities in the Gauteng province of South Africa. For purposes of this study the athlete is regarded as the individual who is a skilled performer who participates competitively in sport. These athletes were eligible to participate in inter-university sports under the auspices of the South African Student Sport Union. The response rate for the questionnaires was 69% (n=276). Forty seven percent (47%) of the respondents were male and 48% were female. Five percent of the respondents did not indicate their gender.

The Instrument and Procedures

Relevant literature on Athlete Satisfaction was reviewed. In addition, an empirical investigation involving the administration of 400 athlete satisfaction questionnaires (ASQ) developed by Riemer and Chelladurai (1998) was undertaken. Participants were requested to indicate the extent of their satisfaction on each item on a 7-point Likert type scale ranging from 1 (not satisfied at all) to 7 (extremely satisfied). In addition athletes were also requested to indicate their gender. The returned questionnaires were subjected to editing and coding for input into the statistical programme for the social sciences (SPSS – version 12).

RESULTS AND DISCUSSION

Exploratory factor analysis was conducted on the items. The responses from the ASQ were subjected to principle axis factor analysis. Using a minimum eigenvalue of 1.0 and a varimax rotation, a total of five first order factors were identified. The Cronbach alpha reliability coefficients for the factors are illustrated in Table 1.

TABLE 1. **CRONBACH ALPHA RELIABILITIES OF THE FIRST ORDER FACTORS PER NUMBER OF ITEMS**

Factor	Cronbach Alpha	Number of items
Support	0.929	13
Individual performance	0.924	14
Personal treatment by coach	0.924	14
Team task contribution	0.899	8
Strategy	0.874	5

The Cronbach alpha values ranged from 0.874 to 0.929 which were much higher than the value of 0.7 suggested by Nunally (1978). Thus the extracted factors are deemed reliable.

Athlete satisfaction factors

In the tables that follow, the scales from 1–7 reflect the extent of satisfaction experienced by athletes and range from very dissatisfied to very satisfied.

TABLE 2. **ITEMS, MEANS AND FREQUENCIES (PERCENTAGES) WITH REGARD TO SUPPORT**

Item description	mean	1	2	3	4	5	6	7
The medical personnel's interest in the athletes	3.64	23.5	11.6	10.4	17.5	14.9	11.2	10.8
The fairness with which the medical personnel treats all players	3.82	21.4	10.3	8.9	18.1	16.6	16.2	8.5
The promptness of medical attention	3.23	28.1	9.3	20.7	15.2	13.0	8.1	5.6
The personnel of the academic support services	3.77	20.0	11.9	12.2	17.8	13.3	14.8	10.0
The amount of money spent on my team	3.48	20.6	16.5	12.5	14.7	18.0	10.7	7.0
The local community's support	3.18	23.2	16.2	20.6	15.4	11.8	9.9	2.9
The media's support of our program	3.18	22.4	19.9	18.4	15.4	11.8	7.7	4.4
The supportiveness of the fans	3.67	17.6	13.2	14.3	19.9	15.4	11.4	8.1
The fairness of the team's budget	3.52	17.5	17.9	13.8	17.5	15.7	10.4	7.1
The funding provided to my team	3.36	19.8	21.2	15.0	10.3	17.6	8.4	7.7
The competence of the medical personnel	3.51	18.9	17.4	13.7	17.4	15.9	10.7	5.9
The academic support services provided	4.15	11.0	7.3	13.9	21.2	19.8	16.1	10.6
The support from the university community	3.76	15.4	14.0	17.3	16.2	17.3	12.5	7.4

Table 2 illustrates the extent of satisfaction experienced by athletes with regard to support. This factor is concerned with satisfaction with medical support, financial support, community support, media support and academic support. Athlete satisfaction can originate from the support structures that the organization provides. According to Table 2, athletes experienced moderate satisfaction with medical support, academic personnel support, financial support, community support, media support and fan support (the means of all the items with the exception of "the academic support services provided" being below 4). They experienced least satisfaction with the support of the local community and media. The community,

inclusive of students, staff and fans, are not directly involved in the affairs of the team (Chelladurai & Riemer, 1997) yet they play a significant role on how well the team or athlete performs through their implicit and explicit support for the team. This support, in turn, affects the level of satisfaction experienced by the team or athlete. The vital role that fans play in the performance of a team has been demonstrated in the findings of extensive research by Courneya and Carron (1992). If the performance of the team is good, the team is buoyed by the fans to perform better. This ultimately increases the satisfaction experienced by the athletes both with their own performance as well as with the fans. The media brings the athletes under public scrutiny, thus exerting pressure on them to succeed. This has an influence on the levels of stress and anxiety experienced by the athletes. Consequently this affects their performance which determines the level of satisfaction experienced by the athlete.

The medical support in terms of injury prevention, injury rehabilitation and illness prevention provided by the organization influences the level of satisfaction experienced by athletes. Traditionally, the prevention of injuries and illness had been the responsibility of the athletic coach (Unruh, 1998). Today that responsibility lies with trained medical personnel which is either provided by the organization or contracted by the organization. How competent and professional the medical staff is perceived to be by the athlete influences their level of satisfaction.

The support that the organization provides in terms of monetary resources to the athletes is a source of the athlete's satisfaction (Riemer & Chelladurai, 1998). The satisfaction that athletes experience with the financial support that they receive is analogous with the satisfaction that employees experience with their pay. If the pay is in accordance to the output and performance of the employees, it is highly likely that the employee will be satisfied. Similarly, athletes are likely to be satisfied with monetary rewards that reflect their outputs or performance. Most universities provide scholarships or bursaries, particularly for members of the less-privileged social classes, that make attending a university possible (Beyer & Hannah, 2000). This helps provide a desirable social status and identity to assume when they are faced with unfamiliar settings of a university where athletes have an accepted and a relatively high status in the student body. This source of identity influences their level of satisfaction. This supports the finding of Riemer and Chelladurai (1998) that the support that the organization provides in terms of monetary resources to the athlete is the source of the athlete's satisfaction. Research conducted by Ryan (cited in Amorose & Horn, 2000) indicated that scholarships, in some instances, resulted in increased motivation. It can be concluded that increased motivation leads to better performance resulting in greater satisfaction. On the other hand, scholarships can be perceived as a controlling factor which binds athletes to the organization (Amorose & Horn, 2000). This may result in dissatisfaction experienced by athletes.

The highest level of satisfaction was experienced with regard to academic support services. Beyer and Hannah (2000) comment that athletes may be among the most powerless students on the campus, having a strict regimen that dictates almost every activity of their day. In the eyes of non-athlete students, athletes may appear as pampered with special privileges such as better accommodation, meals and tuition. This is not necessarily true since athletes are "answerable" to their bursars, coaches, the media and their families. According to Leland (cited in Trail & Chelladurai, 2000), the goal of the coach, which is results-driven and the goal of the university, which is revenue-driven are over-emphasized and impact on the academic

and social development of the student-athlete. Student-athletes, who have problems that stem from heavy demands of their athletic role, are forced to sacrifice attention to academic, social and leisure needs to participate. Astin (as cited in Berty *et al.*, 2002) found that measures contributing to the student-athlete's level of satisfaction with academic experience to be the quality of the academic institution, degree of faculty interest in students, relationship with the college administration, curriculum and contacts with faculty and fellow students. Previous research by Trail and Chelladurai (2000) found that student athletes rated academic achievement as the most important goal. Therefore, there was a need for academic goals to be the focus of the athletic department. The findings of the current study are contrary to the findings of previous studies by Coakley (1994) and Sage (cited in Chelladurai & Riemer, 1997) which found that the athletics programme violated the cardinal principle of Higher Education in that the educational interests of the athletes are overlooked. In this study, the high level of satisfaction experienced by the athletes leads to the conclusion that the academic interests of the athletes are catered for in the South African context.

