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DEVELOPING A PEAK PERFORMANCE PROFILE MEASUREMENT FOR SPORT

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ABSTRACT

The purpose of this study was to construct a measuring instrument to assess sportspersons' psychological strengths and weaknesses. With this in mind, various developmental procedures were applied in the construction and development of an instrument over a period of more than seven years. The research was conducted in phases beginning with an initial 82-item instrument administered to 304 sport science students who participated in a variety of sports to the last phase culminating in a 15-item peak performance profile containing three independent subscales, namely concentration, stress control and confidence.

Key words: Mental skills; Sport psychology; Psychometrics; Peak performance.

INTRODUCTION

A major tenet of sport psychology is that sportspersons can maximise their performance if they can master their mental states. Assessing the strengths and weaknesses of the mental skills of sportspersons can provide valuable information when deciding on performance enhancement interventions.

Psychological assessment in sport goes back to the work of Coleman Griffith in the 1930s (Kroll & Lewis, 1970). He used surveys to assess attitudes, perceptions and personality characteristics of coaches and sportspersons. In the late 1960s, Tutko *et al.* (1969) formally introduced the *Athletic Motivation Inventory* to bring psychological testing into the sport milieu. Other instruments followed. The construction of the *Test of Attentional and Interpersonal Style (TAIS)* by Nideffer (1976) is an example of significant progress in psychological assessment in sport. Other well-known examples of sport-related instruments are the *Sport Competition Anxiety Test (SCAT)* (Martens, 1977) and the *Competitive State Anxiety Inventory-2 (CSAI-2)* (Martens *et al.*, 1990). The publication of the *Directory of psychological tests in sport and exercise* (Ostrow, 1990) is an indication of the interest in sport-related assessment tools.

The development of the *Psychological Skills Inventory for Sports-5 (PSIS-5)* (Mahoney *et al.*, 1987) arose from a need for an instrument to assess a broad range of psychological skills that could be used to differentiate between successful and less successful sportspersons. Despite its promise as a research instrument, it had shortcomings and limited usefulness (Chartrand *et*

al., 1992). This was followed by a multidimensional scale that measures subscales of psychological skills, namely the *Athletic Coping Skills Inventory-28* (Smith *et al., 1995)*.

Gould *et al*. (1992) pointed out that existing mental skills inventories have shortcomings. Investigators typically ask sportspeople to respond to already developed instruments, so there is relatively little opportunity to identify previously unknown or hypothesised factors that influence sport performance. Secondly, instruments are usually administered only once, usually well before competition, and hence investigators fail to evaluate sportspersons' reactions to the actual competitive experience. Finally, a need exists to move beyond the identification of general factors associated with successful performance to an in-depth examination of such factors. The tests have also been criticised because of their lack of utility and applicability, as well as their construct and predictive validity (Hackford & Schwenkmezer, 1989; Summers & Ford, 1990).

Durand-Bush *et al*. (2001) introduced the *Ottawa Mental Skills Assessment Tool (OMSAT-3)* to address some of these shortcomings. This 48-item instrument includes 12 mental skills subscales grouped under three broad components, namely foundation, psychosomatic, and cognitive skills. The development of the mental skills inventory reported on in this article took place at more or less the same time as the construction and development of the *OMSAT-3*. The initial purpose of the current study was similar to that of the researchers of the OMSAT-3, namely to study the nature of mental skills in sport performance and the measurement thereof.

PURPOSE OF THE STUDY

The purpose of this study was to:

1. Identify the psychological factors that affect sport performance.
2. Construct a practical, reliable and valid instrument to assess the psychological attributes of sportspersons.

METHOD

Phase 1

A vital aspect of test construction is a review of literature relevant to the field of study. An extensive review of sport psychology literature was undertaken (Wheaton, 1998). This included articles about successful sportspersons, as well as research articles dealing with mental skills. A review of psychological tests was also done. On the basis of this review the following seven mental skills were identified: achievement motivation; goal setting; anxiety control; maintaining confidence; concentration; mental rehearsal; and coping strategies. Of these seven mental skills, the first six formed the basis of the inventory. A separate category for coping strategies was not deemed necessary due to its diverse nature. They were, however, incorporated into the other six subscales.

