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Research article

Why do they engage in such hard programs? The search for excellence in youth basketball

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Abstract
Excellent performance in sport has a strong positive relationship with the accumulated hours of practice. The specialization years are seen as a decisive moment to lift the skill level, athletic readiness and commitment but the selection and orientation of talent has been strongly dependent of biological and motor variables. The purpose of this study is to describe the achievement and motivation variables that can explain the belonging to an elite competitive level of young basketball players. Eighty-two basketball players under 16 years fulfilled the WOFO Questionnaire (Spence and Helmreich, 1983), and an adapted version of the DPMQ (De Bruin, Rikers and Schmidt, 2007). Forty players (mean age 15.8 ± 0.96) were engaged in high performance centres and forty-two (mean age 15.6 ± 1.01) played in national level clubs. A decision tree and a random forest analysis between elite and national level players were performed. The most discriminant variable was Will to Excel, with 85,2% true positives in elite or national level. Mastery and competitiveness did not enter the final model. The will to reach excellence in performance can be considered as a condition to engage in more specialized and demanding practice. The assessment of the path to expertise only through motor variables or through the accumulated hours of deliberate practice is limited and can lead to mistaken identification or orientation of young sport talents. The use of a more comprehensive model is needed.

Key words: Youth, talent specialization, motivation, expertise.

Introduction

Excellent performance in sport has a strong positive relationship with the accumulated number of hours of practice, and the specialization years are seen as a decisive moment to lift an athlete's skill level, readiness and commitment (De Bruin et al., 2007; Gonçalves et al., 2009). The assumption behind the argument is that experts are always made, not born (Ericsson et al., 2007). This theory translated to the youth sport domain means that if an athlete wants to be a real high level performer, he/she needs a deliberate engagement in practice during the specialization years, spending time wisely and always focusing on tasks that challenge the current performance.

The Deliberate Practice model raises an important issue to sport pedagogy because it led the sport organizations responsible for the development of young sport talents to increase the amount of hours spent in organized practice, under the supervision of specialized coaches at increasingly lower ages. It seems reasonable that if the young athletes are better selected, have better training conditions and practice and compete more time with better teammates and opponents, the chance of becoming competent adult athletes is greater. The 10.000 hours rule and the Long Term Athlete Development model (Bályi and Williams 2009; Ericsson et al., 2007) express this perspective, proposing a training volume sequentially balanced through more or less 10 years of sport specialization. In addition, Chi (2006) argues that the road to expertise means that efforts must be consistent focused on weaknesses improvement and produce successful outcomes (winning the competitions).

Trying to adjust to the Deliberate Practice model many sport organizations in several countries around the world created specialized training centres where selected young talents practice under the supervision of experienced coaches in order to become professional athletes and integrate youth national teams. In team sports this process has been adopted by professional clubs or national sports associations, and starts usually at around 14 years of age. In most cases, a part or all the youngsters live, go to school and practice at the training campus, isolated from the families and native environments. This choice towards an elite restricted group at early ages raises the problem of talent identification and selection. The concept of readiness, associated with growth and maturation (Malina et al., 2004) underlines the risks associated with high training loads and the complexity of decision making about future performances of immature individuals. To recruit adolescents or pre-adolescents to join a demanding training program in a full commitment basis is a complex task that should be well scientifically grounded, in order to prevent errors in prognosis. Approaching this critical issue, Helsen et al. (2000), or Elferink-Gemser et al. (2007) argued that the selection and orientation of talent has been strongly dependent on biological and motor variables, although these variables are not able to fully differentiate athletes by competitive levels.

It is believed that in order to engage in a demanding schedule of year-long practice, individuals have to be highly motivated. Moreover, most research pointed out that an orientation for mastery achievement is critical for overcoming challenging motor tasks (Duda, 2001; Roberts, 2001), and a competitive, ego achievement orientation has been described as a deterrent factor for enjoyment in practice and will to continue activity (Sarrazin and Guillet, 2001; Sage and Kavussanu, 2007).