TABLE 3. **ITEMS, MEANS AND FREQUENCIES (PERCENTAGES) WITH REGARD TO INDIVIDUAL PERFORMANCE AND RECOGNITION**

Item description	mean	1	2	3	4	5	6	7
The degree to which I have reached (reached) my performance goals during the season	4.57	4.0	4.4	15.7	22.3	24.5	18.6	10.2
The coach's choice of plays during competitions	4.43	6.2	5.5	14.7	24.2	21.2	16.5	11.7
The degree to which my abilities are (were) used	4.58	3.6	5.1	15.7	22.3	24.5	18.6	10.2
The training I receive (received) from the coach during the season	4.73	7.7	5.8	10.9	15.7	20.1	21.2	18.6
The recognition I receive (received) from my coach	4.55	5.9	7.3	13.9	17.6	24.2	16.8	14.3
My social status on the team	4.68	2.2	6.2	14.6	17.9	28.1	20.4	10.6
The team's win/loss record this season	4.58	7.7	4.4	12.8	24.5	15.8	16.5	18.3
The tutoring I receive (received)	4.44	9.2	5.5	12.1	20.1	22.3	18.3	12.5
How the team works (worked) to be the best	4.48	2.9	10.6	13.9	20.1	26.4	13.2	12.8
The extent to which teammates provide (provided) me with instruction	4.54	4.1	4.5	15.6	23.0	23.8	17.8	11.2
The extent to which all team members are (were) ethical	4.24	4.8	8.1	15.4	27.9	25.0	12.1	6.6
The degree to which I do (did) my best for the team	4.98	1.5	3.6	10.2	19.7	27.4	19.0	18.6
My teammates' sense of fair play	4.94	1.8	2.2	10.6	19.3	28.8	25.2	12.0
My dedication during practices	5.43	0.4	1.8	6.2	15.3	23.4	27.4	25.5

The athlete's level of satisfaction with regard to individual performance and recognition is illustrated in Table 3. With regard to this factor, it is evident from Table 3 that athletes were satisfied with their individual performance and the recognition that they received. Bebetsos and Theodorakis (2003) found that the more practices per week in which the athletes engaged, the more satisfied they were with their personal performance. Performance is a major outcome in athletics (Chelladurai & Riemer, 1997). Athletes may set themselves individual performance goals. The extent to which these goals are attained will determine the extent to which athletes experience satisfaction. In setting goals for themselves athletes may pursue excellence and the closer to excellence that they get, the more positive feelings they have about themselves. In addition, athletes are interested in the contribution that they make to a team. Any positive contribution would result in raised feelings of satisfaction in the athlete. With regard to recognition, there are various ways in which athletes receive recognition. For example, they may receive recognition from the coach, team mates, fans, community and media. The recognition may be for successful performance or contribution to the team and can motivate the athlete, leading to increased satisfaction.

TABLE 4. **ITEMS, MEANS AND FREQUENCIES (PERCENTAGES) WITH REGARD TO PERSONAL TREATMENT BY COACH**

Item description	mean	1	2	3	4	5	6	7
The extent to which the coach is (was) behind me	4.58	4.7	8.0	15.7	18.2	18.2	20.4	14.6
The manner in which coach combines (combined) the availible talent	4.69	5.1	8.8	12.8	17.5	16.1	20.4	19.3
My coach's loyalty towards me	4.97	1.8	5.8	8.4	17.9	26.3	23.7	16.1
Coach's game plans	4.56	4.8	5.9	12.5	23.1	25.3	19.0	9.5
How the coach makes (made) adjustments during competitions	4.73	4.8	5.5	8.8	22.4	23.5	22.4	12.5
The degree to which my role on the team	4.60	2.6	5.2	13.3	27.7	18.5	25.1	7.7
The level of appreciation my coach shows (showed) when I do (did) well	5.01	5.5	5.9	7.7	14.3	20.6	22.4	23.5
The coach's teaching of the tactics and techniques of my position	4.93	4.4	4.8	10.3	16.5	23.8	20.1	20.1
The amount of time I play (played) during competitions	4.93	3.6	4.4	9.9	18.6	21.5	23.0	19.0
The extent to which teammates play (played) as a team	4.94	3.3	1.8	11.3	19.0	25.9	23.7	15.0
Coach's choice of strategies during games	4.75	3.3	4.4	11.4	24.5	23.8	17.9	14.7
The friendliness of the coach towards me	5.11	2.6	2.9	10.3	18.8	19.9	22.4	23.2

Table 4 illustrates the level of satisfaction experienced by the athletes with regard to personal treatment by the coach. This factor is concerned with those coaching behaviours that directly affect the individual, yet indirectly affect team development. Athletes were overall satisfied with regard to the personal treatment that they received by the coach (the means of all items in the scale were greater than 4). In South Africa, relatively little research has been conducted in the sport setting to investigate coaching behaviour as a factor affecting collegiate athletes' motivation. However, there is evidence from other fields that coaching behaviour may, in fact, influence athlete satisfaction. For example, research in the academic sector (Amorose & Horn, 2000) indicates that the behaviour of the teacher influences the behaviour and performance of students. The coach, whose functions are multi-faceted (Surujlal, 2004) can be, among others, viewed as a teacher. Athletes interact constantly with the coaches and these interactions are likely to result in numerous outcomes (like winning/losing, improved/diminished performance) which can influence the level of satisfaction experienced by the athlete. The relationship between the athletic coach and the student-athlete has been identified as being of fundamental importance (Unruh, 1998), and most coaches are in agreement that it is important to develop a strong rapport with their athletes. Coaches can have a profound impact on the life of the student-athlete, regardless of the levels of sport involvement (Baker *et al.*, 2003). Previous research by Terry (as cited in Baker *et al.*, 2003) on elite athletes and Riemer and Toon (2001) have effectively indicated that coach behaviour is an important determinant of athlete satisfaction. Athletes hold the coach accountable for clarifying their role responsibilities (Eys *et al.*, 2003). Therefore it can be concluded that the personal treatment that the athletes get from the coach may influence their level of satisfaction.

