ASSESSING THE MORPHOLOGIC, MOTORIC AND PSYCHOLOGIC STATUS OF YOUNG BOYS IN ALPINE SKIING BASED ON EXPERT MODELLING

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OCENJEVANJE MORFOLOŠKEGA, MOTORIČNEGA IN PSIHOLOŠKEGA STATUSA MLAJŠIH DEČKOV V ALPSKEM SMUČANJU NA PODLAGI EKSPERTNEGA MODELIRANJA

ABSTRACT

We formed for a chosen sample of 24 young alpine skiers (11 – 13 years old) a reduced prognostic model of competitive successfulness based on 8 morphological, 20 motor and 20 psychological variables, using the »expert system« method. We obtained a predicted value for each competitor on all levels of the decision tree.

Then we calculated the linear correlation between the predicted (expert system) and actual successfulness (criterion). The statistical significance of the Pearson coefficient shows a high correlation and enables us to confirm the validity and quality of the reduced prognostic model and possibilities for its application in praxis in the future.

Keywords: skiing, young boys, morphology, motoric, psychology, successfulness

IZVLEČEK

Na podlagi 8 morfoloških, 20 motoričnih in 20 psiholoških dimenzij smo za vzorec 24-ih najboljših mladih alpskih smučarjev (11 do13 let) oblikovali t.i. reducirani model potencialne uspešnosti mladih tekmovalcev. S pomočjo metode ekspertnega sistema (hevristični pristop) smo za vsakega posameznika izračunali ocene tako na najvišjem kot tudi na vseh nižjih nivojih odločitvenega drevesa.

V nadaljevanju smo izračunali stopnjo povezanosti med predvideno oceno tekmovalne uspešnosti (ekspertni sistem) in dejansko uspešnostjo (kriterijska spremenljivka). Statistična značilnost izračunanega Pearsonovega koeficienta korelacije kaže na visoko povezanost postavljenega modela z uspešnostjo in hkrati potrjuje tako veljavnost kot tudi kvaliteto reduciranega modela ter možnost za nadaljnjo uporabo le-tega v praksi.

Ključne besede: smučanje, morfologija, motorika, psihologija, mlajši dečki, uspešnost

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INTRODUCTION

In sport, as in other fields, constant change is present, advances can be only made as a consequence of creativity and ever new approaches to studying and solving existent or new-coming problems. Results in top competitive sport are therefore the consequence of suitable professional work, enabling the development of those dimensions of the psychosomatic status that are important in a certain sport.

The top-level results of current generations of Slovene alpine skiers are without doubt the best proof of a quality-orientation of the selection process of younger as well as older categories of competitors. We must keep in mind that the route to the top is through ever stronger competition even in the youngest categories and because these are the basis on which top results are built, we must ensure for them a suitable, professionally led and organised training process.

An analysis of the successfulness of athletes can base on the competitive or the potential viewpoint of the successfulness model. Success depends on many factors (4), therefore we cannot take them all into account. We were forced to limit ourselves to a few, those that have the greatest predictive power and most show the potential successfulness of young competitors in alpine skiing (6).

In the competitive realisational viewpoint of the successfulness model, however, the starting point are the actual results (achieved at competitions) and we try in reverse to find those factors that most defined the achieved results.

By focusing on the three named subspaces (morphologic, motor and psychological subspace) of the general model of potential successfulness (3) we only slightly limited its dimensionality. A full treatment of the three subspaces would namely still be unmanageable. Therefore we further reduced the mentioned subspaces to those 48 dimensions, which are considered in theory and praxis as the best indicators of the status and level of preparedness of young competitors for successful competition.

In general we can treat the potential **model of morphologic dimensions** (1) as a very simplified whole that offers a sufficiently precise and (for skiing) essential insight into the complex of the morphological characteristics of an individual. On the basis of some other studies (6, 8) we can say that only larger departures from the average values in individual variables would lessen the possibility for achieving good results.

The potential **model of specific and basic motor dimensions** represents a certain common denominator of an assessment of the motor status of the competitors. It consists of a part of those primary key specific potential dimensions which are the conditio-sine-qua-non for successfulness in alpine skiing. It is a fact that the whole process in sport is about transforming competitors into a state that enables top results. However, as is evident from the general model of successfulness (4), the motoric dimensions are not the only ones defining successful competitive appearances. Together with the morphologic and functional dimensions they represent the primary potential successfulness dimensions, while the psychological dimensions are a part of the tertiary specific potential dimensions and are of course also essential for achievement of results.

