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ORIENTEERS

Psychological characteristics of champion orienteers: should they be considered in
talent identification and development?

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Abstract

A range of cognitive skills that support the development of sport potential have been suggested to be important for athletes and coaches. This study explored performers' psychological characteristics within orienteers. The psychological skills of World Elite orienteers and athletes in the National Junior Squads of both Great Britain and Switzerland were assessed using the six factor Psychological Characteristics of Excellence Questionnaire. Data suggested that, as juniors, elite orienteers reported less support for long-term success than the Swiss juniors, perhaps because of the earlier adoption of self-coaching, but were not significantly different from either junior group on all other Factors. British juniors were not significantly different from the other two groups on any Factor. Follow up qualitative approaches explored possible reasons for the World Elites' early reliance on 'self' rather than 'other', the role of the coach and the self-coaching phenomenon. The role of orienteering in developing these skills is also discussed along with unique psychological challenges faced by high performing orienteers.

Keywords

Orienteering; coaching; talent, psychological characteristics; mental skills

INTRODUCTION

In many sporting and performance-related domains, achieving excellence and elite status is the ultimate goal; talent identification (TI) and its development (TD) is, therefore, an important process. Researchers and practitioners in sport continue to look for methods to identify the best performers of the future and, whilst it is generally accepted that psychological factors are associated with successful sporting performances [1, 2], the role of psychological characteristics have been less prominent in talent identification and development (TID) processes and without consensus for how these characteristics are developed [3]. Support for the consideration of psychological characteristics in TID comes from research that has indicated that performers who initially exhibited desirable physical and technical characteristics often failed to succeed unless they received encouragement, nurturance, training and education [4-8].

When psychological traits such as commitment, motivation, self-belief and competitiveness are developed systematically along with cognitive skills and behaviors such as goal setting, performance planning and evaluation, it has been proposed that they may compensate, in part, for physical or technical limitations [9] and may underpin an athlete's ability to translate 'potential' into elite performance and success [10]. These characteristics have been termed the psychological characteristics for developing excellence (PCDEs) by MacNamara (2011) and are reported to underpin an athlete's

capacity to make the most of his/her abilities and opportunities as well as to cope with challenges and transitions as he/she moves along the development pathway [11-13]

BACKGROUND TO THE STUDY

At the start of the study, the principal investigator was employed by British Orienteering in the role of Talent Development Coach for orienteers in the 16 – 20 year age group. The athletes had been invited onto the Talent and Performance Pathway as part of British Orienteering's Talent Squad (TS) initiative.

In order to better understand the components that make up talent in orienteering, for this age group, and the interventions that may support or accelerate their development, information was gathered from athletes, parents, athlete's personal coaches, and orienteering coaches and managers in similar TID positions within national teams from other countries in Europe.

As part of this information gathering exercise, details of the talent program delivered by the Swiss Orienteering Federation were further explored via email exchanges and visits to Switzerland to observe talent identification sessions. The Swiss Olympic Talent Selection System is held, anecdotally, to be a model of best practice in orienteering. It is referred to as PISTE (prognostic, interactive, systematic coach evaluation), employed by the Swiss Orienteering Federation comprises four focus areas: running speed on the track (3000m); cognitive capability; map reading skill; and behavioral characteristics as well as results in competitions. This system proposes to aid the identification of talent in

athletes who have spent less time training specifically in orienteering. The 3000m time trial measure elements of running fitness and the cognitive tests may indicate an athlete's potential to learn the technical navigational skills. The 'Athletenfragebogen' (Athlete questionnaire) requires coaches to rate, amongst other things, the athlete's attitudes and behaviors. This multiplicative and weighted model allows the variation and diversity of the athlete's value in each component to be taken into account [14, 15]. The results of these tests, along with performances in competition, are tracked over two years to give an indication of an athlete's progression and response to the systematic training they receive in club and regional squads. This enables the Swiss Orienteering Federation to distinguish between an athlete's current performance level and potential for progression [14].

In addition to talent identification discussions with the Swiss team, we had the opportunity to conduct deductive interviews with the coaches for two current world champions, the coach of a world champion from 2010 and the talent and performance program manager for the Swiss Orienteering Federation. The interviews with the coaches probed self-reliance and the deployment of psychological skills. The interview with the program leader explored his thoughts on the impact of the PISTE system on athlete (and coach) development.

AIM OF THE STUDY

This study aimed to compare the psychological characteristics present in elite level orienteers when they were juniors with those identified as talented juniors by British

Orienteering and the Swiss Orienteering Federation. Both the British and Swiss programs aim to support the development of talent so that athletes may reach their full potential and win medals at future senior world championships. However, their methods of identifying emerging talent and selecting athletes to higher squads within their programs differ. Whilst providing a program that supports athletes with their physical, technical and psycho-behavioral development, the British Orienteering Talent and Performance Program has emphasized data from results in competition when selecting athletes into the program and promoting them to higher squads with little regard to psychological characteristic identification or development. The Swiss Orienteering Federation uses the multifarious PISTE system.