Relevant items for each mental skill were formulated. It is usually recommended that roughly twice as many items as what are envisaged for the final inventory need to be drawn upon in

the initial test construction (Thorndike, 1982). An inventory of 82 items was subsequently constructed.

Phase 2

The provisional 82-item inventory was administered to 304 university sport science students who participated in a variety of sports, such as badminton, basketball, cricket, golf, hockey, gymnastics, netball, rugby, swimming, track and field, volleyball and waterpolo. They responded to each inventory item on a 5-point Likert scale ranging from *never* (0) to *always* (4). Respondents also completed an anonymous questionnaire to strengthen the reliability of the results. This questionnaire contained the following three items:

I answered this inventory the way I truly and honestly felt (Yes/No.)
I answered this inventory according to how I thought my coach would like me to answer (Yes/No).
I answered this inventory so that I would give the best impression of myself (Yes/No).

A test-retest of the inventory was performed using 22 postgraduate sport science students in a class setting. The retest was administered one week after the initial test. The correlation for the six skills ranged from 0.79 to 0.97.

The sample of sport science students (N=304) was divided into two achievement-level groups. Group 1 (n=245) consisted of sportspersons who participated at school, club or provincial level. National school, senior provincial and national sportspersons (n=59) were allocated to group 2. Group 2 recorded significantly higher mean scores, as assessed by applying a t-test ($p \leq 0.05$), in all six mental skills than Group 1. The largest differences were in the goal-setting and mental rehearsal skills. This could serve as an indication of the potential of the instrument to discriminate between successful and less successful sportspersons.

An important aspect of Phase 2 was to determine which items differentiated the successful from the less successful sportspersons. There were 16 items that produced statistically significant ($p \leq 0.05$) correlations between individual mental skills scores and level of performance. Another aspect of the statistical analysis was the correlation of individual questionnaire items with the subscale total scores. The 10 best correlated items from each mental skill were selected for inclusion in the final 60-item inventory.

Phase 3

Seven registered psychologists administered the 60-item *MSI* over a period of more than five years to elite South African sportspersons. These individuals were part of the High Performance Programme of the *Sport Information and Science Agency (SISA),* a government-sponsored body with the main function of assisting and developing elite sportspersons in South Africa. The data of 768 elite sportspersons were available for statistical analysis.

Phase 4

The data collected on the MSI were used to subject the MSI to a confirmatory factor analysis (CFA). The goodness-of-fit of the CFA model was not satisfactory with a RMSEA of 0.13 (should be <0.05), a GFI of 0.8 (should be >0.95) and an AGFI of 0.79 (should be >0.95). The data were then randomly split into two samples namely a calibration sample and a validation sample.

An exploratory factor analysis (EFA) was performed on the calibration data to evaluate if the items contained in the 60-item MSI load on the mentioned mental skills. Four independent factors with loadings of >0.5 emerged (varimax normalised rotation using oblique factors) (Table 1). These four factors explained 61% of the variance in the data.

TABLE 1: **EXPLORATORY FACTOR ANALYSIS RESULTS**

Factors and related statement items	**Factor Loading**
Factor 1: Concentration	
13. If I get behind in competition I feel that winning is impossible.	0.70
17. I have trouble concentrating during important competitions.	0.80
18. I find it difficult to visualise clear mental pictures of my sport in my imagination.	0.78
23. When unexpected things happen during important competitions it disrupts my concentration.	0.68
29. My concentration lets me down during important competitions.	0.85
34. I have doubts about my ability in sport.	0.77
35. My thoughts interfere with my performance during important competitions.	0.81
40. My confidence tends to drop as an important competition draws nearer.	0.84
47. Negative remarks by other people (such as spectators or opponents) upset me during important competitions	0.67
59. When a competition is not going well, my concentration is easily disrupted.	0.70
Factor 2: Confidence	
3. Before I compete in important competitions I worry about not performing well.	0.72
9. I worry about making mistakes in important competitions.	0.82
57. I am concerned that others will be disappointed with my performance in important competitions.	0.72
Factor 3: Stress Control	
16. Before important competitions I am confident that I can handle the pressure.	0.69
27. I can control my nervousness before important competitions.	0.66
28. Before important competitions I am confident that I can meet the challenges.	0.61
33. I can handle unexpected stress during important competitions.	0.62
41. I can effectively block out negative thoughts during important competitions.	0.57
Factor 4: Visualisation	
24. I visualise my sport in my imagination during practice sessions.	0.62
30. I visualise my sport in my imagination just before going into important competitions.	0.68
36. I visualise my sport in my imagination during competitions	0.70
48. I use visualisation in the period just before the beginning of important competitions.	0.70

When interpreting the structure of the above factors by inspection of the item loadings on each of the factors it appears that: Factor 1 (10 items) provides a broad measure of *Concentration* in sport. Factor 2 (3 items) pertains to *Confidence.* Factor 3 (5 items) provides a broad measure of *Stress Control* in sport. Factor 4 (4 items) deals with the use of *Visualisation*.