Among the psychic characteristics we feel that three complexes are specially important for young alpine skiers, they ensure (from the psychological point of view) a relatively holistic insight into the individual and his/her possibilities for success. This is the first and till now the most complex battery of tests (4) meant for younger categories and it seems that it is also useful in praxis.

Sport Psychology is only one of the branches of psychology and represents an important part that can add greatly to achieving good (or bad) results in sports. This subspace is also treated by different complexes that are essential for successfulness in alpine skiing. We tried to take into account the fact that psychological factors that influence the successfulness of an athlete depend to a lesser or greater degree on genetic, socialisational and other (training) effects. Therefore it was our purpose to find also among specific psychic abilities, motivation and personality characteristics the key ones that determine successfulness of younger categories in alpine skiing. The psychological characteristics that construct the presented model will enable us to infer results in other, not used, but still important dimensions.

The presentation of the reduced model of potential successfulness for the competitive category of junior boys in alpine skiing is only a part, which we discussed in this work in close connection with the actual successfulness of the mentioned competitive category. For this purpose we constructed a competitive model of successfulness, built of levels defined by the nature and level of competition, as shown in Table 1.

In order to keep the competitive data objective and relevant only the third level competitions (competitions for the Radenska Cup) were taken into account. Finding the actual (competitive) successfulness means trying to evaluate the achieved results of each individual, but not by the objective success on the course (time), but through points given by Slove-

Table 1: Competitive model of successfulness (3).

COMPETITIVE SUCCESSFULNESS
+– **INTERNATIONAL COMPETITION**
+– **DOMESTIC COMPETITION**
+– **COMPETITION 3. LEVEL** (6 races for the Radenska Cup competition)
+– **COMPETITION 2. LEVEL** (regional competition)
+– **COMPETITION 1. LEVEL** (inter-club competition)

ne Skiing Association for a certain placement (rank) at a competition (9).

METHODS

SUBJECT SAMPLE

A sample of 24 alpine skiers (of adequate quality) was analysed in this study. The skiers had to fulfil the following criteria:

- born in 1983 or 1984
- placed in the final list of competitors of the Radenska Cup competitions in the season 1994/95 and had more than 100 points
- participated in the training process of their ski club
- without physical injuries or morphological aberrations

The mark of potential successfulness was computed with the expert system method (7). The basis of every expert model is the **knowledge base,** whose formalism consists of the criterion tree (model reference), decision rules (model configuration) and the so-called normalisers. The normalisers are formed according the heuristics theory.

The criterion tree **(model reference)** consists of factors which influence successfulness of athletes in a certain sport. These are ordered in the form of a decision tree. The lowest are the basic criteria, that is the tests – the results of the individual obtained with the measurements. These are then combined upwards into derived criteria. At the highest level is the predicted mark of successfulness (see Table 3).

The **configuration of the model** (see Table 3) – the absolute decision rules, presented in the column »weight«, are set by the expert with decision rules, where (s)he assesses the contribution of each factor with a certain percentage. This sets the importance of each factor for competitive successfulness. The decision rules can be given in relative percentages (on each level the sum must be 100%) or absolute percentages – the total sum of the contributions of all the factors is one hundred percent.

The individual factors must be evaluated with the help of **normalisers** (see Table 3) with which we numerically set the boundaries of the individual results (in their original metrics) of all the dimensions (factors). The boundaries must be set for five classes: excellent, very good, good, adequate and not adequate. The mark (from 1 to 5) on the highest level of the decision tree will then be computed for each individual, showing the competitors potential successfulness for alpine skiing.

The formalism of the knowledge base is presented in the form of a decision tree of successfulness. The lowest levels of the tree are the basic criteria, whose values are the individual's measured results. The highest level on the other hand represents the so-called potential assessment of successfulness, which can be computed with the help of the proposed reduced model of successfulness. The model also gives the predicted values at all the intermediate levels between the lowest (measured results) and the highest (assessment of potential successfulness).