TABLE 5. **ITEMS, MEANS AND FREQUENCIES (PERCENTAGES) WITH REGARD TO TEAM TASK CONTRIBUTION**

Item description	mean	1	2	3	4	5	6	7
Team member's dedication to work together toward team goals	4.84	3.7	1.8	11.4	20.2	28.7	20.2	14.0
The constructive feedback I receive (received) from my teammates	4.78	4.0	4.0	7.7	22.8	28.7	20.2	12.5
My teammates' sportmanlike behaviour	5.00	3.0	1.8	7.7	21.4	26.2	25.8	14.0
The degree to which my teammates accept (accepted) me on a social level	4.97	2.6	2.2	11.1	17.7	28.8	21.0	16.6
The extent to which the team is meeting (has met) its goals for the session	4.64	5.6	4.1	13.3	20.0	22.6	22.6	11.9
My enthusiasm during competitions	5.11	0.7	2.2	7.7	18.7	30.0	26.7	13.9
The team's overall performance this season	4.87	2.9	3.3	15.8	16.8	24.2	17.6	19.4
The degree to which teammates share (shared) the same goal	4.67	3.3	4.0	12.1	24.5	25.6	17.2	13.2

Table 5 illustrates the level of satisfaction with team task contribution. This factor is concerned with those actions by which the team and coach serves as a substitute for leadership for the athlete. The coach, together with the team, sets up goals to be achieved over a season or tournament. These may include scoring targets and number of games won. The attainment of these goals may be a legitimate performance indicator (Chelladurai & Riemer, 1997), therefore it constitutes a facet of athlete satisfaction. Sometimes the goals may not be achieved, but there are improvements in the performance of the team over a season and this may be the source of athlete satisfaction. There may be an overall growth and development of team members in terms of mastery of skills, tactics and strategies in sport. These contribute to the overall satisfaction of athletes. Understanding and acceptance of strategies and tactics, recognition and respect for each other's strengths and contributions toward the team's goals as well as a collective determination to perform to the best of their ability helps develop solidarity within a team (Chelladurai & Riemer, 1997). These may influence the satisfaction of athletes. Furthermore, the degree to which team members get along well as a group and support each other may also influence their level of satisfaction.

TABLE 6. **ITEMS, MEANS AND FREQUENCIES (PERCENTAGES) WITH REGARD TO STRATEGY**

Item description	mean	1	2	3	4	5	6	7
The level to which my talents are (were) employed	4.66	3.7	6.6	12.8	18.3	24.9	23.1	10.6
The improvement in my performance over the previous season	4.95	3.3	3.3	10.6	17.2	25.3	23.1	17.2
The instruction I have received from the coach this season	4.84	5.9	5.5	7.0	18.4	24.3	21.0	18.0
The role I play (played) in the social life of the team	4.78	2.9	4.4	11.4	23.8	21.2	22.0	14.3
The tactics used during games	4.74	4.4	5.1	10.2	21.5	23.4	23.4	12.4

The athletes' level of satisfaction with strategy is illustrated in Table 6. This factor is concerned with strategic and tactical decisions. Athletes were also overall satisfied with regard to the personal treatment that they received by the coach (the means of all items in the scale were greater than 4). The success that a team achieves is largely a result of strategic choices made by the coach (Chelladurai & Riemer, 1997). Within the constraints of the rules of the game, a coach has the power to alter the structure and processes within the team. These may include a game plan which will influence the selection of players. The coach's understanding of the sport and tactics associated with it therefore influences the satisfaction of the athletes.

CONCLUSION

The present study has identified support, individual performance, personal treatment by the coach, team task contribution and strategy as important indicators of athlete satisfaction. The findings of the study have important implications for the university as a whole as it can influence the reputation and image of the institution, the financial and other resources being

made available for the institution, the number of quality athletes that can be attracted to the institution and the culture of the institution. Institutions can use inter university sport to gain a competitive advantage. There are also implications for further research. For example, the relationship between sport type and athlete satisfaction, the coach and athlete satisfaction and the sports bureau/department and athlete satisfaction could be investigated.

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REFERENCES

AMOROSE, A.J. & HORN, T.S. (2000). Intrinsic motivation: relationships with collegiate athlete's gender, scholarship status, and perceptions of their coaches' behaviour. *Journal of Sport & Exercise Psychology,* 22: 63-84.

BAKER, J.; YARDLEY, J. & CÔTE, J. (2003). Coach behaviors and athlete satisfaction in team and individual sports. *International Journal of Sport Psychology,* 34: 226-239.

BEBETSOS, E. & THEODORAKIS, N. (2003). Athletes' satisfaction among team handball players in Greece. *Perceptual and Motor Skills,* 97: 1203-1208.

BERTY, D.; GRIFFY, L.; LUCKEY, J. & WIEMERS, R. (2002). A comparison of the satisfaction levels of collegiate student-athletes and their non-athlete peers with their collegiate experience. *The Academic Athletic Journal,* 16(1): 11-21.

BEYER, J.M. & HANNAH, D.R. (2000). The cultural significance of athletics in U.S. Higher Education. *Journal of Sport Management,* 14: 105-132.

CHELLADURAI, P. & RIEMER, H.A. (1997). A classification of facets of athlete satisfaction. *Journal of Sport Management,* 11: 133-159.

COAKLEY, J.J. (1994). *Sport in society: issues and controversies* (5th ed.). St. Louis, MO: Mosby.

COURNEYA, K.S. & CARRON, A.V. (1992). The home ground advantage in sport competitions. *Journal of Sport and Exercise Psychology,* 14: 13-27.

EYS, M.A.; CARRON, A.V.; BRAY, S.R. & BEAUCHAMP, M.R. (2003). Role ambiguity and athlete satisfaction. *Journal of Sports Sciences,* 21: 391-401.

LIEBENBERG, J.S. (2005). Factors influencing a customer service culture in a higher education environment. Unpublished doctoral dissertation. Johannesburg: Rand Afrikaans University.

NUNALLY, J.C. (1978). *Psychometric theory.* New York, NY: McGraw-Hill.

RIEMER, H.A. & CHELLADURAI, P. (2002). Manual for the Athlete Satisfaction Questionnaire (ASQ). Regina, Saskatchewan: University of Regina.

RIEMER, H.A. & CHELLADURAI, P. (1998). Development of the athlete satisfaction questionnaire. *Journal of Sport and Exercise Psychology,* 20(2): 127-156.

RIEMER, H.A. & TOON, K. (2001). Leadership and satisfaction in tennis: examination of congruence, gender, and ability. *Research Quarterly for Exercise and Sport,* 72(3): 243-256.

SMART, D.L. & WOLFE, R.A. (2000). Examining sustainable competitive advantage in intercollegiate athletics: a resource-based view. *Journal of Sport Management,* 14: 133-153.

SURUJLAL, J. (2004). Human resources management of professional sport coaches in South Africa. Unpublished doctoral dissertation. Johannesburg: Rand Afrikaans University.

TRAIL, G. & CHELLADURAI, P. (2000). Perceptions of goals and processes of intercollegiate athletics: A case study. *Journal of Sport Management,* 14: 154-178.

UNRUH, S. (1998). Perceptions of athletic training services by collegiate student-athletes: A measurement of athlete satisfaction. *Journal of Athletic Training,* 33(4): 347-350 Oct.-Dec.

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(Subject editor: Prof. M. Saayman)

RUDOLPH LEWIS EN SUID-AFRIKA SE GROOTSTE OLIMPIESE OORWINNING: NUWE FEITE

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ABSTRACT

South Africa's biggest achievement at the Olympic Games was in 1912 when Rudolph Lewis won the 320 km cycle road race in Stockholm. This was the only cycle event at these Games and he was the only South African among the 123 riders from 16 countries. His winning time of 10:42:39.0 under shocking conditions bettered the Swedish record by 39:48:00. This article uncovers new information regarding his private life that has been unknown for 93 years. He had beaten the top South African rider of his day, W.R. Smith, in the Olympic trials by being the only rider from a field of 53 to finish a gruelling race over 150 miles in wet conditions. He was born on a farm in the Waterberg district (near Pretoria) but grew up in Germiston. In his youth he was also a good boxer and skater. He worked underground in a gold mine for the nine years preceding the 1912 Olympic Games. In 1913 he joined the professional road racing circuit in Germany, albeit with mixed success. He returned there for the 1914 season and was caught up in the First World War. He apparently served in the German army and was awarded the Iron Cross. The war and life of a prisoner of war left him in a weakened state. He died in 1933 at the relatively young age of 46.