Phase 5

The 22 items contained in the four factors were considered for inclusion in this phase of the instrument development.

The 10 items in the *Concentration* subscale were reduced to 5 after eliminating item 29 ("My concentration lets me down during important contests") because it was considered too similar to item 17 ("I have trouble concentrating during important competitions"). Although items 34 and 40 also loaded on the *Concentration* category ("I have doubts about my ability in sport" and "My confidence tends to drop as an important competition draws nearer") were eliminated on the assumption that there were better items in the remaining list that pertain more directly to concentration. The 5 remaining items (17, 23, 35, 47, 59) with the highest loadings on the *Concentration* factor were retained for further statistical analysis.

All 3 items (3, 9, 57) on *Confidence* were retained since their loadings were >0.5. Two items from factor 1 (Concentration), item 34, "I have doubts about my ability in sport", and item 40, "My confidence tends to drop as an important competition draws nearer" were included under this subscale for further analysis (see Phase 6).

All 5 items (16, 27, 28, 33, 41) in the *Stress Control* subscale yielded factor loadings of >0.5 and were retained for the next phase.

All 4 items in the *Imagery* subscale were eliminated. At this stage of the study it was decided to change the focus of the measuring instrument away from a mental skills inventory because the factor analysis resulted in a limited number of mental skills. It was considered incorrect to present the few remaining items as an *inventory* of mental skills. Instead a *profile* of mental attributes appeared to be more meaningful. Imagery, in contrast to stress control, concentration and confidence does not follow this pattern of reasoning and was, therefore, omitted. At the end of Phase 5 the investigators were left with an instrument, provisionally entitled "Peak Performance Profile" that included 3 independent psychological attributes, namely Stress Control, Concentration and Confidence. This instrument was further analysed in the next phase.

Phase 6

Two of the *Concentration* items (34 and 40) mentioned in the discussion of Phase 5 above ("I have doubts about my ability in sport" and "My confidence tends to drop as an important competition draws nearer") were again included to determine if they could be used in the *Confidence* category. A confirmatory factor analysis (CFA) was done on calibration data using the 15 items selected from the MSI in Phase 5.

Goodness-of-fit indices indicated an unsatisfactory fit (RMSEA=0.071) to the hypothesised factor structure of the instrument. The hypothesis that RMSEA <0.05 was rejected (p<0.001).

The data of the validation sample were subjected to a CFA after eliminating items 34 and 40 in order to determine the best fitting model from the calibration sample. The CFA on the validation sample yielded satisfactory goodness-of-fit (RMSEA=0.041; GFI=0.99; AGFI=0.98). The hypothesis that RMSEA <0.05 was accepted (p=0.63). Loadings on all 13 items were significant (t-values>1.96). Table 2 shows some final reliability statistics for the instrument. The variance extracted and Cronbach alpha for confidence are just below the usual norms (VE>0.5 and alpha>0.7). More attention should be given to this scale in future research.

TABLE 2: **RELIABILITY STATISTICS FOR THE THREE SCALE PEAK PERFORMANCE PROFILE INSTRUMENT**

Scale	Variance extracted	Construct reliability	Cronbach alpha
Concentration	0.59	0.88	0.85
Confidence	0.44	0.70	0.65
Stress control	0.56	0.86	0.82

Proposed instrument

A preliminary 13-item instrument for assessing psychological attributes of sportspersons is proposed (see Appendix). The following 3 independent subscales are contained in the proposed "Peak Performance Profile":

Concentration (Items 1, 4, 7, 10, 13)
Stress control (Items 2, 5, 8, 11, 14)
Confidence (Items 3, 6, 9).

New items 12 and 15 were added to this subscale for future analysis.