Our model was therefore defined with a relatively small number of variables, even if we were fully aware that fully objective results could only be obtained by taking into account all the dimensions of the psychosomatic status. In this way we constructed a **reduced model** of potential successfulness, consisting only the most important morphological, motor (5) and psychological dimensions (4), as shown in Table 2.

Table 2: Reduced model of potential successfulness (6).

POTENTIAL SUCCESSFULNESS (assessment of successfulness in alpine skiing)
+– **MORPHOLOGICAL CHARACTERISTICS**
+– **MOTORIC ABILITIES**
+– **PSYCHOLOGICAL CHARACTERISTICS**

The Pearson coefficient of correlation (r) was used to asses the correlation between the predicted mark of competitive successfulness obtained with the expert system.

In the Radenska Cup competition series, which is becoming traditional in Slovenia for the junior girls and boys age group, five giant slalom, three slalom and two super giant slalom races were held in the competitive season 1995/96. Each race at which a competitor participated and managed to complete the course gave a certain number of points. The Slovene Skiing Association (SZS) ranks the successfulness of competition participants according to an agreed-upon criterion – first place is 150 points, second place 135, third 120, fourth 108, fifth 96 and so on (9). We tried to enhance the objectivity of the

Table 3: Absolute decision rules and normalisers for younger boys (6)

	Mark: Weight	Normalisers >=4.0 excellent	>=3.5 very good	>=3.0 good	>=2.0 adequate	units of measure
OCENA	100.0					
+-MORFO	19.0					
+-AT	8.0	510-610	430-680	400-700	370-720	(millimetres – mm)
+-EKSGEOR	7.0					
+-DOLRAZ	2.0					
+-AV	1.0	1540-1660	1450-1740	1420-1760	1400-1780	(millimetres – mm)
+-ADN	1.0	860-970	830-1000	800-1030	780-1050	(millimetres – mm)
+-PRAZSO	2.5					
+-APKOLL	1.8	>=90	>=88	>=85	>=83	(millimetres – mm)
+-APSSL	0.7	>=64	>=60	>=57	>=54	(millimetres – mm)
+-OBSNOG	2.5					
+-AOSL	2.5	460-530	430-560	410-570	400-600	(millimetres – mm)
+-INTGEOR	4.0					
+-AKGT	2.0	<=7.2	<=8.3	<=9.4	<=10.5	(millimetres – mm)
+-AKGSL	2.0	<=11	<=13.5	<=15	<=16	(millimetres – mm)
+-MOTORIKA	66.0					
+-OSMOT	26.2					
+-ENKOGI	12.4					
+-MOČ	8.1					
+-ODRMOČEN	4.1					
+-MMEN3SM	4.1	>=595	>=590	>=583	>=578	(centimetres – cm)
+-ODRMOČSO	2.5					
+-MMENSDM	2.5	>=210	>=205	>=199	>=193	(centimetres – cm)
+-REPMOČ	1.5					
+-MMRTDT	1.5	>=41	>=39	>=36	>=33	(no. of repetitions)
+-HITROST	3.0					
+-MMENS20	1.5	<=3.55	<=3.62	<=3.69	<=3.76	(seconds – s)
+-MHGNS20L	1.5	<=2.88	<=2.98	<=3.12	<=3.2	(seconds – s)
+-VZDRŽLJIV	1.3					
+-MVAA1500	1.3	<=362	<=368	<=376	<=384	(seconds – s)
+-INKOGI	13.8					
+-KOORDIN	8.7					
+-MHK	6.0					
+-MKKRPN	6.0	<=8.7	<=8.9	<=9.1	<=9.3	(seconds – s)
+-MHALT	2.7					
+-MHFRTB15	2.7	>=16	>=15	>=14	>=13	(no. of repetitions)
+-GIBLJIVOST	1.1					
+-MGATPK	1.1	>=50	>=46	>=42	>=38	(no. of repetitions)
+-RAVNOTE	4.0					
+-MRSOSVT	2.0	>=5.2	>=5	>=4.7	>=4.3	(seconds – s)
+-MRSOSPT	2.0	>=5	>=4.5	>=4	>=3.6	(seconds – s)
+-SPMOT	39.7					
+-ENKOGI	14.7					
+-MOČ	14.7					
+-ODRMOČVZ	8.4					
+-MMRNPK	8.4	>=51	>=48	>=45	>=43	(no. of repetitions)
+-STATMOČ	6.3					
+-SMPRE	6.3	>=85	>=80	>=75	>=70	(seconds – s)
+-INKOGI	25.0					
+-KOORDIN	25.0					
+-MHK	5.0					
+-MKHRVIS	5.0	<=12.9	<=13.9	<=15.6	<=17	(seconds – s)
+-MAG	11.5					
+-SKI9	7.5	<=32.8	<=33.2	<=34	<=35	(seconds – s)
+-MKAGKVS	4.0	<=9.7	<=9.9	<=10.1	<=10.4	(seconds – s)
+-MRE	1.6					
+-MMENSDN	1.6	>=86	>=80	>=75	>=71	(centimetres – cm)
+-MKR	3.5					
+-MKRBNR	3.5	>=17	>=16	>=15	>=14	(no. of repetitions)
+-MHALTN	3.4					
+-MHFNTD	1.7	>=22	>=21	>=20	>=19	(no. of repetitions)
+-MHFNTL	1.7	>=22	>=21	>=20	>=19	(no. of repetitions)