METHOD

Participants: 60 orienteers, three coaches and a program manager were recruited to participate. Participants were purposefully sampled from four groups [15]: British Talent Squad, n=20; Swiss international juniors, n=20; World Orienteering Championship (WOC) top ten finishers from 2012 and 2013 and/or ranked top 15 in the world, n=20 [16]; Coaches of world champions, n=3; and a program manager, n=1. Table 1 shows the demographic details of gender and nationality of the athletes included in this study.

Table 1. *Group, gender and nationality of participants in this study.*

| | <i>Talent Squad</i> | <i>Swiss Juniors</i> | <i>World Elite</i> |
|-------------|-------------------------|-------------------------|--|
| Gender | Male = 11 Female = 9 | Male = 11 Female = 9 | Male = 9 Female = 11 |
| Nationality | British = 20 | Swiss = 20 | British = 3 Danish = 2 Finnish = 2 French = 1 Latvian = 1 Norwegian = 3 Swedish = 5 Swiss = 3 |

Measures: Psychological characteristics proposed to be associated with talent identification and development were measured, within the groups of athletes, using MacNamara and Collin’s Psychological Characteristics of Developing Excellence Questionnaire (PCDEQ) [17]. The PCDEQ uses 96 items that have been assessed for reliability, relevance and validity through a combination of expert panel reviews, cognitive interviews and empirical study. The questionnaire is intended for athletes described as aspiring elite aged between 14 and 21 years of age. MacNamara and Collins suggest that coaches and program managers use it as a tool to identify areas that need attention and to inform training programs.

Six Factors of the PCDEQ measure between 5 and 17 items on a six-point Likert scale (1 = 'very unlike me' to 6 – 'very like me'). The six-point scale is deliberate so that there is no 'middle ground' where a participant could remain neutral [17, 18]. There is a mixture of positively (n=48) and negatively (n=12) worded items to prevent acquiescent bias [19]. Table 2 gives sample items from the PCDEQ.

Two Factors (1 and 6) are associated with how coaches or significant others promote and reinforce psychological characteristics. MacNamara and Collins found that the PCDEQ was able to distinguish between good and poor developers with 67% and 75% accuracy in team sports and individual sports respectively.

In order to make the PCDEQ more orienteering-specific, one question was added in Factor 2, regarding the use of imagery. 'I use imagery to correct my technical performance' was added in front of, 'I use imagery to correct my physical performance'. This enabled the athletes to consider how they applied imagery in both areas relevant to orienteering. In addition, the term 'practice' was changed to 'training' as this is more normal vocabulary for the participants in this study.

Interviews with the coaches were recorded using a dictaphone and transcribed verbatim by the lead researcher within 12 hours following the interview. The interview questions were designed to match the Factors in the PCDEQ. Table 3 gives examples of interview questions within each Factor.

Table 2. *Factors and sample items from the PCDEQ.*

| Factor | Sample items |
|--|--|
| Factor 1 Support for long-term success (17 items) | My coach encourages me to seek advice from appropriate others |
| Factor 2 Imagery use during practice and competition (12 items) | I use imagery to correct my physical performance I imagine myself handling the arousal and excitement associated with competition |
| Factor 3 Coping with performance and developmental pressures (11 items) | When I make a mistake I find it difficult to get my focus back on task My coach doesn't push me to overcome difficulties I find it difficult to overcome my feelings of anxiety when I perform |
| Factor 4 Ability to organize and engage in quality practice (7 items) | In practice, I really think about and focus on what I have to do in that session I set myself challenging goals that I have to work hard to achieve |
| Factor 5 Evaluating performances and working on weaknesses (5 items) | I analyze my performances to find out what I did well and what I did badly I consider my weaknesses and work hard on these in practice |
| Factor 6 Support from others to compete to my potential (7 items) | My coach helps me to prepare for the unexpected My coach uses training to build my confidence in my own ability |

Table 3. *Factors and sample questions from coach interviews.*

| Factor | Sample items |
|---|---|
| Factor 1 Support for long-term success | Did you plan a long way ahead? Did you plan together? At what age did he/she start to plan his/her own goals? |
| Factor 2 Imagery use during practice and competition | Did he/she do any armchair ‘geeking’ ^a ? Did he/she have any pre-competition routines? |
| Factor 3 Coping with performance and developmental pressures | What about the pressure? When he/she became the best in the nation, how did he/she handle it? Did he/she ever become nervous and worry about living up to expectations? |
| Factor 4 Ability to organize and engage in quality practice | Did he/she need any help with time management, with knowing how to plan and manage his/her time? Were there training sessions that he/she didn’t like? Did you have to persuade him/her to carry out these sessions? |
| Factor 5 Evaluating performances and working on weaknesses | Was performance analysis a big part? Did he/she spend time analyzing performances? |
| Factor 6 Support from others to compete to my potential | Did he/she practice coping with set-backs? Was consideration given to what he/she would do if things went wrong? Did you have to think of ways to build his/her confidence? |