CONCLUSION

Stress in sport is probably the most discussed topic in sport psychology (Hanton *et al*., 2005). This is not surprising if one takes into account the stress involved in competitive sport. When conceptualising stress, Lazarus (1999) recommends that both environmental, as well as personal factors should be considered. There are two approaches to stress control (Thomas *et al*., 2009). The first is a reduction strategy that includes various relaxation techniques and stress inoculation such as simulation training (Williams & Harris, 2006). The second approach is the restructuring strategy. This deals with sportspersons' interpretation of anxiety-related symptoms (Hanton & Connaughton, 2002). Mental skills associated with this approach include imagery, goal setting, positive self-talk and rationalisation/restructuring skills (Thomas *et al*., 2009).

The ability to concentrate on what is most important in a situation while ignoring distractions is essential for top performance in sport (Moran, 2009). Research on peak performance

experiences in sport supports the vital link between total absorption in the task at hand and optimal performance (Harmison, 2007). Despite the importance of concentration, there has been a dearth of evaluative studies in this field (Moran, 2009). Nideffer's (1976) *Test of Attentional and Interpersonal Style* (*TAIS*) is considered a pioneering contribution to sport psychology and widely used in sport counselling. However, attempts at validating the TAIS have produced mixed results (Moran & Summers, 2004).

A third psychological dimension that has a profound effect on optimal performance is confidence (Bull *et al*., 2005). Confidence is a consistent characteristic that successful elite sportspersons possess (Gould *et al*., 2002). Measuring Confidence in sport has been elusive due to practical and conceptual issues. Vealey and Knight (cited in Vealey & Chase, 2008) developed a 14-item *Sport Confidence Inventory* that contains three subscales (physical skills, cognitive efficiency and resilience). Manzo *et al*. (2001) published the 13-item *Carolina Sport Confidence Inventory* that contains two subscales, namely dispositional optimism and perceived sport competence. Vealey and Chase (2008) are of the opinion that despite shortcomings of existing self-confidence inventories, they can nevertheless be used to evaluate the effect of psychological interventions on the global self-confidence of sportspersons.

The *Peak Performance Profile* instrument provides a practical, economic (few items) and valid way of assessing three important mental factors that effect of peak performance in sport (stress control, concentration and confidence). However, the instrument needs further development. It is especially in the confidence subscale where the inclusion of additional items could improve the usefulness of the questionnaire. The authors plan to make this part of the next phase of the development of the instrument.

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APPENDIX: PEAK PERFORMANCE PROFILE

Information provided by you is **confidential** and will not be given to any person without your permission.

Instructions

Read each statement carefully and then indicate with an "X" how it applies to you when you compete in **important competitions**.

There are no correct or incorrect answers. All you need to do is to consider each statement in terms of your own sport experience.

Please make sure to respond to all the items.

1. CONCEN	I find it difficult to concentrate during important competitions.
2. STRESS	Before important competitions I'm confident that I can handle the pressure.
3. CONFID	I worry about making mistakes in important competitions.
4. CONCEN	When something unexpected happens at important competitions it disrupts my concentration.
5. STRESS	I can control my nerves before important competitions.
6. CONFID	Before important competitions I'm worried that I will not perform well.
7. CONCEN	My thoughts interfere with my performance in important competitions.
8. STRESS	Before important competitions I'm confident that I can meet the challenges.
9. CONFID	I am concerned that other people may be disappointed with my performance in important competitions.
10. CONCEN	Negative remarks by other people (such as spectators or opponents) upset me at important competitions.
11. STRESS	I can handle unexpected stress at important competitions.
12. CONFID	I'm confident that I can remain in control in important competitions.
13. CONCEN	When an important competition is not going well, my concentration is easily disrupted.
14. STRESS	I can effectively block out negative thoughts at important competitions.
15. CONFID	I'm confident that I will perform well in important competitions.

Scoring

Items 2, 5, 8, 11, 12, 14 & 15

Never = 0 *Rarely = 1* *Sometimes = 2* *Often = 3* *Always = 4*

Items 1, 3, 4, 6, 7, 9, 10 & 13

Never = 4 *Rarely = 3* *Sometimes = 2* *Often = 1* *Always = 0*

Calculate subscale scores by summing, divide by the number of items, and multiply by 10. If a respondent fails to tick off an item, merely sum and divide by the items answered.

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