However, the pursuit of expertise in sport means that progress in performance must be constantly evaluated and the most efficient kind of evaluation is competition,

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with its wins-losses record. If practice is oriented to improve performance, it is reasonable to expect that athletes show a strong interest in competitive outcomes and see victory as an important moment of the process. Gould, Dieffenbach and Moffett (2002), in a study with Olympic champions found that they are very competitive and self-confident. Harwood et al., (2004) in a study with young performers showed that they express a high task-/ego-orientation, and argue that elite athletes cope better with competitive stress when their achievement orientations are both high.

The concept of elite young athletes has not been clearly defined. McArdle and Duda (2004) considered elite those who participate in competitions in national championships. Elferink-Gemser et al., (2004) considered as talented field hockey players those who participate in the national youth teams programs, a decision that fits with a definition of elite as a restricted group of gifted individuals. In this study we consider as elite those players selected by the national Basketball Association to live and practice in high performance centres and play for the national teams in European competitions.

Hence, the decision to engage in such programs should be founded on a clear orientation towards competitive success and on a strong will to become an expert player, ready to practice at the standards of volume and intensity required by excellent performance. Although the athletes are first of all adolescents, the characteristics we expect to discriminate elite players from their peers playing at a lower level are achievement orientations and the will to become experts through deliberate practice. We argue that it would be useful for coaches and families who carry the responsibility of choice and lead the young performers to have better information about important non biological variables when making decisions that can influence all the youngsters' life.

The Work and Family Orientation Questionnaire (WOFO; Spence and Helmreich, 1983) assesses general achievement orientations, independent of task or context. The instrument contains four sub-scales: work (the desire to practice and perform well), mastery (the desire to face challenging tasks), competitiveness (the desire to be better when compared to others), and personal unconcern (lack of concern with others' opinions). The reliability of the WOFO questionnaire has been tested in sports (Gill, 1988). According to De Bruin et al. (2007), the personal unconcern scale has little value in achievement research, and only the other three scales were used in the study. In this work we hypothesized that mastery, work and competitiveness contribute to predict the belonging to the elite or local level.

Besides dispositional general achievement orientations, our purpose was to assess the situational specific circumstances that could motivate the youngsters to engage in deliberate practice in high performance centres. De Bruin et al. (2007), in a study with young chess players, argue that to stay focused on a task for long periods of time, besides achievement orientation, specific motivation for a specific sport is determinant. The same authors designed an instrument, called Deliberate Practice Motivation Questionnaire (DPMQ), to assess the individuals' will to become an excellent performer and to improve in competition. Although in team sports there is no objective measure of the evolution of performance of a single player, the theoretical framework of deliberate practice is useful to the same purposes with basketball young elite athletes. Therefore we adapted the DPMQ to Basketball both to long time goals ("I want to be a professional Basketball player"), and to specific changing situations of this sport ("I like tough drills in practice because they help me to improve my skills" or "I prefer to play 3 on 3 with friends rather than practicing hard").

The relation between the achievement variables as assessed by WOFO and the motivational variables measured by the adapted DPMQ allowed us to suggest a model that clarifies the belonging and continuity to elite or local level groups. For this task we used paired athlete/outcome data to build a Decision Tree, a well known support tool for classification problems (Breiman et al., 1984). Decision Trees belong to the class of nonparametric, nonlinear, exploratory supervised learning algorithms which also include neural networks and support vector machines and can be used to make predictions on data, given that a training dataset for which the true outcomes are known is available. Decision Trees are however particularly well for our purpose given that besides being able to classify athletes into categories, they are also easily interpretable and provide information on the relative importance of each input variable to the final predicted classifications, something that cannot be straightforwardly found with neural networks and support vector machines. Furthermore, decision tree algorithms have the advantage of being able to handle mixed types of variables, being robust to outliers and being robust to irrelevant inputs.

The first purpose of this study is to describe the achievement and motivation variables that can explain the belonging to an elite competitive level of young basketball players. The second goal is to suggest an explanatory model able to predict the engagement in deliberate practice.