^a ‘Geeking’ refers to the study of maps that have been used in previous competitions and helps the orienteer to understand the nature of the terrain as well as the style of the course planner. The athlete may try to anticipate where a planner will set control points as well as the start and finish and then plan their route through the anticipated course. This helps to prepare mentally for the race.

Procedures: Before contacting the participants, ethical permission was granted from the University's local research ethics committee and written informed consent was obtained from all participants as well as independent written informed consent from parents of participants under the age of 18. The athletes in the British TS completed a paper copy of the questionnaire at the Junior World Orienteering Championships (n = 12) or at the annual Talent Development Camp (n=8). The athletes in the Swiss National Junior Team completed a paper copy of the questionnaire at the Junior European Cup (n = 7) or at the European Youth Orienteering Championships (n=13). The British athletes and the Swiss athletes completed the questionnaire in quiet, classroom conditions. The World Elite orienteers completed an electronic version of the questionnaire.

The wording for the junior orienteers and the elite were as follows:

Junior: 'Over the next couple of pages there are a series of statements which refer to your participation in orienteering. Please indicate how much of each statement describes what you generally do in your activity right now.'

Elite: 'Over the next couple of pages are a series of statements that refer to your participation when you were a junior orienteer. Please indicate how much of each of the statement describes what you generally did in your activity when you were 16 – 20 years old.'

Coach interviews were conducted face-to-face in the coach's home or work place.

DATA ANALYSIS

Mean scores were compared between the groups (TS, Swiss Juniors, and World Elite) in an attempt to gain insight into whether those who have achieved success at World level demonstrated high levels of PCDEs at junior level and to compare with current junior athletes from Britain and Switzerland. Assumption testing was conducted on the various data sets to check for normality and homogeneity of variance and no violations were noted. As the PCDE Factors are independent characteristics, a one-way ANOVA was used for each Factor to determine any significant difference between the groups with follow-up Tukey HSD *post hoc* tests. The level of statistical significance for all analyses was set to $\alpha = 0.05$. Effect sizes are reported as partial eta squared (η^2_p).

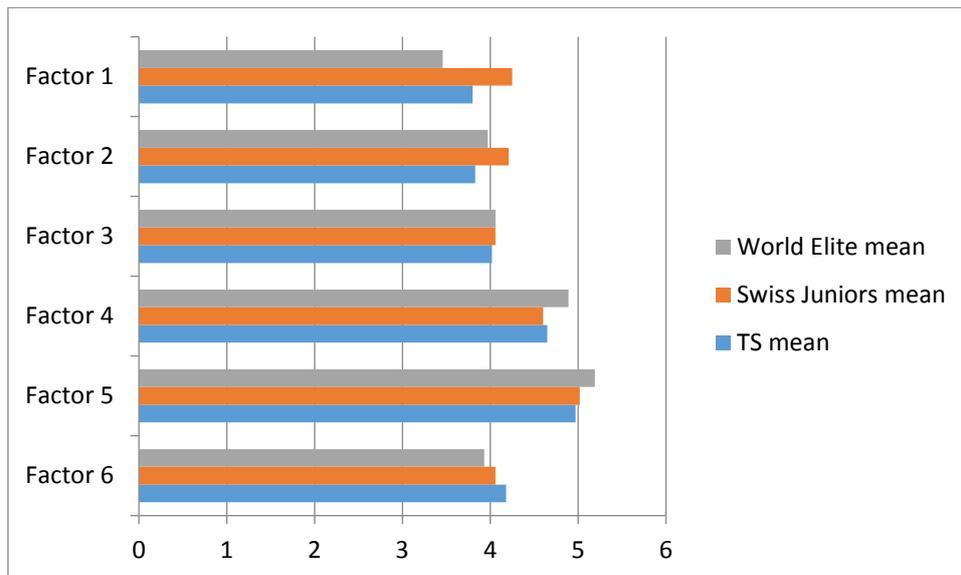
There was a statistically-significant difference between World Elite and the Swiss Juniors for Factor 1 (support for long term success), $F_{(2,57)} = 4.76$, $p=0.012$, $\eta^2_p = 0.32$. There were no significant differences between the groups for any of the other Factors.