+–PSIHOLOG	15.0					
+–SPOSOBNO	5.2					
+–PREVODŽS	5.2					
+–KRČ	3.2					
+–HITROSTK	2.6	<=3.8	<=5.3	<=6.8	<=8	(seconds – s)
+–STABILK	0.6	<=7	<=15	<=22	<=30	(seconds – s)
+–ERČ	2.0					
+–HITREN	1.6	<=7.8	<=8.5	<=9.2	<=9.8	(seconds – s)
+–STABEN	0.4	<=0	<=1	<=2	<=3	(sum of mistakes)
+–MOTIVAC	4.6					
+–STORMOT	1.8					
+–SPLOŠNA	0.9					
+–USPNGDEL	0.6	5-7	4-8	3-9	1-11	(points)
+–USPGDELO	0.3	>=8	>=7	>=6	>=4	(points)
+–TEKMOT	0.9					
+–POZIT	0.6	>=75	>=72	>=68	>=55	(points)
+–NEGAT	0.3	30-42	27-48	24-55	21-80	(points)
+–NOTRMOT	1.4	>=140	>=135	>=128	>=120	(points)
+–CILJORI	1.4					
+–ORZMAG	0.7	>=26	>=23	>=20	>=16	(points)
+–ORCILJ	0.7	>=28	>=26	>=24	>=21	(points)
+–OSEBLAST	5.2					
+–TEKLAST	4.2					
+–ANKSIOZ	2.1					
+–TEKMANKS	1.5	<=37	<=43	<=54	<=57	(points)
+–POTEZANK	0.6	<=37	<=43	<=54	<=57	(points)
+–PERCTEKS	2.1					
+–PERCDRUG	1.3					
+–OCNASPR	0.7	3-4	2-5	1-5	0-6	(points)
+–VPLOCDR	0.6	3-4	2-5	1-5	0-6	(points)
+–PERCSEBE	0.4					
+–SAMOZAUP	0.1	>=6	>=5	>=4	>=2	(points)
+–TEKMOVAL	0.3	>=60	>=55	>=50	>=44	(points)
+–PERPOMTE	0.4	>=5	>=4	>=3	>=2	(points)
+–AGRESIV	1.0					
+–INSTRUM	0.7	>=19	>=16	>=13	>=10	(points)
+–REAKTIV	0.3	<=19	<=26	<=29	<=32	(points)

VARIABLE SAMPLE

The sample of independent (predictor) variables consists of 28 tests (Lešnik 1996):

