Presentation of doctoral dissertation

RELATIONSHIP AMONG SELECTED DIMENSIONS OF PSYCHOSOMATIC STATUS AND COMPETITIVE SUCCESSFULNESS OF CROSS-COUNTRY SKIERS
(Branimir Černohorski, Ph.D.)

Predstavitev doktorske disertacije

POVEZANOST MED IZBRANIMI RAZSEŽNOSTMI PSIHOSOMATIČNEGA STATUSA IN TEKMOVALNO USPEŠNOSTJO SMUČARJEV TEKAČEV
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Ključne besede: smučarski tek, potencialna uspešnost, model, ekspertno modeliranje, strojno učenje

Branimir Černohorski, Master of Science in Kinesiology, defended his doctoral dissertation entitled Relationship among selected dimensions of psychosomatic status and competitive successfulness of cross-country skiers on 22 December 2003 at the Faculty of Sport in Ljubljana. His mentor was Dr. Janez Pustovrh and co-mentor Dr. Matej Tušak, both from the Faculty of Sport, University of Ljubljana.

In the introduction the author defines the transformation process in top sport and seeks its basis in cybernetic and systems approach. The preparations of top competitors involve the managing of the process for system transformation. The effects can only be controlled if a general model exists of the status of the subjects which are influenced. Thus, in the continuation the author presents the theory of psychosomatic status, which defines the human model and is based on much reduced "human system". The theory of competitive successfulness in sports specifies the so-called competitive and potential training model of successfulness. Both represent the basis for studying, in terms of substance, the task which is aimed at identifying the common points of both models. Due to its complexity, the theory of competitive successfulness uses the artificial intelligence methods for studying. The dissertation presents the bases of expert systems and machine learning. Both methods are in the introduction defined in terms of modelling and generating a knowledge base. In the subject matter and the issue the author points to research oriented towards studying and evaluating competitive and potential successfulness of cross-country skiers based on a reduced prognostic successfulness model. He characterises more predictive individual subspaces of psychosomatic status of cross-country skiers, which will function as the elements of the model. In doing so, the author relied mainly on the structural functional aspects of theories of individual subspaces. An overview of research carried out so far offers the findings arrived at through scientific research work covering a narrower field.

The sample of subjects consisted of 48 Slovene cross-country skiers from three competitive categories, aged between 13 and 18. The measurements were carried out in April 2001. The sample of variables included the morphological, motor, psychological, sociological and functional space of psychosomatic status. The goals of the dissertation can be divided into three groups. The first group includes the selection of the most adequate criterion of competitive successfulness, the creation of two universal reduced models of potential competitive successfulness and the identification of basic characteristics of the sample. The second group consists of the estimate of potential successfulness of subjects by two different procedures of expert modelling SMMS (using dependent and independent weighting determination) and identifying the criteria for establishing potential successfulness by decision trees based on different methods of machine learning. The last group includes the examination of the relationship between the estimates of potential successfulness of the subjects, obtained by using two different methods for setting weightings, the validity of both created models and the longitudinal monitoring of the estimate throughout competitive categories. In the first phase the author used the basic descriptive statistics, tested the normality of variable distribution and by the Peta programme checked the linearity of their connections with the successfulness criterion. In the continuation he established the level of connections between variables by different correlation coefficients. In order to construct decision trees according to machine learning methods the tool MtDeciT 3.0 Gen was used. Using this tool, some hybrid methods were tested, which were developed at the Faculty of Electrical Engineering and Computer Science in Maribor.

The interpretation of the obtained results is presented transparently in logical order of hypothesis verification in accordance with the goals, the subject matter and the issue of the dissertation. In line with the first goal and hypothesis of the research the author defined several criterion variables. One of them is also the factor-defined criterion of successfulness, where the author by component factor analysis condensed all competitions within the domestic competitive system into the first main component, i.e. K-1 vector. Based on comparative analyses of dependable variables the author selected the most suitable criterion. Even though the variable SLO FIS cannot be used to make the competitive successfulness criterion uniform for all three competitive categories, this variable proved to be the closest to it, especially as the number of subjects is preserved. All variables of the sociology subspace were found to be linearly connected with the criterion, while the number of non-linear connections was 1 in morphological, 5 in psychological, 3 in functional and 6 in motor subspace, mainly in the category of older youth, which hypothetically points to somewhat less homogenous sample in comparison with the other two competitive categories. The results of linearity checks and the established characteristics of the description statistics parameters of independent variables helped the author to create, based on expert knowledge, two universal reduced models of potential successfulness named by the author MMPS and MFMPS in view of the psychosomatic status subspaces which they cover. In our case the sociological subspace is included in both reduced models of competitive successfulness, which is a novelty. The MFMPS model differs from MMPS in that it was additionally extended by functional space, which the author originally defined as the studied sports activity and was chiefly due to financial restrictions investigated only within the competitive category of older youth. In both models the structure of subspaces is demonstrated in the form of a decision tree. Base variables represent the basic criteria based on which aggregated criteria are formulated at higher levels, up to the highest level, namely potential successfulness of an athlete. In the case of both models different methods were applied for dimensional configuration of knowledge base - by the method of dependent and independent weighting determination, which basically differ in terms of methodology used for

setting the weighting for individual elementary and aggregated criteria. The positional configuration, i.e. creation of the so-called normalisers for all competitive categories in absolute sense, is determined identically in both models, which means that the models are universal.