Statistical data are presented in Table 4 and Figure 1 shows a bar chart of the group means.

Table 4. Means, standard deviations and probabilities for PCDEQ Factors.

| | <i>TS mean (SD)</i> | <i>Swiss Juniors mean (SD)</i> | <i>World Elite mean (SD)</i> | <i>Probability values</i> |
|----------|---------------------|--------------------------------|------------------------------|---------------------------|
| Factor 1 | 3.80 (1.19) | 4.25 (1.23) | 3.46 (1.09) | P=0.012 |
| Factor 2 | 3.83 (1.20) | 4.21 (1.15) | 3.97 (1.05) | P>0.05 |
| Factor 3 | 4.02 (1.28) | 4.06 (1.39) | 4.06 (1.21) | P>0.05 |
| Factor 4 | 4.65 (1.04) | 4.60 (0.86) | 4.89 (1.03) | P>0.05 |
| Factor 5 | 4.97 (0.79) | 5.02 (0.88) | 5.19 (0.75) | P>0.05 |
| Factor 6 | 4.18 (1.33) | 4.06 (1.21) | 3.93 (1.11) | P>0.05 |

Figure 1. Means for PCDEQ Factors.



A deductive analysis was carried out on the coach interviews using the Factors in the PCDEQ. The qualitative data is explored in the following section and aims to provide a greater richness to the understanding of the findings from the quantitative data.

KEY THEMES AND DISCUSSION POINTS

Support for long-term success: A significant difference was found between the World Elite and the Swiss Juniors for Factor 1 (support for long-term success) with the World Elite reporting lower scores for this Factor. This may reflect the change in the perceived emphasis of agency-related psychological support characteristics from ‘other’ to ‘self’ at an earlier stage for the World Elites’ development. From the coach interviews, it was also apparent that these athletes had moved more towards ‘self’ and away from ‘other’ before they had reached the junior ranks:

Coach 1: ‘when you say “who set the goal?” I think it was herself. She had in her mind that she wanted to improve, to get better, to compete at the international level because at that time she was already very good in Switzerland. She was the best one in her class, in her age and she already had a plan in her head how she would develop.’

Coach 2: ‘We make an analysis of the past year and then we set the goals together, not I, he has so we are discussing and he has them set for next year and not only the goals for world champs but technical-wise, physical-wise and mental.’

Communications received from participants, however, suggest that some of the World Elite did not have access to the coaching opportunities that the Swiss Juniors had when they were in the junior age group. Low scores from the World Elite may reflect the lack of coaching they received. There was not a request for comments on the questionnaire but some of the World Elite volunteered them:

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Athlete 1: 'I don't have a coach and rarely have had one that has put me in situations that it describes.'

Athlete 2 'I haven't had any coach in that meaning the questions are put. It was my own motivation that was crucial.'

Athlete 3: 'I actually didn't have a coach, who could have learned me a lot. My father started orienteering as a hobby in the age of 30 and was developing his skills together with me. For us it was always important to enjoy training and having mental development. For me it was important to challenge myself to reach the top-level goals. I was very keen to train hard already by the age of 13. My father just had to stop me sometimes'

Athlete 4: 'There was just one thing I wanted to remark. The work with my coach was not too close when I was 16-20 years. I always did most of my planning/analysis by myself. He was more for general coaching and advice. We usually sat together intensively 3-4 times a year and talked maybe once every second week.'

These responses suggest that the World Elite were further along the continuum from 'other' to 'self' when they reached the junior age group and seemed to have less direct coaching support although there was some evidence for 'support for long term success' from parents in the background. It is unclear how they developed this greater independence or whether it was through design (encouraged by the coach or parent) or by necessity (because there was no coach).

The PISTE system, used by the Swiss Orienteering Federation, requires each athlete's coach to complete the Athletenfragebogen. The coach rates the athlete in: performance related motivation; focus and determination; technical and mental abilities; mental training; training efficiency; resilience; and environment. According to the program manager, the Swiss coaches' awareness of internal, abstract and implicit cognitions and attitudes appears to have been raised since the introduction of the Athletenfragebogen in 2012. Since this time, there is also evidence that the coach-athlete relationship has also been enhanced, as the requirement for coaches to reflect on athletes' strengths and weaknesses has encouraged a deeper, shared understanding of the individuals they are working with. This positive development allows the Swiss Orienteering Federation to promote their philosophy of talent identification and development and raise awareness of Factors they believe should be addressed by coaches [20]. It would be interesting to explore further whether this contributed to the higher mean score for the Swiss Juniors in Factor 1, than for the World Elite or TS. It may be that this greater awareness and understanding has resulted in the coaches dedicating more time and effort to developing performance-focused attitudes and behaviors in their athletes.