Methods

Participants

Eighty-two male basketball players under 16 years participated in the study. Forty players (mean age 15.8±0.96) were engaged in high performance centres of the Portuguese National Basketball Association, and forty-two players (mean age 15.6 ± 1.01) played in national level clubs. The previous average number of years of experience in Basketball was similar for both groups (5.3 years for elite players and 6.1 for the local players). The number of hours of practice and the number of games played were also collected for both groups.

Measures

The Work and Family Orientation Questionnaire/WOFO (Spence and Helmreich, 1983) has 19 items and assesses four dimensions of achievement: personal unconcern, work, mastery and competitiveness. In this study only the last three subscales were used and each questionnaire item is rated in a 5-point Likert scale (1=completely disagree, 5=completely agree).

The second instrument was an adapted version for

Basketball of the Deliberate Practice Motivation Questionnaire/DPMQ, originally designed for chess by De Bruin et al. (2007). The DMPQ assesses two dimensions of deliberate practice: will to compete and will to excel. The 18 items were rated in a 1-5 Likert scale (1 =c ompletely disagree, 5 = completely agree).

Procedures

The researchers got in contact with the national Basketball association and with the secretariats and coaches of community clubs. All contacted institutions agreed to take part in the study and convenient meeting dates were then arranged. All athletes received consent forms to be filled in by their parents or guardians. To none of the athletes permission was denied to participate in the study. A two-section questionnaire was distributed by the main researchers before a normal practice in a sport facility. The visits to the national centres and to the clubs took place in the first week of the season. At all meetings, instructions on how to fill in the questionnaire were provided and it was emphasised that responses would be kept confidential to stimulate respondents to answer as honestly and spontaneously as possible. It was stressed that there were no right or wrong answers. The questionnaires required approximately 20 minutes to be completed.

Data analysis

To assess the reliability and internal validity of the Deliberate Practice Motivation Questionnaire two-factor structure, exploratory factor analysis was performed. The correlations between the three subscales of the WOFO and the two subscales of DPMQ were calculated.

To test the hypothesis of a model approaching the relationships between the achievement orientations measure, the deliberate practice motivation measure and belonging to the elite or local level, we built a decision tree which allowed us to find which variables best explain the elite outcome, i.e. to predict or explain the outcome of the elite/local dependent variable from the measurements on one or more predictor variables.

Intrinsic to the concept of a supervised learning algorithm is the problem of over-fitting of the model to the training data and sensitivity to noise. To overcome these issues we chose to use random forests which perform cross-validation using “Out of Bag” data. Random forests have among other advantages, accuracy comparable with modern machine learning methods such as neural networks and are also able to estimate the importance of variables in determining classification. A random forest is a collection of hundreds of decision trees which together create an ensemble model in which all the trees vote and the result is taken from the majority. Manifestly random forests are less sensitive to noise in the training dataset than a single decision tree would be. The decision tree and the subsequent random forest were obtained with the "rpart" package, available as a package in the R statistical language (Breiman et al., 1984).

Results

The mean number of hours of practice per year is similar for both groups: 250 hours for elite players and 239 hours for local ones. The main difference in activity volume and training patterns is the number of games: 22.3 for local teams and 70.1 for elite players.

The structure of the DPMQ was explored through exploratory factor analysis. Two factors were identified. The first factor, with 13 items, showed an eigenvalue of 7.35 and explained 29.30 % of the variance. The second factor, with five items primarily loaded, had an eigenvalue of 1.83 and explained 14.46 % of the variance. The first factor measured the “will to excel” in basketball (“I want to become a professional basketball player”, or “I need to practice basketball every day”). The second factor focused on “winning” the games (“When I play a basketball game, winning is everything”). The reliability of the two factors was acceptable. For the factor Will to Excel , Cronbach’s alpha was 0.73 and for the factor Winning, Cronbach´s alpha was 0.72.