- 8 variables of the morphologic subsystem **(MORFO):**
  Body weight **(AT),** body height **(AV),** length of lower extremities **(ADN),** left knee diameter **(APKOLL),** left ankle diameter **(APSSL),** left thigh circumference **(AOSL),** abdominal skin fold **(AKGT),** left thigh skin fold **(AKGSL).**
- 20 variables of the motor subsystem **(MOTORIKA):**
  Basic motor abilities **(OSMOT):**
  standing triple jump **(MMEN32M),** standing long jump **(MMENSDM),** sit-ups **(MMRDTDT),** 20m sprint - high start **(MMENS20),** 20 m sprint – flying start **(MHGNS20L),** 1500 m run **(MVAA1500),** polygon backwards **(MKKRPN),** plate-tapping with better arm **(MHFRTB15),** bend and touch **(MGATPK),** balancing on both legs parallel on balance board **(MRSOSVT),** balancing on both legs perpendicular on balance board **(MRSOSPT),**
  Specific motor abilities **(SPMOT):**
  jumps over Swedish bench **(MMRNPK),** downhill-skiing-position **(SMPRE),** climbing up and down benches and ladders **(MKHRVIS),** figures of eight around obstacles **(SKI9),** side-stepping **(MKAGKVS),** standing long jump backwards **(MMENSDN),** drumming with hands and feet **(MKRBNR),** plate-tapping with right leg **(MHFNTD),** plate-tapping with left leg **(MHFNTL).**
- 20 variables of the psychological subsystem **(PSIHOLOG):**
  HITROSTK (complex reaction time), **STABILK** (stability of complex reaction), **HITREN** (simple reaction time), **STABEN** (stability of simple reaction), **USPNGDEL** (need for achievement without regard to invested effort), **USPGDELO** (need for achievement through invested effort), **POZIT** (positive competitive motivation), **NEGAT** (negative competitive motivation), **NOTRMOT** (intrinistic motivation), **ORZMAG** (win-orientation), **ORCILJ** (goal-orientation), **TEKMANKS** (competitive anxiety), **POTEZANK** (anxiety trait), **OCNASPR** (competitor assessment), **VPLOCDR** (influence of own assessment by others), **SAMOZAUP** (self-confidence), **TEKMOVAL** (competitiveness), **PERPOMTE** (race-importance perception), **REAKTIV** (relative aggression), **INSTRUM** (instrumental aggression).

All variables in Table 3 are given in bold text.

results in our study by defining as the criterion variable (actual successfulness) the sum of the following points:

1. sum of points of the two best **slalom** placements (max. 300 points),
2. sum of points of three best placements in **giant slalom** (max. 450 points) and
3. points of the best placement in **super giant slalom** (max. 150 points).

Table 4 shows the individual criterion values:

Table 4: Values of criterion variable for junior boys

rank	Surname and name	achieved points
1.	K	816
2.	Č	801
3.	B	687
4.	J	556
5.	M	528
6.	R	473
7.	F	462
8.	C	451
9.	A	410
10.	D	361
11.	I	338
12.	O	281
13.	H	237
14.	E	204
15.	V	201
16.	Š	190
17.	T	187
18.	N	179
19.	Z	176
20.	U	152
21.	L	125
22.	P	114
23.	G	111
24.	S	78

RESULTS

RESULTS OF EXPERT SYSTEM

The values of the final marks computed by the expert system method (Table 5) show that there was no competitor in the tested sample with a »not adequate« mark on the highest levels. The obtained results are therefore congruent with the quality of the tested sample that consists only of the most successful competitors in alpine skiing in the category junior boys.

A general overview of the obtained results of the measured sample will encompass in our case only the first two levels of nodes, formed with linear combinations of the variables on lower levels of the successfulness tree.

The results in Table 5 show a quite large range between the marks on the highest level of the successfulness tree (the highest level is marked as OCENA). It can be seen that most of the 24 subjects received the marks good (11) and adequate (9). Only one competitor received the mark excellent, the remaining three were assessed with »very good«. Such results are a quite logical consequence of the highly set standards for selection of competitors into the selections of the junior categories of alpine skiers. Two thirds (16) of the competitors received a mark above 3.0, which represents quite a good result, attested also by the 3.1 average value.

A comparison of the three main sublevels of the model (the sublevels are marked as MORFO – morphologic dimensions, MOTORIKA – motoric dimensions and PSIHOLOG – psychological dimensions) gives a first glance impression that the marks are quite similar (Table 6). A closer inspection of the morphology subspace shows that only one competitor received a mark lower than 3.0. However, we must mention that especially in the internal geometric characteristics node (INTGEOR) some »not adequate« marks are present, mostly due to bad results in the skin-folds. The morphology subspace shows mostly high marks, also attested by the average mark of the measured sample of 3.6, which is higher than that of motorics (2.9) and psychology (3.4). Since the morphology subspace is less important for skiing than mo-

Table 5: The values of the final evaluations, obtained by the expert system method:

Rank	Skier	Age	Mark
1.	A	13	4.23 excellent
2.	B	13	3.82 very good
3.	C	13	3.58 very good
4.	D	13	3.55 very good
5.	E	13	3.49 good
6.	F	13	3.40 good
7.	G	13	3.32 good
8.	H	13	3.31 good
9.	I	13	3.30 good
10.	J	13	3.26 good
11.	K	13	3.25 good
12.	L	13	3.17 good
13.	M	13	3.12 good
14.	N	13	3.09 good
15.	O	13	3.06 good
16.	P	12	2.96 adequate
17.	R	12	2.94 adequate
18.	S	13	2.92 adequate
19.	T	12	2.91 adequate
20.	U	13	2.62 adequate
21.	V	12	2.61 adequate
22.	W	13	2.50 adequate
23.	X	12	2.42 adequate
24.	Y	12	2.26 adequate

Marks on the higher levels of the decision tree are shown on the Table 6.

torics, it also has a lower weight (19%) as can be seen in Table 6. The problems of setting the norms for the morphologic, motor and psychological subspaces come mostly from the changes in development, characteristic for the age span of this sample.

The status of the subject in the motoric subspace has the greatest influence on successfulness also in skiing, therefore the weight is the largest, in our case 66% (Table 3). Because of this we set all the norms of the motoric dimensions high in light of the used sample. Proof of this can be seen in the fact that only the best marked subject achieved the mark »excellent«. However, the quality of the sample is attested to by the fact that — in spite of harsh norms — more than half achieved a mark above 3.0 and that only two subjects were assessed with »not adequate«. Most of the marks are »adequate« and »good«, mirrored in the average mark of the motoric status of 2.9, which is lower than the average values of the other two subsystems.

The psychological complex of dimensions has in many instances a decisive influence on success in alpine skiing, both in the younger and the older age categories (Lešnik 1996). The mark of psychological