Although not significantly different to the World Elite or Swiss Juniors, the TS athletes' results for Factor 1 were nearer to those of the World Elite. In a similar way to the World Elite, many of the TS athletes reported that they did not have a personal coach with whom they had regular contact. Some of these athletes also chose to write comments

that may indicate independent deployment of psychological skills, on their questionnaires:

Athlete 1: 'In my case, a coach gives me physical training advice and that's mostly it, so on sections about the coach helping psychologically I put "very unlike me" but that is because it is not his job, not just that he isn't doing it.'

Athlete 2: 'I think that when referring to a coach's input it is difficult to answer fully if you are not in physical contact with your coach on a weekly basis, i.e., not part of your training group/doesn't live near to you. I believe that this is a key part to the development of an orienteer, to be able to perform/train without constant input from your coach, to aid your mental development through not having to have a constant reliance on this person.'

The self-coaching phenomena: Several athletes in the World Elite group and the TS declared that they were either self-coached or did not have regular coaching input. The self-coaching phenomena is, therefore, worthy of further consideration. There appears to be a lack of literature that examines self-coaching in sport although there are some famous examples of self-taught musicians and parallels may be drawn from the development of expertise in music and applied to sport [21]. For example, it has been suggested that there were six Factors that supported Louis Armstrong's development of expertise: immersion in a rich, musical environment; early systematic exploration of a performance medium; freedom to explore and experiment without negative consequences; a lack of distinction

between ‘practice’ and ‘performance’ (developing and learning whilst working); enduring internal and external motivation and a graded series of opportunities and challenges [22]. These Factors could be argued to cross domains and provide a starting point to investigate the development of expertise in non-coached athletes in sports such as orienteering. Many athletes are immersed directly into the sport via family interest and regular orienteering opportunities are available for athletes to test themselves on graded courses as and when they feel curious to experiment and explore. It could be argued that the sport of orienteering lends itself to independent learning and practice since training can take place without others as indeed can competition. Athletes normally run the course independently and test themselves with immediate knowledge of terrain and navigational demands. Testing against others is a secondary knowledge of overall performance and the actions of other competitors rarely affect an individual’s results.

Further research that determines whether enforced independence helped the World Elite to become successful along with studies that track how each TS athlete and Swiss Junior develops PCDEs with or without close input from coaches could provide coaches and program managers with a greater understanding of how and when to intervene in order to develop PCDEs and their independent deployment.

The coaching environment: Apart from the significant difference between the World Elite and the Swiss Juniors, in Factor 1, there were no significant differences between the groups. However, it may be worth considering the data for Factor 6 (support from others

to compete to my potential). There were two low scores of 2.57 in the TS and, within the Swiss Juniors, there was one low score of 2.57 and one high score of 5.14. This Factor, like Factor 1, considered the support received from others. The questions refer to how ‘significant others’ help the athlete to cope with developmental demands and to stay focused, reflecting the level and type of support in the Talent Development Environment (TDE) for each athlete.

The wide range of responses, for Factor 6, suggest that different levels of support were present within the groups. It could be that some athletes had developed personal strategies in, for example, maintaining focus and coping with pressure whereas others still required input to this area. Sessions and workshops to support athletes in developing their organizational skills, pre and in-competition routines, ability to use self-talk and other mental strategies are provided for athletes in both the TS and the Swiss Junior Squad but there may be variation in the delivery of these sessions as well as reinforcement, to a greater or lesser extent, from personal coaches or ‘significant others’.

Coach 1 explained how his athlete used action-focused coping strategies during competition [25]: ‘[she had] a concept to react very quickly so that’s a moment and there is a red lamp and I have to do that, that, that. She had to practice that in training and she reached a high level in doing that and in reacting very quickly.’

Coach 2 spoke of instilling the importance of a pre-competition routine: ‘They have fast training in the national team and then you have to prepare like a big

competition. You have to warm up and then four minutes before the start it is always the same procedure...They have to write down what they want to do and it should be not more than one page.’

Does orienteering support the development of psychological skill? The Factors are deemed to be independent from each other, however, all groups scored higher in Factors 4 and 5 than the other Factors. Factor 4 measured athletes in their ability to organize and engage in quality practice. The questions that explore this Factor probe concentration and commitment. It has been suggested by Eccles and Arsal (2015) that the demands of orienteering, to maintain concentration and pay attention to detail, has facilitated the development of advanced cognitive and behavioral strategies [23]. This could perhaps go some way to explaining why the orienteers, in this study, produced high scores in this area as technical orienteering training, by its very nature, demands high levels of technical concentration and commitment.

