

The structure of personality characteristics of dancers

Evagelia Boli, Dragan Popović & Jasna Popović

Faculty of Sports and Physical Education, the University of Priština
temporarily based in Leposavić, Serbia

e-mail: evagelia.boli@pr.ac.rs

1. Introduction

The efficiency of performing any human activity, and therefore dancing, is not independent of the characteristics that regulate the behavioral modalities. Some characteristics from the cognitive space constrain the efficiency in different activities directly, while in others indirectly, for instance, because of the contaminating effect on cognitive functions or on some other abilities. There cannot be excluded the possibility that the same conative traits in some activities are the restrictor while in others they are the stimulator of efficiency, if, certainly, they take part in the success of a certain activity.

There is also a valid rule that there are not even two subjects with the completely identical structure of any, and therefore those traits, regardless of their final number. This is the reason why the knowledge of the complexity of any activity, which also includes the space of conative traits, is a significant assumption of operationalization of the goal of every activity, including dancing.

2. The research methods

2. 1. The sample of examinees

The sample of examinees is conditioned by the financial capabilities necessary for the research procedure. Besides, the sample depends on the number of qualified and trained measurers, on the instruments and standardized conditions in which the planned research may be realized.

In order to conduct a correct research with satisfactorily stable results, in the sense of sampling error, it is necessary to include a satisfactory number of examinees into the sample. The size of the sample for research of this type is as well conditioned by the aims and tasks of the research, size of the population and the level of variability of the applied system of parameters.²⁷

According to the selected statistical-mathematical model and the aim of the research, the sample of examinees included 131 female dancers and 136 male dancers, aged from 11 to 13, actively engaged in standard and Latin American dances in the Serbian dancing clubs.

The size of the so defined sample should satisfy the following criteria:

- the effectives of the sample should be planned so that it enables as many degrees of freedom as necessary for any coefficient in a pattern or correlation matrix, which is equal to or bigger than 0.22, to be considered different from zero with an inference error less than 0.01.
- in order to successfully apply the adequate statistical methods according to the latest convictions, the number of subjects in the sample must be five times bigger than the number of the applied variables.

During all factor procedures, it should always be kept in mind that the results of the analysis depend on three major systems which determine the selection and transformation of information: the sample of variables, sample of examinees, and the selected extraction, that is rotation, method.²⁸

27 Popović, D.: Determining the structure of psychosomatic dimensions in fights and developing the procedures for their evaluation and monitoring - The Monograph, the Faculty of Physical Education, University of Priština, Priština, 1993.

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2. 2. The sample of variables

2. 2. 1. The sample of personality variables

For estimating personality dimensions, the following measuring instruments have been selected so that they may cover the dimensions of the model of the functioning of conative regulatory mechanisms. The model assumes a hierarchical organization of the mechanisms for regulation and control of the behavioral modalities, and it is constructed so as to avoid the artificial dichotomy to normal and pathological factors.

The selected measuring instruments are:

- 1) Activity regulator (EPSILON)
- 2) Regulator of organic functions (HI)
- 3) Regulator of defensive reactions (ALFA)
- 4) Regulator of offensive reactions (SIGMA)
- 5) System for the coordination of regulatory functions (DELTA)
- 6) System for the integration of regulatory functions (ETA).

The activity regulation mechanism is one of the elementary and lowest positioned systems in the hierarchy. Its function is the regulation and modulation of the activation function of the reticular formation; therefore, it is responsible for the activity and energy level at which other subsystems, including cognitive processes, function. Extroverted and introverted behaviour models depend on the functioning of the system.

Disorders of this system can produce the energy basis for hypomanic or depressive reactions and they probably affect the speed of information stream in the central nervous system.

The mechanism for regulation and control of organic functions is defined by the effectiveness of the coupling between subcortical regulation functions of the organic systems and higher-ranking cortical systems for regulation and control.

Disorders of this system are manifested by a functional disorder of the primary organic systems, such as cardiovascular, respiratory and gastrointestinal systems, and by functional disorders of input and output operations.

The mechanism for regulation and control of the defensive reactions is defined by the appropriate modulation of tonic arousal, probably based on the adequacy of programs that are of genetic origin or are formed during the evolution and positioned in the center for the regulation of defensive reactions.

Disorders of the system for regulation of defence reactions are manifested by various symptoms of anxiety and they form the basis for specially modulated pathological reactions, such as phobia, obsession and compulsion.

The mechanism for regulation and control of offence reactions is also defined by the appropriate modulation of tonic arousal, based on the adequacy of the programs transmitted by the genetic code or formed under the influence of conditioning and positioned in the center for the regulation of offensive reactions.

Disorders of the system for regulation and control of offensive reactions are manifested in various aggressive reactions and in poor control of immediate impulses.

The mechanism for homeostatic regulation is determined by the coordination of activities of functionally and hierarchically different subsystems, especially including the coordination of functions of conative regulatory system and intellectual processors. Owing to this, the homeostatic regulatory system is functionally superior to the systems for the regulation of organic functions, defensive and offensive reactions, and furthermore it controls the processes occurring in the system for the regulation of excitation and inhibition.

Disorders of the system for homeostatic regulation cause dissociation and disorganization of conative and intellectual processes, including motor functions that depend on the system for the structuring of movement.