Key words: Rudolph Lewis; 1912 Olympic Games; Stockholm; Cycling; South Africa.

INLEIDING

In die groter prentjie was die Olimpiese Spele van Stockholm in 1912 van belang omdat die sukses daarvan die moderne Olimpiese Spele-beweging gered het. Vir Suid-Afrika was dit van belang vanweë ons oes van ses medaljes; goud én silwer in die marathon, goud én silwer in die mansenkelspeltennis, goud in die mansdubbelspel en die grootste prestasie van almal, die goue medalje in die padwedren vir fietsryers. Laasgenoemde word nie net as ons grootste prestasie in die Spele-geskiedenis beskou nie, maar ook as een van die grootstes in Suid-Afrika se ganse sportgeskiedenis. Die bekende joernalis, Herbert B. Keartland, het laat in sy lewe gesê: "As one that has watched South African sport for nearly 70 years and been close to many champions, I rate the best of all of them this man [Lewis] who rode alone" (Keartland, 1978).

Die volgende feite is reeds bekend, maar word ter wille van die agtergrond herhaal.

Die enigste fietsrybaan in Swede is met die oprigting van die Olimpiese stadion in Stockholm vernietig. Dit het die organiseerders genoop om slegs 'n padwedren op die Olimpiese program aan te bied. Sedert 1901 is die jaarlikse Sweedse langafstandkampioenskap vir fietsry rondom die Mälar-meer beslis, alhoewel daar al in 1892 en 1893 ook by geleentheid hierlangs gejaag is. Hierdie gewilde roete sou dus as die enigste fietswedren by die Spele dien. In uiters warm

toestande het 'n rekordtal van 123 jaers uit 16 lande die stowwerige grondpadroete van 320 kilometer aangedurf. Die volgorde van wegspring is deur loting bepaal en die individuele jaers sou met tussenpose van twee minute wegspring (pasaangee is verbied). By die 11 kontrolepunte kon die jaers verversings, tegniese hulp en inligting ontvang.

Suid-Afrika se enigste inskrywing, Rudolph Lewis, is tweede geloot en het twee minute ná die eerste jaer weggespring. H.B. Keartland, wat die Spele as joernalis bygewoon het, het ook as die span se atletiekafrigter opgetree. Sy raad aan Lewis was om van elke kontrolepunt 'n eindpunt te maak. Omdat hy voor gejaag het, kon hy nie sy tye met die res van die veld vergelyk nie.

Lewis het inderdaad dié raad gevolg en die fietsrywêreld verstom. Hy het om 02:02 weggespring en om 03:00 is daar in die stadion berig dat hy alreeds die eerste kontrolepunt verbygesteek het. Dit het beteken dat hy 33 km in 57 minute afgelê het. Vergelyk dit met die 1908-Spele waar die eerste 40 km van die 100 km-baanwedren maar in 60 min afgelê is. Alhoewel Lewis se kragte teen die einde afgeneem het, het hy nogtans die wedren maklik gewen. Sy wentyd was 10:42:39.0. Hy het nie net die Sweedse rekord van 1909 met 39 minute en 48 sekondes verpletter nie, maar sy gemiddelde spoed vir die 320 km was 29 km per uur! As in ag geneem word dat dit sonder 'n verskeidenheid van ratte in versengende hitte en in versmorende stof op 'n heuwelagtige grondpad was (Van der Merwe, 1978: 75, 103-109, 631), dan is dit vandag nog 'n prestasie wat jou verstom laat.

Van dié Spele se goue medaljewenners was die minste oor Rudolph Lewis bekend. 'n Sweedse fietsry-historikus, Gunnar Svartengren, beaam dit deur te skryf dat Lewis "…[was] an extraordinary person but is very little known (sic)" (Svartengren, 2004). 'n Behoefte om meer oor Lewis te wete te kom, het uit hierdie stelling van die Sweed ontstaan. Die feit dat die notules van die Suid-Afrikaanse Olimpiese Vereniging (tot voor Oktober 1920) verlore geraak het, ontneem die navorser van belangrike primêre inligting. Nuwe feite wat nou opgediep is, raak die volgende aspekte:

BIOGRAFIESE GEGEWENS

Die *Star* (1912a: 9) gee sy volle name as Rudolph Ludewyk Lewis en sê dat hy te Waterberg, in die Pretoria-distrik, gebore is. Volgens Laubscher (2002: 21) is sy geboortedatum 12 Julie 1887. Hy het sedert 15-jarige ouderdom in Germiston gewoon. Dit strook met 'n biografiese skets deur Harold Browne getitel "An old time Olympic champion cyclist" (Browne, g.d.). Browne (g.d.: 1) voeg net by dat Lewis op 'n plaas in die Waterberg grootgeword het. Of Lewis ooit op 'n stadium in Robertson gewoon het, soos die *Cape Times* beweer, kon nie met sekerheid vasgestel word nie. Dié berig in die *Times* (1912a: 8) lui soos volg: "Two events stand out from all others at the Olympic Games. These are the Marathon and the 200 miles cycle race – the only wheel event on the programme. South Africa, thanks to a grand performance by the ex-Robertson rider R. Lewis – has already gained one of these coveted distinctions, …". Die *Star* (1912a: 9) noem verder dat hy drie jaar voor die Spele getroud is en die vader van twee kinders was.

Lewis het 'n week na sy Olimpiese oorwinning 25 jaar oud geword. Hy het eers teen die einde van 1909 mededingend begin fietsry toe hy by die "Germiston District Cycling Club" aangesluit het. Vriende wat saam met hom geoefen het, het gereeld vertel van sy buitengewone talent. Dit is vir die eerste keer bewys toe hy op 15 September 1909 die klub se 50-myl-wedren in rekordtyd gewen het. Die roete was van Germiston na Heidelberg en terug. Hierna het hy ook twee keer die vinnigste tyd in die Diamond Road-wedren behaal. Sy onkunde rakende wedrenstrategie was egter so opvallend dat 'n veteraanjaer, Arthur E. George, hom begin touwys maak het (*Star*, 1912a: 9).

Dit moes vrugte afgewerp het, want in 1911 het hy die "Rand Roads Cycling Club" se "100-guinea B.S.A. gold vase" verower toe hy die 100-myl-padwedren in die vinnigste tyd ooit gewen het. Hy het vyfde geëindig nadat hy sonder voorgee weggespring het (*Star*, 1912d: 11).

Volgens Browne (g.d.: 2) het hy sonder finesse gery en op blote krag en stamina staatgemaak.

Hy skryf ook die volgende: "In road racing, should he see a sluit (sic) a foot or so wide directly in his path, he usually jumped it. He simply stood up on his pedals at full speed and lifted his machine across. No mean accomplishment, because he did not use a free-wheeling machine, so that his legs were rotating continuously" (Browne, g.d.: 2).

Bogenoemde biografiese skets deur Browne (g.d.: 1) bring 'n interessante nuwe brokkie inligting na vore. Volgens hom was Rudolph se bynaam "Pa". Ander populêre bronne verwys na "Okey" (Emery, 1956: 28; Opperman & Laubscher, 1987: 6). Volgens Browne (g.d.: 2) was Rudolph eers 'n rolskaatser voordat hy aan fietsry as sport begin deelneem het. Toe rolskaatsry sy hoogtepunt in gewildheid aan die Rand bereik het, het Lewis sy stamina getoon toe hy die 15- en 25-myl-wedrenne gewen het.