The correlations between the subscales of DPMQ and WOFO are shown in Table 1, some of them appearing moderately high and with statistical significance. The relations between Will to Excel, Winning and Competitiveness made plausible that these three variables, linked to an orientation towards competitive success could discriminate the young players by elite or local level. On the other hand, due to the importance of achievement orientation to engage and persist in sport, the relation between the Mastery and Work variables allowed us to suggest a new model to discriminate between the two groups of basketball players.

Table 1. Correlation between the WOFO and DPMQ factors.

	WN	WE	CO	M	WR
Winning (WN)	-	.479**	.054	.208	.206
Will to excel (WE)		-	.278*	.067	.204
Competiv. (CO)			-	.252*	.237*
Mastery (M)				-	.523**
Work (WR)			.		-

* $p \leq 0.05$, ** $p \leq 0.01$

To test the hypothesis, a decision tree was built using the subscales Will to Excel, Winning, Competitiveness, Mastery and Work as independent variables and the belonging to the local or elite level as the target variable. Decision trees are automatically built by splitting the source set, also known as root, into subsets or nodes based on an attribute value test and repeating this process recursively on each of the derived subsets. This process, called recursive partitioning, ends when either all items in a subset have the same value as the target variable (belonging to the elite or not), or when splitting provides no more information gain. At each step the algorithm chooses the variable with the highest information gain which best separates the data into homogeneous subsets with the same value of the target variable.

A Decision Tree obtained by using the complete dataset as the training set is represented in Figure 1 with the root at the top, branching into several nodes, and the leaves at the bottom. Associated with each non-leaf node is a test which indicates which branch to follow.

The nodes are labelled with coloured numbers (3,4,10,11) to help navigate the tree. At the root we have Will to Excel as the variable that was found to best

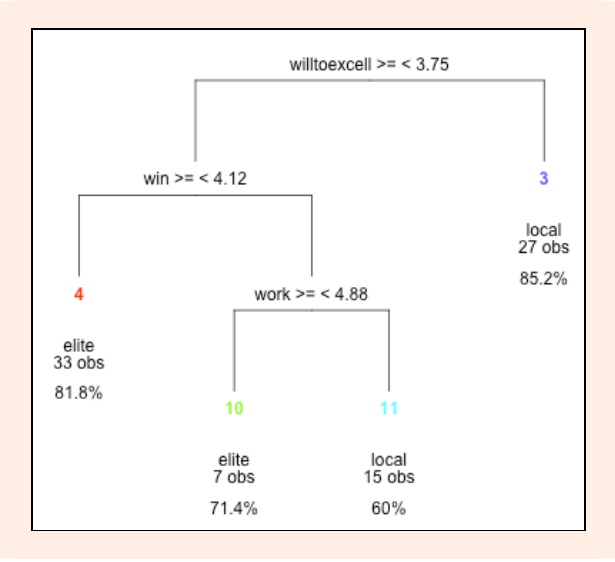

Figure 1. Decision tree obtained from the WOFO and DPMQ factors.

separate the data in the 1st instance. Athletes with a will to excel score >= to 3.75 follow the left branch of the tree and the ones with a score < 3.57 follow the right branch. Those 27 athletes with low will to excel that followed the right branch all were classified by the tree to be local. While 23 were truly local, 4 were classified as local although they truly belong to the elite and so, for that particular decision the tree made the correct prediction for 85.2% of the cases. The next branch is represented by Winning that accounts for 81.8% of the belonging to the elite level. The final branch of the tree shows the variable Work explaining 71.4% of the belonging to the elite level group and 60% of the local level group. No other explanatory variables are considered by the decision tree algorithm.

In addition to the tree depicted we confirmed our results using a random forest.

Figure 2 depicts two importance scores, Mean Decrease Accuracy and Mean Decrease Gini, given to the variables by the algorithm. The Gini index is one the most well known indices to measure the degree of impurity and indicates the predictive accuracy of the model. These two measurements agree with each other in ranking Will to Excel, Winning, Mastery, Competitiveness, and Work in decreasing order of importance, consistent with the results of the single decision tree for which the rank was Will to Excel, Winning, and Work. In both types of analysis, the competition-related variables play the main role to discriminate the athletes by level. The task orientations, like Mastery or Work discriminate the players in a much lower percentage.