Table 6: Marks on the higher levels of the decision tree

	A-Mark	B-Mark	C-Mark	D-Mark	E-Mark	F-Mark
OCENA	4.2 exc.	3.8 v.g.	3.6 v.g.	3.5 v.g.	3.5 good	3.4 good
+–MORFO	4.0 exc.	3.5 v.g.	3.2 good	4.6 exc.	4.3 exc.	4.0 exc.
+–AT	3.7 v.g.	3.8 v.g.	2.3 adq.	4.8 exc.	4.2 exc.	4.3 exc.
+–EKSGEOR	4.3 exc.	4.2 exc.	3.6 v.g.	4.6 exc.	4.5 exc.	4.7 exc.
+–INTGEOR	4.2 exc.	1.6 n.ad.	4.4 exc.	4.0 exc.	4.0 v.g.	2.4 adq.
+–MOTORIKA	4.5 exc.	3.9 v.g.	3.7 v.g.	3.3 good	3.3 good	3.2 good
+–OSMOT	4.6 exc.	3.8 v.g.	4.0 exc.	4.2 exc.	4.4 exc.	2.5 adq.
+–SPMOT	4.4 exc.	4.0 v.g.	3.5 good	2.7 adq.	2.5 adq.	3.6 v.g.
+–PSIHOLOG	3.4 good	3.9 v.g.	3.5 good	3.5 v.g.	3.4 good	3.5 v.g.
+–SPOSOBNO	3.9 v.g.	3.6 v.g.	3.4 good	3.7 v.g.	3.4 good	4.3 exc.
+–MOTIVAC	2.7 adq.	4.0 exc.	3.5 good	3.0 good	3.2 good	2.9 adq.
+–OSEBLAST	3.5 v.g.	4.0 exc.	3.5 good	3.9 v.g.	3.5 v.g.	3.4 good
	G-Mark	H-Mark	I-Mark	J-Mark	K-Mark	L-Mark
OCENA	3.3 good	3.3 good	3.3 good	3.3 good	3.2 good	3.2 good
+–MORFO	3.2 good	3.6 v.g.	3.8 v.g.	3.7 v.g.	3.7 v.g.	3.7 v.g.
+–AT	2.3 adq.	3.1 good	3.4 good	3.9 v.g.	4.0 v.g.	3.9 v.g.
+–EKSGEOR	3.6 v.g.	3.9 v.g.	4.1 exc.	3.8 v.g.	4.0 exc.	4.4 exc.
+–INTGEOR	4.2 exc.	4.3 exc.	4.2 exc.	3.0 good	2.5 adq.	1.8 n.ad.
+–MOTORIKA	3.3 good	3.1 good	3.1 good	3.2 good	3.1 good	3.0 adq.
+–OSMOT	3.3 good	3.2 good	2.2 adq.	3.4 good	2.9 adq.	2.8 adq.
+–SPMOT	3.3 good	3.0 adq.	3.6 v.g.	3.1 good	3.3 good	3.1 good
+–PSIHOLOG	3.4 good	4.0 v.g.	3.6 v.g.	3.0 good	3.3 good	3.3 good
+–SPOSOBNO	3.6 v.g.	3.8 v.g.	3.9 v.g.	2.2 adq.	3.7 v.g.	3.3 good
+–MOTIVAC	3.0 adq.	4.2 exc.	3.2 good	3.3 good	3.0 good	3.4 good
+–OSEBLAST	3.6 v.g.	3.9 v.g.	3.7 v.g.	3.5 v.g.	3.2 good	3.4 good
	M-Mark	N-Mark	O-Mark	P-Mark	R-Mark	S-Mark
OCENA	3.1 good	3.1 good	3.1 good	3.0 adq.	2.9 adq.	2.9 adq.
+–MORFO	3.7 v.g.	3.3 good	3.6 v.g.	3.5 good	3.3 good	3.6 v.g.
+–AT	3.8 v.g.	4.0 exc.	3.1 good	3.5 v.g.	4.3 exc.	3.7 v.g.
+–EKSGEOR	4.5 exc.	4.2 exc.	3.8 v.g.	4.0 v.g.	4.1 exc.	4.2 exc.
+–INTGEOR	1.8 n.ad.	0.1 n.ad.	4.1 exc.	2.5 adq.	0.0 n.ad.	2.3 adq.
+–MOTORIKA	2.9 adq.	2.9 adq.	2.8 adq.	2.8 adq.	2.7 adq.	2.6 adq.
+–OSMOT	2.3 adq.	2.5 adq.	2.3 adq.	3.3 good	2.9 adq.	3.4 good
+–SPMOT	3.3 good	3.2 good	3.2 good	2.5 adq.	2.6 adq.	2.1 adq.
+–PSIHOLOG	3.4 good	3.6 v.g.	3.4 good	3.0 adq.	3.4 good	3.3 good
+–SPOSOBNO	3.2 good	2.9 adq.	3.3 good	2.4 adq.	3.5 good	2.1 adq.
+–MOTIVAC	3.7 v.g.	4.1 exc.	3.2 good	3.5 good	3.3 good	3.7 v.g.
+–OSEBLAST	3.4 good	3.8 v.g.	3.6 v.g.	3.1 good	3.6 v.g.	4.0 exc.
	T-Mark	U-Mark	V-Mark	W-Mark	X-Mark	Y-Mark
OCENA	2.9 adq.	2.6 adq.	2.6 adq.	2.5 adq.	2.4 adq.	2.3 adq.
+–MORFO	3.9 v.g.	3.2 good	3.5 v.g.	3.1 good	4.1 exc.	2.9 adq.
+–AT	3.9 v.g.	3.7 v.g.	2.8 adq.	3.6 v.g.	3.6 v.g.	1.9 n.ad.
+–EKSGEOR	4.8 exc.	4.0 v.g.	3.9 v.g.	4.2 exc.	4.4 exc.	3.3 good
+–INTGEOR	2.3 adq.	0.8 n.ad.	4.3 exc.	0.0 n.ad.	4.6 exc.	4.4 exc.
+–MOTORIKA	2.4 adq.	2.4 adq.	2.2 adq.	2.1 adq.	1.6 n.ad.	1.8 n.ad.
+–OSMOT	2.6 adq.	2.4 adq.	1.8 n.ad.	1.8 n.ad.	1.6 n.ad.	1.3 n.ad.
+–SPMOT	2.3 adq.	2.4 adq.	2.5 adq.	2.4 adq.	1.6 n.ad.	2.1 adq.
+–PSIHOLOG	3.7 v.g.	3.0 adq.	3.1 good	3.5 good	3.8 v.g.	3.5 good
+–SPOSOBNO	3.8 v.g.	1.2 n.ad.	3.3 good	2.8 adq.	3.6 v.g.	3.6 v.g.
+–MOTIVAC	3.4 good	4.4 exc.	2.6 adq.	4.0 v.g.	3.9 v.g.	3.1 good
+–OSEBLAST	3.9 v.g.	3.5 v.g.	3.4 good	3.7 v.g.	4.0 exc.	3.6 v.g.