After the results of estimates of potential successfulness had been shown, the author compared the obtained estimates of two subjects on all levels of the MFMPS model, using the dependent weighting determination method. The author illustrated the possibility of establishing quality and weak points of an individual in all studied dimensions on a practical case. Based on this information it is much easier to direct the transformation process in the desired direction. The hypothesis that the connection between the estimates of individual subspaces in both models and those obtained based on both methods of weighting determination is statistically insignificant on the level of 5 - percentage risk can be accepted almost in full. This confirms the theory of minimum connection of individual dimensions of the successfulness model, while the correlation with the criterion has to be maximal. In general, motor ability is in both models most closely connected with the other subspaces. In the MMPS model, both in the framework of dependent and independent weighting determination, the most statistically significant connections were in all three categories of subjects recorded between the final estimate and the estimate of motor and morphological space (mostly on the level of 1 - percent risk). Similar applies to motor and functional space in the MFMPS model. By establishing correlations between the estimates of the same dimensions, obtained by different methods of weighting determination, the author aimed to identify their differences and common points. In both models the uniformity of estimates obtained using different methods of weighting determination is statistically significant on the level of 1 - percentage risk, which means that practically no differences were found.

The aim of studying the validity of the models was to determine their useful value. The validity of the MMPS model was according to the applied weighting determination method statistically significant in the categories of older boys and older youth (the highest in older youth using the method of dependent weighting determination, which accounts for 62% of the criterion variance). The MFMPS model, which was checked only in the age category of older youth, showed high predictability (between 76 and 81% of explained criterion variance), however, it has to be accepted with some reservation due to some non-linear relationships established at lower levels of successfulness model. The method of dependent weighting determination in both models displayed slightly more predictive results, which points to greater model validity. As expected, the most predicative dimensions in the MFMPS model were motor and functional space. Independent determination of weighting in the MFMPS model enables mutual comparison of the validity of models of different sizes. Although the differences are minimal, it turned out that the inclusion of a larger number of subspaces into a model does not necessarily result in greater model validity. By excluding individual subspaces from a model it was established that the highest informative value was in this cases that of the model which includes motor, functional and psychological spaces at the same time.

The use of new hybrid methods of machine learning in this sport activity led to the findings that the base of competitors in our area is at present too small for these methods to provide quality classificators in all subspaces, based on which athletes' potential could be established. The interpretation of obtained results in terms of predictions "if/then" can too often be speculative, which is why the results have to be interpreted with caution. The valuations of potential successfulness by means of applied methods of machine learning can due to the current difficulties with learning facilities be carried out only at test level.

The longitudinal monitoring of the subjects throughout all competitive categories showed that in the age between 13 and 18 there are periods when as a result of developmental laws continuous progress is not possible in some dimensions of the psychosomatic status. Therefore, the principle of individuality has to be consistently applied especially while planning the transformation process. Although the subjects are not the same, it was established that the change in average estimates of potential successfulness in terms of competitive categories is not statistically different in the sociological and partly psychological space. The author concluded the dissertation by providing instructions for further research covering a narrower subject matter and by arguing the importance of such work both in theory and practice.

In statistically reliable way the author confirmed or rejected the hypotheses set up according to the research goals. The results of the research point to practical usefulness of such competitive successfulness projections in cross-country skiing and at the same time indicate the probable orientation of these methods in scientific and research work in the future. In terms of quality the dissertation represents a unique upgrade of the past scientific endeavours to assess the competitive potential of top athletes and of the theory of competitive successfulness in general. The results are an important contribution to science, especially as regards the identification and verification of new knowledge about competitive successfulness, while at the same time several dimensions of psychosomatic status of subjects are dealt with. The dissertation also offers a comparative analysis of models for evaluating potential successfulness, developed based on different methodologies. In relation to this, particularly the first attempt to structure such an extensive universal model of potential successfulness has to be stressed, while emphasis has to be placed also on the first ever integration of sociological space into a model and the presentation of original configuration of the knowledge base both in functional and psychological space within the scope of this sports activity. The originality of the research is proved also by the test for determining athlete's potential based on generation of decision trees, obtained by means of new different hybrid methods of machine learning. Information acquired from within individual spaces is also important, as in mutual interaction sheds light on the model characteristics of Slovene cross-country skiers and provides the basis for adequate interpretation of applied potential successfulness models. All of the above represents a unique contribution to kinesiology.