Nog 'n brokkie nuwe inligting kom uit 'n Duitse bron, *Die Matadore der Landstrasse*, wat 'n onderafdeling aan Rudolph Lewis gewy het. Hiervolgens, en dit is iets wat Browne heeltemal verswyg het, was Lewis 'n bokser van formaat voordat hy fietsry as sport aangepak het. Hy sou "14 goue medaljes" as bokser verwerf het teenoor die "62 goue medaljes" vir fietsry voor sy Olimpiese oorwinning. Hierdie Duitse bron fouteer oënskynlik deur Lewis se geboortedatum en -plek as 1890 en Johannesburg onderskeidelik aan te gee (Franz, 2005).

VOOR DIE SPELE

Dit blyk dat Lewis die laaste spankeuse vir die Spele was. Hy het sy insluiting verdien deur 'n buitengewone vertoning in die proewe te lewer. Hy was die enigste fietsryer wat dié 150-myl-roete (241.4 km) kon voltooi (*Illustrated Star*, 1912: 13). Sy grootste mededinger om 'n plek in die span was W.R. Smith. Op dié dag was Lewis egter beter. Die proewe is in die laaste week van April gehou en dit was 'n onplesierige dag met reën wat in vlae neergekom het. Die roete was plek-plek onder water en modder. Dit het die proefren in 'n toets vir stamina verander, want van die 53 jaers wat weggespring het, kon net Lewis die wedren voltooi! Smith het weliswaar vir 75 myl (121 km) voorgeloop, maar ses papwiele opgedoen (wat hy self moes regmaak). Na 120 myl (193 km) het hy toe maar tou opgegooi (*Cape Times*, 1912a: 8).

Nadat Lewis vir die span genomineer is, het dit uitgelek dat hy finansieel swaargekry het en nie so 'n reis sou kon bekostig nie. Gelukkig het Arthur George en Edwin George, twee bekende fietsryers en die eienaars van 'n fietswinkel in Germiston, na vore getree en 'n fonds gestig om die geld vir die aankoop van die nodige toerusting vir Lewis in te samel (Browne, g.d.: 3).

Twee tot drie weke voor die Spele 'n aanvang geneem het, het die span soos gebruiklik in Engeland voorberei. Omdat die Spele op 6 Julie geopen het, moes die Springbokke dus in Junie hul voorbereiding gedoen het. In 1912 het hulle naby Brighton gebly en Lewis het lang afstande op sy fiets met hardloop afgewissel (Emery, 1956: 17, 19). Lewis het soggens om 04:00 opgestaan sodat hy gewoond kon raak aan oefening só vroeg in die oggend (dit was toe al bekend dat die Olimpiese wedren om 02:00 sou begin) (*Cape Times*, 1912a: 8).

TYDENS DIE SPELE

Lewis het 'n Swift-fiets met 'n 88-rat gery en nie met 'n vrywiel (soos berig is) nie. Hy het tweede weggespring. Die Fransman voor hom het met 'n 77-rat gery, maar Lewis het hom binne vyf myl ingehaal. Al die jaers wat gevolg het, het by die kontrolepunte na sy tye gevra en hulle was dit eens dat hy nie die pas sou kon volhou nie. Vir die eerste 100 myl het hy 'n

wind van voor gehad, maar met die omdraaislag kon hy baie spoed optel met sy hoë rat. Volgens hom was sy snelheid oor die laaste 20 myl (32 km) vinniger as dié oor enige soortgelyke afstand tevore. Die oppervlak van die roete het hy as skokkend beskryf. Dit was veel erger as die gewone Transvaalse paaie waaraan hy gewoond was (*South Africa*, 1912d: 503; *Rand Daily Mail*, 1912i: 8).

Die roete om die Mälar-meer was baie moeilik. Dit was heuwelagtig en die pad was vol wielspore en gate. Diegene wat die roete geken het, het voorspel dat die wentyd nie vinniger as 12 uur sou wees nie (*Cape Times*, 1912a: 7) - Lewis se wentyd soos alreeds genoem was 10:42:39 (Bergvall, 1913: 443). Hy het nie net die Olimpiese goue medalje verower nie, maar ook 'n spesiale silwerbeker ontvang vir sy beste tyd tussen Stockholm en Vesteras ('n afstand van 125 myl) (*Rand Daily Mail*, 1912a: 4). Dit verskil effens van die amptelike verslag oor die Spele. Volgens hierdie verslag is ses bekers uitgedeel. Die een wat Lewis ontvang het, was die "Eskilstuna Commemoration Cup" en dié beker was vir die wenner van die totale wedren (Bergvall, 1913: 452). Terloops, Lewis het die stadion 'n halfuur voor die verwagte tyd bereik en net 12 deelnemers kon die stadion binne twee uur ná Lewis haal (*London Times*, 1912: 10).

H.B. Keartland, wat na Lewis en die atlete omgesien het, het ná die Spele met sy aankoms in Londen die volgende verklaring aan die *Sporting Life* gedoen:

"… it would have been a foolish thing to dogmatise on the probabilities of any man winning this Lake Malar race. It was too much of a lottery. However, when we knew that he had drawn second place, I can tell you we felt pretty sure of his victory. My instructions to Lewis were: 'Go right away from the start; ride your first 50 miles at top speed; and then put it all in on the rough portions of the journey'. You see, I knew this

lad could stay and I also believe that he is fast enough to beat the 50 miles record. So my idea was that if he once got away the others would wear themselves out in trying to catch him. I may also add that he probably rode the lightest machine in the race, and was the lightest-clothed rider, for he only wore the usual patch-racing suit, used Dunlop racing tyres, and was in every way fitted to dash away as if the race had been on the fastest roads in the world instead of some of the worst" (*Rand Daily Mail*, 1912e: 8).

Dié wedren het basies neergekom op 'n 320 km-tydtoets (*Cape Times*, 1912a: 8).

Die Franse jaer wat eerste weggespring het, het vroeg in die wedren amper veroorsaak dat Lewis geval het. Dit was tydens die Springbok se verbysteekpoging, slegs vyf myl (agt km) vanaf die wegspring. Die uiteinde van die saak was dat hierdie jaer self in die sloot beland het (*Rand Daily Mail*, 1912e: 8; *Rand Daily Mail*, 1912i: 8). Van die ander deelnemers het wel noue ontkomings gehad. 'n Skotse jaer, [John] Wilson, het drie keer in 'n sloot beland. Met

die derde valslag het 'n Sweedse jaer bo-op hom geval en die Engelse jaer, [Leon] Meredith (wat uiteindelik vierde geëindig het (Van der Merwe, 1978: 108)), bo-op beide van hulle. Meredith het sy fiets beskadig en 'n halfuur verloor. Nog 'n jaer, A.J. Stokes van Engeland, het weer sy sleutelbeen gebreek toe hy geval het en moes hom aan die wedren onttrek (*Rand Daily Mail*, 1912d: 8; Bergvall, 1913: 444).

Die Sweedse kampioen, wat twee minute ná Lewis weggespring het, kon die Springbok ook nooit inhaal nie. Vir die eerste helfte van die wedren het Lewis met 'n wind van voor gery en

by die kontrolepunte het die beamptes hom gewaarsku dat hy nie sy vinnige pas met so 'n groot rat sou kon volhou nie. Sowat ses myl voor die eindpunt (wat in die Olimpiese stadion was) het hy 'n papwiel gekry. Hy moes daarna elke kwartmyl stilhou om die wiel op te pomp. Alhoewel hy hierdeur tyd verloor het, het dit ook gemaak dat hy relatief vars by die stadion aangekom het. In sy eie woorde: "When I reached the stadium I felt quite fresh, … I never realised my strength and my powers of endurance till then" (*Rand Daily Mail*, 1912i: 8).