Factor 5 measured the athlete’s ability to evaluate performance and the willingness to work on weaknesses. Again, it would be interesting for future research to consider whether orienteers develop this skill to a higher level than others. High level orienteering is somewhat dependent on the ability to deploy a number of skills over several ‘legs’ (or sections) of a course and requires task-oriented practice followed by evaluation of how each ‘leg’ was run and assessment of the effectiveness of the skills

chosen, thereby lending itself to a process driven approach. The coach interviews exposed deliberate teaching of this Factor.

Coach 3 explained how he taught his athlete to evaluate performance: ‘I have a special sheet. ... We have discussion at the end why do you use this why and not the other one and it’s of the runners to justify to explain why they choose this ... putting the maps on the wall and discussing about route choice, analyzing split times. Of nearly 10 years we did this kind of training.’

It should be noted, however, that Factor 5 only comprised five items and had the lowest loading of all Factors. Future work is needed before it could be argued that orienteering, more so than other sports, enhances the capacity for organizing and engaging in quality practice and effective evaluation of performance.

Limitations of the PCDEQ for orienteering: Although MacNamara and Collins conclude that the PCDEQ is sufficiently sensitive to discriminate between good and poor developers in team and individual sports, data from this study suggests that may not be sufficiently sensitive to some of the more psychological challenges faced by orienteers. The cognitive demands for navigation of high performance orienteering set alongside the athlete’s need for a high level of running skill and fitness are unlike most team and individual sports. When psychomotor fatigue and competitive stress is added into the mix, high level orienteering becomes the most unique of sports [24].

Distraction control is important to orienteering. Attention has to switch between map and environment whilst, often, in a highly fatigued state. Eccles and colleagues have highlighted this challenge facing orienteers, suggesting that they have to simultaneously pay attention to the map, ground and travel but with limited attentional resources [25-28]. Task-irrelevant distractions, such as seeing another competitor or hearing the commentary from the arena may increase the likelihood of a technical mistake. Further, if an athlete realizes a mistake or is distracted, refocusing is required. This specificity of attentional control and coping with distractions is suggested in Factor 5 of the PCDE questionnaire but not proposed in the details that may be required as an explicit psychological skill for orienteers.

Coach 2 commented on his athlete's ability to refocus but warned that this skill can also be a disadvantage and felt that his athlete had, at times, become too complacent about making mistakes because he was confident in his refocusing ability after the mistake, 'Yes, all the time [he could refocus quickly] and maybe this is an advantage but also disadvantage. When you know I will find very quick back you rely on this. Then you have the other problem you make too many [mistakes] and you make maybe three or four mistakes: 30 seconds, two minutes and this is also four minutes for a competition. It's like a big one!'

Although it is included in Factors 2 and 3, coping with setbacks is not addressed comprehensively within the PCDEQ. The evidence from this study suggests that,

certainly for orienteering, it could be an additional Factor. Technical mistakes in competition are common in orienteering, especially at the Talent level when juniors are still in the developmental stage. The emotional response to mistakes and early, unexpected success requires management from the athlete and coach and skillful use of coping and preparation strategies; the young elite orienteer needs coping skills for both poor and good performances [29].

Coach 3 spoke of his athlete's reaction to poor performances, 'When he got bad results inside him it gives him a new strength. It's very strange. New strengths. He doesn't suffer bad results. [He asked himself] what is the reason because I did this kind of error and very often after mistake in the forest, after the competition, he go back to the place when he can do it. We went back to the place where he did mistakes and he tried to understand why he has badly read the map.' This example describes how an athlete can use a negative outcome positively for future performances. Coach 3 went on to describe the athlete as a 'fighter' and said 'He's a warrior. He enjoyed to have pressure, to have objective, goals and result goals. Even when he was very young he enjoyed this kind of pressure.' This example demonstrates how competitive stress, typically reported as a negative emotion, can be interpreted as 'challenge' and facilitates performance [29]. An ability to react to mistakes in a positive way and to learn from them is a skill that is likely to enhance an orienteer's pathway to excellence.

An orienteering-specific version of the PCDEQ may provide helpful insights into how specific skills and behaviors underpin the development of talent over the long-term. A modified version would need to be sensitive to the unique cognitive processes required for high performance orienteering. Within the modified Factors, items that probe the high-pressure decision-making skills required during high-fatigue situations may need to be added. Other additional Factors that address the development of visual-cognitive skills, coping strategies and learning from mistakes may also contribute to a more valid PCDEQ for orienteers.

LIMITATIONS OF THE STUDY

This was the first study of its kind to explore the psychological characteristics of developing excellence within orienteering. As a preliminary study, however, there were a number of limitations. 60 athletes were recruited for this study. Although the majority of the World Elite orienteers agreed to take part and this number was matched for the TS and Swiss Juniors, it meant there were only 20 in each group. This created a problem in achieving statistical power from the questionnaire data and the possibility of making a number of type two errors. The low numbers also limit the extent to which generalizations can be made. However, the population base of elite orienteers is limited and this study was able to access the majority of that population both within the UK and across Europe.