Discussion

The similarity in number of practise sessions and total amount of hours of practice between the two groups is somewhat surprising. The main goal of the national performance centres is to increase of the quantity and quality of the training volume, based on the belief that the adolescence stage represents the decisive moment to lift the skill level and athletic readiness to reach expertise. In contrast the number of games is very high for the elite players, who play on average three games per week during competition season, three times more than their local teams' peers. For those who are selected for the national

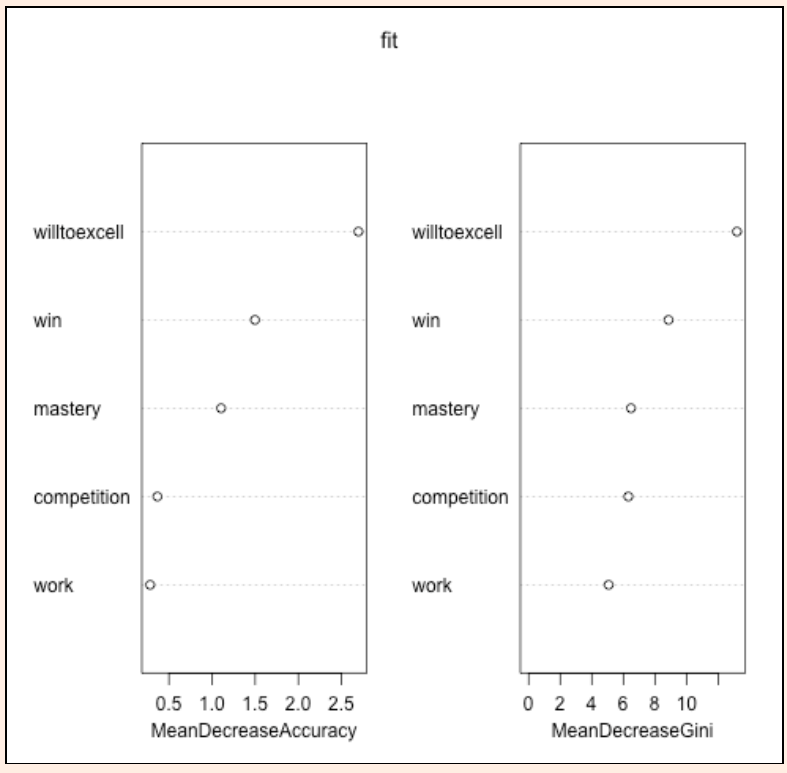

Figure 2. Random forest obtained from the WOFO and DPMQ factors.

teams in international competitions, the number raises by 10-15 games. These results suggest that elite players are focusing on competitive outcomes and athletic status instead of improving their skills through deliberate practice. Because they play almost every two days, the athletes must recover from fatigue and practices aim almost exclusively to prepare the team against the next opponent. To win the games and to play an important role in the team as a good defender or scorer can influence dispositional orientations of the elite athletes.

The positive correlations between Will to Excel and Winning or between Mastery and Work agree with the findings of De Bruin et al. (2007) or, using a different measure for achievement orientations, with Miller, Roberts and Ommundsen (2005).

Most of the research on achievement orientations used the Achievement Orientation Theory, as postulated by Nicholls (1989). This theory says that normative- or self-orientations are orthogonal; the individuals can be high or low oriented in both senses. That will be the case of elite athletes that believe that success is a combination of hard training and a strong will to beat the opponents (Harwood et al., 2004). However our analysis found that the most discriminant variable was Will to Excel, explaining 85.2% of the belonging to the elite or national level. Moreover, the Decision Tree method excluded Mastery and Competitiveness from the final model. The results confirm previous studies (Figueiredo et al., 2009; Gonçalves et al., 2009) that did not find a significant effect of achievement variables (Work, Mastery) on talent orientation or dropout. Also Elferink-Gemser et al., (2007) showed that motivation is a more important variable to differentiate elite young athletes from non-elite ones than athletic readiness or skill proficiency. These findings suggest that a self orientation to excellence may play a crucial role in persistence in practice, in order to achieve higher standards in competition. The will to reach excellence in performance can be considered as a condition to engage in more specialized and demanding practice.