dimensions is a linear combination of nodes dealing with psychic abilities (SPOSOBO), motivation (MOTIVAC) and personality characteristics (OSEBLAST) of the competitors. We feel that the importance of this subsystem, at least in comparison with the other two, is lower and is set at 15%. Since all the competitors received marks above 3.0 this attests to their high level of psychic characteristics and abilities. The average mark of the psychological dimensions was 3.4.

RESULTS OF CORRELATION BETWEEN BY THE EXPERT SYSTEM PREDICTED COMPETITIVE SUCCESSFULNESS (HEURISTIC APPROACH) AND ACTUAL SUCCESSFULNESS (POINTS)

We tried to form the expert system in such a way that it would have the greatest possible power for predicting the competitive result in alpine skiing in the junior boys category. The computed Pearson correlation coefficient shows a high level of correlation between the predicted and the actual competitive result — 0.50, which is statistically significant at the 5% error level. The obtained results therefore confirm and statistically prove the quality of the chosen independent variables, as well as the reference and configuration of the constructed potential model of successfulness for the given sample of subjects.

The border values of statistically significant Pearson correlation coefficients for 24 subjects are:

r = 0.41* at 5-percent error level

r = 0.52** at 1-percent error level.

Table 7: Correlation between predicted and actual successfulness for younger boys

	TOČKE
OCENA	0.50*

DISCUSSION

The possibility of further use of the constructed model of successfulness was confirmed by computing the correlation between the predicted mark by the expert system and the actual competitive result. The obtained Pearson correlation coefficient of 0.50 (Table 7) attests to both the quality of the predictor variables selection and the adequacy of the set normalisers — meant for future practical use with the competitors in the junior boys category in alpine skiing.

The problem that this study attempts to solve is adding information to the theory of successfulness in alpine skiing. Since we have till now only guessed at the connection between the dimensions of the competitors' psychosomatic status and their competitive successfulness, we tried to obtain in this study a representative sample, which would enable sufficient validity, reliability and generalizability of the obtained results. The reference and configuration of the reduced model of successfulness for the junior boys category are based on the morphological, motor and psychological subspaces of the competitors' psychosomatic status. Existent studies dealing with these problems are either out-of-date or represent only a partial contribution to finding and explaining the competitive successfulness of athletes in skiing. Numerous studies, confirmed also in praxis, will enable us to deal not only in hypotheses but also construct a generally valid and accepted theory of successfulness in alpine skiing.

The constructed successfulness model enables also more precise planning and controlling of the individual transformation process, where we should aim for achieving the individually set goals. The use of the expert modelling for monitoring the psychosomatic status of athletes would be welcome both in clubs as well as at the level of various competitive selections. It is possible to direct the training process, with the aim of influencing those abilities that have the dominant role for achieving top competitive results in alpine skiing, on the basis of the computed results in this study. An individually oriented training process is the basis for an optimal insight into the psychosomatic status of each individual competitor.

The subject sample consisted of all best competitors in the category, those which in our opinion represent the future competitive pinnacle of Slovene skiing. Because we expect the progress of the morphologic, motoric and psychological dimensions by next generations we made the norms quite harsh, which is proven by the computed final marks of potential successfulness. In constructing the model of potential successfulness we had to take into account many accompanying factors, which negatively affect the dimensions used as independent variables, especially in the age period under consideration. Among these one should mention especially the disharmony between the skeletal and muscular development, but also psychological and social factors (2).

A selective approach in considering predictors represents a novelty in top competitive sport. This approach is however hindered by the fact that the psychosomatic status of competitors can only be

described with any precision with a large number of variables. Because this requires a lot of time and finances, we should in future base the process of determining potential successfulness of athletes on smaller samples of variables with as high a predictive power as possible.

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