Within the World Elite, only three athletes were from the UK and, although all of the athletes appeared to have good comprehension of written English, it was uncertain

whether the questions were understood fully and answered accurately in the way in which the PCDEQ authors originally planned. Likewise, the Swiss Juniors' understanding of English was limited and this may have influenced responses on the PCDEQ. For example, two Swiss Juniors questioned the meaning of question 31 'My coach helps me to prepare for the unexpected'. One declined to answer the question and the other scored it at 2. These participants declared their confusion but there may have been others who did not comment. Therefore, it cannot be guaranteed that the response options on the scale were interpreted correctly skewing the responses on the Likert scale. In cases of confusion as to the meaning of a question, participants may have chosen a 'safe' middle response and this may have caused a regression to the mean and, again, the risk of a type two error. Whilst the PCDEQ has been validated for use in Great Britain, it may not be as rigorous for other countries or cultures. A follow-up system using self-generated terms of idiosyncratic experiences to probe the understanding of the items and instructions as well as the relevance of item content could uncover further findings, providing a more robust understanding of the subject.[29]. Alternatively, interviews could be used that allow both the participant and the investigator to make any uncertainties explicit. These may be carried out with the support of a translator albeit with the effects of using a translator taken into account [30].

Another important limitation in this study was the variation of conditions in which the questionnaire was completed. The TS and Swiss Juniors were supervised whilst

completing the questionnaire at a competition venue and in quiet conditions. In contrast, the World Elite completed the questionnaire in their own time at home. The TS athletes were supervised by one of the researchers and, although the questionnaires were completed anonymously, there may have been a realization that the researcher could link an athlete with a questionnaire through recognition of writing or otherwise. There was, therefore, the possibility of social distortion linked to Talent Squad selection. In order to obtain sufficient numbers in each group, the social distortion limitation was unavoidable in the current study.

The World Elite were asked to answer the questions by recalling their attitudes and feelings as a junior. One athlete described the difficulty in doing this:

Athlete 1: 'I tried to remind me, how was I like in the age of 20. Because, I've been so long into my orienteering performance, it's difficult to see the weaknesses and strengths I used to have in that age. Anyway, I think I found the right direction.'

The validity of this study may have been compromised by junior athletes answering the questions based on how they are right now whilst the elites had to recall how they were as a junior. To gain a full understanding of each group's level of PCDEs, as juniors, further research is required and this may be more accurate using self-generated terms or through qualitative research techniques, such as interviews, that addresses language barrier, [30, 31].

SUMMARY AND RECOMMENDATIONS

The current identification measures used in Great Britain are based on criteria designed to identify current performance at discrete times, rather than potential for development. There is little emphasis on the importance of psychological characteristics. The PCDEQ is an important advancement in the TID literature and highlights the need to consider psycho-behavioral characteristics over key developmental stages of an athlete's life. It is likely that the current approach has led to some talented orienteers in Great Britain not to be discovered or be developed effectively. This research suggests that selection processes should consider psychological attitudes and behaviors, recognize an athlete's position on the agency training spectrum from 'other' to 'self' and consider standards of performance in competition, all with a longitudinal element.

This study has highlighted the notion of self-coaching although it is not clear whether it is helpful or detrimental to an athlete's development pathway and is therefore worthy of further investigation; it is possible that psychological characteristics are enhanced through enforced self-reliance. More understanding of this concept may guide coaches and managers to optimize the Talent Development Environment and provide their athletes with an enhanced coaching system. This paper also highlights the need to develop the psychological demands that impact particularly on orienteers including decision making under fatigue and refocusing after mistakes.

Acknowledgements

The authors would like to thank Dr. Roger Scrutton of the University of Edinburgh for his guidance and feedback on the refinement of the paper.