This early orientation to competitive outcomes raises other issues, suggesting that the young players were driven to overlook their progression in fundamental elements and team work. The results don´t allow such conclusion, but the modest scores for Mastery can produce negatives effects as the specialization and elite process advances in time. Côté, Strachan and Fraser-Thomas (2009) argue that elite performance can be reached through two different trajectories: early sampling and late specialization and early specialization. This last trajectory demands an early selection, is less precise and can produce negative experiences on the long term. The need for the adolescents to focus on game performance can be deterrent for individual skill or team tactics improvement. The same process can also negatively influence coaches and managers decisions. As pointed by Martindale et al., (2005), actual performance is not the same as potential for the future and to be fully reached, the young athletes need autonomy to set their own goals. From an anthropological point of view, Malina et al. (2004) showed that readiness for sport performance is a matter of right time, demanding years of adaptation to higher intensities, volumes and stressful situations.

The participants in the present study were already selected for the elite or local groups when they answered to the questionnaires. Because the moment of the season was the first week of practices, it seems reasonable to assume that the young athletes expressed dispositional orientations, not resulting of the situation they were experiencing at the time. Hence, the present model is not a predictive one, because the coaches had already made their choices, based on the anthropometric and skill development criteria mentioned above. This first study with team sport players engaged in elite programs in such young ages can bring some light about the specific motivation that underpins participation at different levels and help the coaches to be sensitive to non-biological or non-functional variables, leading to a better knowledge and caring of the adolescents they teach. The families of the players, that provide consent to participate in the programs, must also be informed of the possible implications of the full sport engagement. With time and longitudinal research design, as highlighted in the conclusions, it will possible to evaluate, on evidence basis, the goodness of the elite programs and their effects on sport performance, players' careers and individuals' lives.

Conclusion

As pointed by De Bruin et al. (2007), the inclusion of measures of specific motivation in the talent orientation for elite performers is useful and relevant. However, the studies with team sports are scarce and must be a topic of future research. Different sports, different competitive levels must be studied. The gender issue is also an important one, given the lower normative achievement orientation showed by girls in previous studies (Roberts, 2001; Miller et al., 2005). The assessment of the path to expertise only through motor variables or through the accumulated hours of deliberate practice is limited and can lead to mistaken identification or orientation of young sport talents. It is also important to stress that non biological variables are not restricted to motivation and research must address the ability to cope with pressure and to learn.

The use of a more comprehensive model is needed, to provide coaches and managers with useful information to back selection and orientation decisions that can have a major influence in the youngsters' lives. To achieve these goals quantitative methods need to be complemented with qualitative tools. Individual beliefs, expectations and achievement orientations must be studied through open interviews. Ethnographic methods can also give valuable insights about the team climate, player status and interpersonal relationships.

But the time variable has to be always considered. The players assessed in the present must be followed in subsequent years through longitudinal design studies. Their future evolution as elite or local athletes, or even dropouts, represents a key factor to depict a process that, according to the Deliberate Practice framework, is only meaningful over a long period of time.

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Key points

- Excellent performance in sport has a strong positive relationship with the accumulated hours of practice.
- It seems reasonable that if the young athletes are better selected, have better training conditions and practice and compete more time with better teammates and opponents, the chance of becoming competent adult athletes is greater.
- A self orientation to excellence may play a crucial role in persistence in practice, in order to achieve higher standards in competition.
- The specific motivation that underpins participation at different levels and help the coaches to be sensitive to non-biological or non-functional variables, leading to a better knowledge and caring of the adolescents they teach.
- The assessment of the path to expertise only through motor variables or through the accumulated hours of deliberate practice is limited and can lead to mistaken identification or orientation of young sport talents.

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