NA DIE SPELE

Na sy oorwinning het 'n Amerikaanse afvaardiging hom $2 000 aangebied om professioneel te begin jaag, maar hy het nie die aanbod aanvaar nie (*Rand Daily Mail*, 1912i: 8). Hy het ook 'n aanbod ontvang om in Duitsland aan professionele padwedrenne deel te neem (Franz, 2005). Hierdie aanloklike aanbod moes 'n saadjie geplant het, want die volgende jaar het Lewis hom inderdaad by 'n beroepspan in Europa aangesluit.

Lewis het op Saterdag, 27 Julie 1912 met die RMS Walmer Castle uit Southampton vertrek (*South Africa*, 1912a: 191) en op 13 Augustus in Kaapstad gearriveer (*South Africa*, 1912b: 336). Sy aankoms saam met die atlete George Patching, Reuben Povey en John Victor word deur die *Rand Daily Mail* (1912g: 7) bevestig. Lewis het Kaapstad op 13 Augustus met die 11:30-trein verlaat en sou op 15 Augustus om 09:00 by Parkstasie arriveer (*Star*, 1912e: 10). Die *Rand Daily Mail* (1912j: 8) fouteer deur te berig dat hy op 22 Augustus op Parkstasie aangekom het. 'n Klein maar entoesiastiese groepie ondersteuners het Lewis op die stasie ingewag, waar hy dadelik op die skouers getel en rondgedra is (*Star*, 1912f: 11).

Terug tuis in Germiston het Lewis interessante verhale te vertel gehad. Hy het verwys na die kritici wie se monde hy met sy Londen-Brighton-rekord gesnoer het. Nie veel kon oor hierdie rekord gevind word nie, maar dit is wel bekend dat F.H. Grubb op 10 Julie 1912 die rekord oor die 104 myl na 5:9:41 verbeter het (*Rand Daily Mail*, 1912b: 10). Dit kon dus Lewis se rekord gewees het.

Die "kritici" waarna hy verwys was egter net 'n joernalis wat met Lewis se insluiting in die span minagtend verwys na "a cyclist named Lewis, whom nobody knew" wat in die span opgeneem is ten koste van uitstekende jaers wat al verskeie baankampioenskappe gewen het. In die twee jaar wat die Spele voorafgegaan het, was W.R. Smith die mees uitstaande fietsryer in Suid-Afrika. Gedurende hierdie era het Lewis, teen die verwagting in, vir Smith by een of twee geleenthede op 'n moeilike padroete geklop. Met die Paarlse sportdag van 1911, waar daar tradisioneel oor 25 myl om die Blake-beker meegeding is, het Lewis die Olimpiese Spele in gedagte gehad toe hy Smith geklop het (*Cape Times*, 1912a: 8). Smith het dié wedren in 1909 en 1910 gewen en as hy dit weer in 1911 kon vermag, sou die beker sy eiendom word – tot groot bekommernis van die organiseerders. Lewis het die week voor die byeenkoms elke

dag op die baan geoefen om met die skerp draaie vertroud te raak. Met die aanbreek van die laaste rondte was daar vier jaers voor, onder andere Smith en Lewis. In die pylvak het Lewis die ander laat "stilstaan" en eerste oor die wenstreep gejaag. In 1912, terloops, het Smith weer gewen en was Lewis derde (Human, 1984: 49-54). Na sy Paarl-oorwinning was kenners dit eens dat hy Smith se gelyke op die baan was en, wat stamina betref het, ook op die padroetes. Indien fondse dit toegelaat het, sou Smith sy spanmaat by die Spele gewees het. Die kanse dat hulle die eerste twee plekke (soos in die marathon) sou verower het, was baie goed (*Cape Times*, 1912a: 8).

Wat Lewis se prestasie nóg meer merkwaardig maak, is die feit dat sy werk as 'n afbouer by die myn ondergronds van aard was. Hy kon net in sy bietjie vrye tyd sy oefenprogram volg (*Cape Times*, 1912a: 8; Emery, 1956: 25). Vir nege jaar voor die Spele het hy ondergronds vir Consolidated Goldfields gewerk. Ten tyde van sy insluiting in die Olimpiese span was hy werksaam by May Consolidated G.M. Co. (*Star*, 1912a: 9). Op daardie tydstip is die beroepslewe van 'n mynwerker aan die Rand op nege jaar geskat, wat Lewis se prestasie nog meer indrukwekkend maak. Hy was baie gelukkig om silikose (longsiekte) vry te spring (Browne, g.d.).

Rudolph Lewis was dus op 15 Augustus weer tuis in sy huis in Victoriastraat, Germiston. Hy het aan die Germistonse verteenwoordiger van die *Star* gesê dat hy verbaas was om in Kaapstad al die negatiewe koerantberigte oor die spanbestuur te sien. Op 'n vraag of hulle goed onthaal is, het hy geantwoord dat daar nie geld vir onthaal was nie (*Cape Times*, 1912b: 7; *Rand Daily Mail*, 1912i: 8). Oor die gebrek aan geld het die *Star* (1912c: 9) die volgende berig: "…with the amount already raised we are able only to pay the bare travelling and living expenses of some and a portion of the expenses of others who were sent…".

Pas na sy tuiskoms moes Lewis by die Orpheum-teater in Johannesburg verskyn, waar 'n rolprent oor die Spele vertoon is (*Rand Daily Mail*, 1912i: 8). Die ironie is dat die koerantadvertensie oor hierdie rolprent net na die oorwinnings van McArthur, Winslow en Kitson en die "plucky race" van Gitsham verwys het (*Rand Daily Mail*, 1912h: 6). Geen woord oor Lewis nie! Voor die rolprent oor die Olimpiese Spele gedraai het, het hulle 'n rolprent vertoon wat Lewis se aankoms op Parkstasie uitgebeeld het. Toeskouers kon toe sien hoe J.W.F. Hoffman, 'n ene Hossack en ander lede van die Transvaal Fietsry-unie vir Lewis op die skouers rondgedra het (*Rand Daily Mail*, 1912i: 8).

H.B. Keartland, 'n joernalis by die Spele en afrigter van die Springbokke, het die volgende omtrent die 1912-span te sê gehad:

> "A representative team never left South Africa with so little encouragement and it can be pretty safely reckoned that one so severely criticised never will. Those who had faith in the team could be counted on one hand, and just as those few played the game by the team in Africa, so has the team played the game in this country. Apparently the English press took its attitude from the South African standpoint, and considered it best to ignore us, for no team ever had a less cordial welcome. 'We', as a member of the team put it, 'slunk into London by a back door'. From Southampton, instead of proceeding to the world's capital, as usual with all teams, we went straightaway coastwards to training quarters at Brighton, and six hours after landing the team started its arduous training to dumbfound its South African critics" (*Star*, 1912b: 9).