References

1. Durand–Bush N and Salmela JH. The development and maintenance of expert athletic performance: perceptions of world and Olympic champions. *Journal of Applied Sport Psychology* 2002; 14: 154 –171.
2. Orlick T and Partington J. Mental links to excellence. *The Sport Psychologist* 1988, 2: 105 - 130.
3. MacNamara Á, Button A and Collins D. The role of psychological characteristics in facilitating the pathway to elite performance part 1: identifying mental skills and behaviours. *The Sport Psychologist* 2010; 24: 52 - 73.
4. Bloom BS. *Developing talent in young people*. New York: Ballantine Books, 1985.
5. Côté J. The Influence of the Family in the Development of Talent in Sport. *The Sport Psychologist* 1999; 13: 395-417.
6. Feldman DH and Goldsmith L. *Nature's gambit: child prodigies and the development of human potential*. New York: Teachers College Press, 1986.
7. Freeman J. Families, the essential context for gifts and talents. In *International Handbook of Research and Development of Giftedness and Talent*. Edited by Heller KA, Monks FJ, Sternberg R and Subotnik R. Oxford: Pergamon Press, 2000, pp. 573 - 585.
8. Kay T. Sporting excellence: a family affair? *European Physical Educational Review* 2000; 6 (2): 151 - 169.
9. Ceci SJ, Barnett SM and Kanaya T. Developing childhood proclivities into adult competencies: The overlooked multiplier effect. In: *The psychology of abilities, competencies and expertise*. Edited by Sternberg RJ and Grigorenko EL. Cambridge, UK: Cambridge University Press, 2003, 126 - 158.
10. MacNamara Á, Button A and Collins D. The role of psychological characteristics in facilitating the pathway to elite performance. Part 2: Examining environmental and stage related differences in skills and behaviours. *The Sport Psychologist* 2010; 24: 74 - 96.

11. MacNamara Á, Holmes P and Collins D. Negotiating transitions in musical development: The role of psychological characteristics of developing excellence. *Psychology of music* 2008; 36: 335 - 352.
12. MacNamara Á. Psychological characteristics of developing excellence. In *Performance Psychology*. Edited by Collins D, Richards H and Button A. Kidlington, UK: Elsevier, 2011, pp. 47 - 64.
13. Sarkar MDF. Psychological resilience in sport performers: a review of stressors and protective factors. *Journal of Sports Sciences* 2014; 32 (15): 1419 - 1434.
14. Simonton DK. Talent development as a multidimensional, multiplicative, and dynamic process. *Current Directions in Psychological Science* 2001; 10 (2): 39 - 43.
15. Patton MQ. *Qualitative evaluation methods*. New York: Sage publications; 1990.
16. World of O Ranking [<http://runners.worldofo.com/rankingm.html>]
17. MacNamara Á and Collins D. Development and initial validation of the Psychological Characteristics of Developing Excellence Questionnaire. *Journal of Sports Sciences* 2011; 29 (12): 1273-1286.
18. Chang L. A psychometric evaluation of 4-point and 6-point Likert-type scales in relation to reliability and validity. *Applied Psychological Measurement* 1994; 18: 205 - 216.
19. MacNamara Á and Collins D. Do mental skills make champions? Examining the discriminant function of the Psychological Characteristics of Developing Excellence Questionnaire. *Journal of Sports Sciences* 2013; 31 (7): 736 - 744.
20. Pankhurst A, Collins D and MacNamara Á. Talent development: linking the stakeholders to the process. *Journal of Sports Sciences* 2013; 31 (4): 370 - 380.
21. Collier JL. *Louis Armstrong: An American Genius*. Oxford: Oxford University Press, 1983.
22. Ericsson KA and Smith J. *Toward a General Theory of Expertise: Prospects and limits*. Cambridge: Cambridge University Press, 1991.

23. Eccles DW and Aarsal G. How do they make it look so easy? The expert orienteer's cognitive advantage. *Journal of Sports Sciences* 2015; 33 (6): 609 - 615.
24. Seiler R. Cognitive processes in orienteering: a review. *Scientific Journal of Orienteering* 1996; 122: 50 - 65.
25. Eccles DW, Walsh SE and Ingledew DK. A grounded theory of expert cognition in orienteering. *Journal of Sport & Exercise Psychology* 2002; 24: 68 - 88.
26. Eccles DW, Walsh SE and Ingledew DK. The use of heuristics during route planning by expert and novice orienteers. *Journal of Sports Sciences* 2002; 20: 327 - 337.
27. Eccles DW. Thinking outside the box: The role of environmental adaptation in the acquisition of skilled and expert performance. *Journal of Sports Sciences* 2006; 24: 1103 - 1114.
28. Macquet AC, Eccles DW and Barraux E. What makes an orienteer an expert? A case study of a highly elite orienteer's concerns in the course of competition. *Journal of Sports Sciences* 2012; 30: 91 - 99.
29. Hanin YL. Emotions in Sport: Current Issues and Perspectives. In *Handbook of Sport Psychology*. 3rd ed. Edited by Tenenbaum G and Eklund RC. Hoboken, New Jersey: John Wiley & Sons, Inc. 2007, pp. 31 - 58.
30. Squires A. Methodological challenges in cross-language qualitative research: A research review. *International Journal of Nursing Studies* 2009; 46 (2): 277 - 287.
31. Côté J, Ericsson KA and Law MP. Tracing the Development of Athletes Using Retrospective Interview Methods: A Proposed Interview and Validation Procedure for Reported Information. *Journal of Applied Sport Psychology* 2005; 17 (1): 1-19.