Dit is dus duidelik dat die Suid-Afrikaanse publiek aanvanklik nie hoë verwagtinge van hierdie span gehad het nie, maar teen middel-Julie het die pers geskryf dat dit moeilik was om die volle betekenis van die Suid-Afrikaanse prestasies te begryp (*Star*, 1912b: 9). As 'n blyk van "skuldgevoel" is daar tydens 'n groot vergadering in Potchefstroom besluit om die Transvaal Amateuratletiekvereniging en die Transvaal Fietsry-unie te nader oor 'n gepaste geskenk vir die oorwinnings wat McArthur en Lewis behaal het (*South Africa*, 1912c: 426). Op Vrydagaand 16 Augustus het die voorsitter en lede van die Olimpiese komitee in die Orpheum na rolprente oor die Olimpiese Spele gekyk. 'n Kollekte is daar opgeneem om die gepaste geskenke te koop (*Cape Times*, 1912c: 9). 'n Ander berig noem dat geskenke ook vir

Winslow, Kitson en Gitsham gekoop sou word (*Rand Daily Mail*, 1912f: 10).

Browne (g.d.: 3) fouteer in sy biografiese skets van Lewis deur te verklaar dat hy nie bewus daarvan was dat Lewis ná die Olimpiese Spele na Suid-Afrika teruggekeer het nie. Hy is wel korrek deur te verwys na Lewis se era as professionele fietsryer in Europa voor die uitbreek van die Eerste Wêreldoorlog. Hy voeg verder by dat Lewis as 'n korporaal in die Duitse Leër diens gedoen het en dat hy kort na die oorlog in Duitsland oorlede is, maar erken in dieselfde asem dat hy nie vir die waarheid pa kan staan nie. Wat Lewis se sterfte betref, is hierdie feit nie korrek nie, want Lewis is eers op Sondag, 29 Oktober 1933 oorlede (Laubscher, 2002: 21).

'n Tekortkoming in dié navorsing is die gebrek aan inligting oor Lewis se lewe in Duitsland. Hy het wel as professionele jaer in Duitsland opgetree, maar hoe lank hy in totaal daar vertoef het en hoekom hy in die oorlog vir Duitsland geveg het, is onseker. Volgens Ron Thompson (2004; 2005) het hy 'n Ysterkruis vir dapperheid ontvang en is hierdie toekenning lank in 'n hotel in Germiston uitgestal. Enkele navrae aan Duitse historici het nog niks opgelewer nie, so ook nie die Duitse internetposdiens vir fietshistorici nie (Svartengren, 2005). Emery (1956: 28), weliswaar 'n onbetroubare bron, beweer dat Lewis in 1913 na Europa vertrek het om hom by een van die groot padwedrenberoepspanne aan te sluit. Hy het blykbaar goed gevaar, maar toe breek die Eerste Wêreldoorlog uit terwyl hy nog in Duitsland was. Niks is toe 'n tyd lank van hom gehoor nie, totdat hy ná die oorlog in Johanneburg opgeduik het …"his grand physique worn to a shadow and his body racked with disease". Hy was blykbaar betrokke by hewige gevegte aan die oostelike front en is 'n paar keer gewond. Hy het ook groot agteruitgang in die krygsgevangenekampe beleef en nooit weer volkome herstel nie (Emery, 1956: 28).

Human (1984: 54) bevestig dat Lewis in 1913 na Europa is en dat hy 'n paar groot padwedrenne "gewen" het voor die oorlog uitgebreek het. Learmont (1990: 72) is meer spesifiek en noem dat hy vir 'n beroepspan in Sakse gaan jaag het. Hy was blykbaar nie baie suksesvol met die eerste vyf kompetisies nie, maar het die Dresden 226 km-wedren in 7:52:23 "gewen". Hy bevestig ook dat min van Lewis bekend is ná 1914. Ongelukkig verskaf nie een van hierdie outeurs die bronne wat hulle geraadpleeg het nie.

Die belangrikste padwedrenne van 1913 word in die Duitse fietsryjaarboek, *Sport-album der Rad-Welt* (p.126) (Franz, 2005), gelys. Hierdie wedrenne was van 16 Maart tot 21 September. Ongelukkig word net die eerste drie jaers se name gegee en Lewis se naam verskyn by vier van dié uitslae.

Franz (2005) verskaf ook inligting uit 'n Duitse bron, getitel *Die Matadore der Landstrasse*, waarin vertel word dat Lewis en sy afrigter in die lente van 1913 in Chemnitz (oftewel Karl-

Marx-Stadt, nie ver van Dresden nie) gearriveer het om op die fietsrybaan daar te oefen. Dit blyk dat hy steeds met sy groot rat (waarmee hy die Olimpiese wedren gewen het) gery het, maar dit het hom gekniehalter. Dit sou hy in die eerste wedren van die jaar, die Berlyn-Kottbus-Berlyn-wedren op 16 Maart, agterkom. Daarbenewens het 'n wiel ook nog gebreek. Ook die Berlyn-Leipzig-Berlyn-wedren van 30 Maart was 'n teleurstelling. Net toe die publiek hom as 'n mislukking wou afskryf, het die ommekeer plaasgevind. Hy het die regte ratgrootte gevind en in die Völkerschlacht-Jubiläums-trofee het hy in die eerste skof uitstekend gejaag, maar ongelukkig die wegspring in die tweede skof misgeloop. In die wedren oor 250 km rondom Keulen op 4 Mei het hy tweede geëindig. Hy het ook die opvatting dat hy net in uiters warm toestande kon presteer, die nek ingeslaan toe hy op 11 Mei

in koue, mis en reën die bergwedren rondom Spessart en Rhön oor 330 km oorheers het. Dit was net in die laaste deel waar hy sy voortou verloor en met 'n tweede plek tevrede moes wees.

Hierdie fietsryjaarboek verklaar die "fout" wat Learmont gemaak het. Die beampte by die wenstreep in die "Rondom Dresden-resies" oor 226 km op 1 Junie het Lewis as wenner aangewys, maar nadat 'n foto van die eindpoging bestudeer is, is besluit dat Franz Suter hom net-net geklop het. Franz was ook sy spanmaat toe Lewis vyfde in die 12-uur-wedren van Chemnitz was. Ná hierdie wedren is Lewis deur foute of tekortkominge ("Defekt") geteister en kon hy eers weer op 28 Julie op die voorgrond tree. Hy was derde in hierdie wedren rondom Krefeld oor 241.7 km. Tot en met sy laaste wedren op 14 September het Lewis nie veel vermag nie, hoofsaaklik weens "unbelievable bad luck" (Franz, 2005).

Lewis het aan die einde van September na Suid-Afrika teruggekeer met die belofte dat hy in 1914 in Duitsland sou terugwees om aan die padwedrenne deel te neem. "The cordial words that Lewis said towards the now embosomed Germany and his comrades have proved that he felt well amongst the German road cyclists in spite of his many undeserved failures. One will like to see the uncrowned world champion again after he has shown that he is a good racing cyclist and above all an unimpeachable sportsman" (vertaal uit *Die Matadore der Landstrasse*, p.40, deur Franz, 2005).

Hieruit kan gespekuleer word dat Lewis wel in die lente van 1914 na Duitsland teruggekeer het en dat hy met die uitbreek van die oorlog in Augustus in dié land vasgekeer was en saam met sy spanmaats die wapen opgeneem het.

SAMEVATTEND

Wat Suid-Afrika se prestasies in die Olimpiese uithouvermoë-items (die padfietswedren en natuurlik ook die marathon) soveel meer merkwaardig maak, was die gebrek aan 'n gebalanseerde dieet waaraan deelnemers voor en tydens die Spele onderworpe was. Daar was tye dat hulle honger gely het weens die gebrek aan geld om kos te koop. Vir amper twee maande het hulle van broodrolletjies en melk (soms suurmelk) geleef. Dit is hoekom daar na hierdie span as die "Brood-en-melk-span" verwys is. By die Spele self het hulle darem 'n rolletjie en 'n gekookte eier of twee vir ontbyt gekry en dan 'n gekookte aandete. Daar was nie fout met laasgenoemde se kwaliteit nie, maar die kwantiteit was die probleem (Emery, 1956: 12-14).

Die amptelike verslag oor die Spele was van mening dat "The riding of the winner, Lewis, was simply unique, and the result a magnificent one" (Bergvall, 1913: 453). Dit word aanvaar dat Lewis die nie-amptelike amateur-wêreldfietsrykampioen van 1912 was (Franz, 2005). Bogenoemde nuwe feite probeer Lewis se uitsonderlike prestasie gestand doen. Nie net het hy respek in die buiteland afgedwing nie, maar ook op plaaslike front het dit 'n positiewe uitwerking op hierdie sportsoort gehad. Dat Lewis met sy prestasie 'n inspuiting aan plaaslike fietsry verskaf het, is sonder twyfel. Met die oog op die 1912-BSA-padwedren, is berig dat 'n veel groter inskrywingstal verwag is as voorheen en dat dit als te danke was aan Lewis se Olimpiese oorwinning (*Rand Daily Mail*, 1912c: 10).

SUMMARY

Rudolph Lewis and South Africa's biggest Olympic victory: New facts

South Africa's biggest achievement at the Olympic Games was in 1912 when Rudolph Lewis won the 320 km cycle road race in Stockholm. This was the only cycle event at these Games and he was the only South African among the 123 riders from 16 countries. He was second on the starting line. The instruction from his coach was that he should make every one of the 11 controls a winning post, and that he did for nearly all the way. With an average speed of 29 km/hour he broke the Swedish record over this route by 39:48:00. Nobody expected the winning time to be under 12 hours – Lewis did it in 10:42:39. This was certainly an amazing victory as the race was held in scorching heat and dust and over a hilly terrain. The road surface was described by Lewis as "shocking", since it was full of ruts and holes. At the Games Lewis rode a Swift machine with an 88 gear and no free-wheel as was reported. Everybody thought he would not keep the pace due to the bigger gear, but his amazing stamina proved them wrong. About six miles from the stadium he had a flat tyre and from there he had to stop every quarter of a mile to pump his tyre.

For more than 90 years very little was known of Lewis' private life. Enquiries from abroad led to this fuller investigation. We knew he was born on 12 July 1887 and died on 29 October 1933. But that was all. New information is that he had a second name, Ludewyk, and that he was born on a farm in the Waterberg district, near Pretoria. From his teenage years he lived in Germiston. He was apparently a good boxer and skater in his youth. He only took up cycling at the end of 1909. In 1912 the trials for the Olymics were held over a distance of 150 miles and his only challenge came from the top South African rider of that time, W.R. Smith. After six flat tyres, Smith gave up and Lewis was the only trialist out of 53 to finish this gruelling race in very wet conditions. Lewis also worked underground in a gold mine for nine years preceding the Stockholm Olympics.

After his Olympic triumph he was offered a career in professional riding by an American scout, but he declined. Another offer was to ride in professional road races in Germany. He initially declined this too, but in 1913 he changed his mind and joined the professional ranks in Germany from March till September. He did not have much success in the beginning, but after changing to a smaller gear he ended second in a couple of races. He came back to his family (wife and two children) in Germiston, but with the promise to be back in Germany for the summer of 1914.

This is where the information regarding his life ends to a certain extent. The following could not be historically verified. He apparently did go back to race in 1914 and when the First World War broke out, joined his German team-mates in their war effort. Another source tells of his Iron Cross that was exhibited in a Gemiston hotel for a long time. According to the late Ira Emery, long-time secretary of the South African Olympic Games Association, he returned in a poor physical condition after the war. The life in the prisoner-of-war camp had taken its toll. Apparently he never fully recovered from it.

BRONNE

BERGVALL, E. (Ed.) (1913). *The fifth Olympiad. The official report of the Olympic Games of Stockholm 1912*. Stockholm: Wahlström & Wildstrand.

BROWNE, H. (n.d.). Reference A1304f, Department of Historical Papers, William Cullen Library, University of the Witwatersrand, Johannesburg.

CAPE TIMES, THE (1912a). 9 July.

CAPE TIMES, THE (1912b). 16 August.

CAPE TIMES, THE (1912c). 17 August.

EMERY, I.G. (1956). *Springboks of the Olympiad*. Johannesburg: Afrikaanse Pers-boekhandel.

FRANZ, R. (2005). E-pos (fraenzi@trackcycling.de) aan F.J.G. van der Merwe (floris@sun.ac.za), 6 Desember.

HUMAN, E. (1984). *Die Paarl Boxing Day Sports*. Kaapstad: San-uitgewers.

ILLUSTRATED STAR, THE (1912). 13 July.

KEARTLAND, H.B. (1978). Persoonlike korrespondensie met F.J.G. van der Merwe, 28 Februarie.

LAUBSCHER, H.P. (Comp.) (2002). *South Africa's Olympians, 1904-2000*. Menlo Park (Pretoria): Olympia Scripta Historia.

LEARMONT, T. (1990). *Cycling in South Africa*. Sandton: Media House Publications.

LONDON TIMES, THE (1912). 8 July.

OPPERMAN, R.W.J. & LAUBSCHER, L. (1987). *Africa's first Olympians. The story of the Olympic Movement in South Africa, 1907-1987*. Johannesburg: SANOC.

RAND DAILY MAIL, THE (1912a). 9 July.

RAND DAILY MAIL, THE (1912b). 12 July.

RAND DAILY MAIL, THE (1912c). 20 July.

RAND DAILY MAIL, THE (1912d). 2 August.

RAND DAILY MAIL, THE (1912e). 9 August.

RAND DAILY MAIL, THE (1912f). 12 August.

RAND DAILY MAIL, THE (1912g). 14 August.

RAND DAILY MAIL, THE (1912h). 15 August.

RAND DAILY MAIL, THE (1912i). 16 August.

RAND DAILY MAIL, THE (1912j). 23 August.

SOUTH AFRICA (1912a). 27 July.

SOUTH AFRICA (1912b). 17 August.

SOUTH AFRICA (1912c). 31 August.

SOUTH AFRICA (1912d). 14 September.

STAR, THE (1912a). 8 July.

STAR, THE (1912b). 15 July.

STAR, THE (1912c). 16 July.

STAR, THE (1912d). 22 July.

STAR, THE (1912e). 14 August.

STAR, THE (1912f). 15 August.

SVARTENGREN, G. (2004). E-pos (gunnar.svartengren@swipnet.se) aan F.J.G. van der Merwe (floris@sun.ac.za), 13 Januarie.

SVARTENGREN, G. (2005). E-pos (gunnar.svartengren@swipnet.se) aan F.J.G. van der Merwe (floris@sun.ac.za), 18 April.

THOMPSON, R. (2004). E-pos (ron@motive.co.za) aan F.J.G. van der Merwe (floris@sun.ac.za), 18 Mei.

THOMPSON, R. (2005). Telefoniese onderhoud, 24 November.

VAN DER MERWE, F.J.G. (1978). Suid-Afrika se deelname aan die Olimpiese Spele: 1908-1960. Ongepubliseerde doktorale proefskrif. Potchefstroom: PU vir CHO.

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