The mechanism for integration of regulatory functions is responsible for the integration of conative regulatory processes under the guise of the structure of the social field and changes within it. The set of programs which determine its functioning is mostly formed during the educational process. Social disadaptation is an immediate consequence of the functioning of this mechanism.²⁹

2. 3. Methods for results processing

All the data collected in this research were processed in the Multidiscipline Research Centre of the Faculty of Sports and Physical Education, the University of Priština, supported by the system of data processing programmes developed by D. Popović, 1980, 1993, K. Momirović and D. Popović 2003. Therefore the aim of this work is to propose one consistent algorithm for the analysis of latent structures which consists in orthoblique transformation of the principal components significant by PB criterion with additional operations for the analysis of the

29 Popović, D.: Determining the structure of psychosomatic dimensions in fights and developing the procedures for their evaluation and monitoring - The Monograph, the Faculty of Physical Education, University of Priština, Priština, 1993.

components of variances of manifest and latent variables as well as for the evaluation of the reliability of latent variables.

THE ALGORITHM

Let Z be a matrix of the standardized data obtained by the description of some set E of n entity on some set V of m quantitative, normally or, at least, elliptically distributed variables. Let R be an intercorrelation matrix of those variables. Assume, R is a surely a regular matrix, and there can with certainty be rejected the hypothesis that variables from V have spherical distribution, i.e. the eigenvalues of the correlation matrix of population P , from which the sample E has been drawn, are equal.

Let

$$U^2 = (\text{diag } R^{-1})^{-1}$$

be Guttman's estimate of the unique variances of the variables from V , and let λ_p , $p = 1, \dots, m$ be the eigenvalues of the matrix R . Let

$$c = \text{trag } (I - U^2).$$

Define the scalar k as

$$\sum_p^k \lambda_p > c, \sum_p^{k-1} \lambda_p < c.$$

k is now the number of the principal components of matrix Z determined according to PB criterion of Štalec and Momirović (Štalec and Momirović, 1971).

Let $\Lambda = (\lambda_p)$; $p = 1, \dots, k$ be a diagonal matrix of the first k eigenvalues of matrix R and let $X = (x_p)$; $p = 1, \dots, k$ be a matrix of the associated eigenvectors scaled so that $X^t X = I$. Let T be some orthonormal matrix such that it optimizes the function

$$XT = Q = (q_p); p(Q) = \text{extremum}, T^t T = I,$$

where $p(Q)$ is a parsimonious function, for instance, a regular Varimax function

$$\sum_j^m \sum_p^k q_{jp}^4 - \sum_p^k (\sum_j^m q_{jp}^2)^2 = \text{maximum}$$

where the coefficients q_{jp} are the elements of matrix Q (Kaiser, 1958).

Now the transformation of the principal components, defined by the vectors in the matrix

$$K = ZX,$$

into semiorthogonal latent dimensions determined by type II orthoblique procedure (Harris and Kaiser, 1964), is defined by the operation

$$L = KT = ZXT.$$

The covariance matrix of those dimensions is

$$C = L'L_n^{-1} = Q'RQ = T'\Lambda T;$$

Denote a matrix of their variances as

$$S^2 = (s_p^2) = \text{diag } C.$$

If the latent dimensions are standardized by the operation

$$D = LS^{-1},$$

in the matrix

$$M = D'D_n^{-1} = S^{-1}T'\Lambda TS^{-1}$$

there will be their correlations; it can be seen, that C , and therefore M , cannot be diagonal matrices, so that thus obtained latent dimensions are not orthogonal in the space of E entity.

The matrix of correlations between variables from V and latent variables, usually classified as a factor structure matrix, will be

$$F = Z'D_n^{-1} = RXTS^{-1} = X\Lambda TS^{-1};$$

and since the elements of matrix F are orthogonal projections of Z vectors on D vectors, the coordinates of these vectors in the space stretched by D vectors are the elements of the matrix

$$A = FM^{-1} = XTS.$$

But since

$$A'A = S^2$$

then the latent dimensions obtained by this procedure are orthogonal in the space stretched by the vectors of variables from Z ; the squared norms of the vectors of those dimensions in the space of variables are equal to the variances of those dimensions.

EVALUATION OF THE RELIABILITY OF LATENT DIMENSIONS

For its simplicity and clear algebraic and geometric meaning and latent dimensions, and the identification structures associated with those dimensions, the reliability of the latent dimensions obtained by orthoblique transformation of principal components, may be determined in a clear and unambiguous manner.

Let $G = (g_{ij})$; $i = 1, \dots, n$; $j = 1, \dots, m$ be an acceptably unknown matrix of measurement errors when describing the set E on the set V . Then the matrix of the real results of entity E on the variables from V will be

$$Y = Z - G.$$

If, in accordance with the classical measurement theory (Gulliksen, 1950; Lord and Novick, 1968; Pfanzagl, 1968) it is assumed that the matrix G is such that

$$Y^t G = 0$$

and

$$G^t G n^{-1} = E^2 = (e_{ij}^2)$$

where E^2 is a diagonal matrix, then the covariance matrix of real results will be

$$H = Y^t Y n^{-1} = R - E^2$$

since

$$R = Z^t Z n^{-1}$$

is an intercorrelation matrix of variables from V defined on the set E .

Assume, the reliability coefficients of variables from V are known; let P be a diagonal matrix whose elements ρ_j are those reliability coefficients. Then the variances of measurement errors for standardized results on variables from V will precisely be the elements of the matrix

$$E^2 = I - P.$$

Now the real values on the latent dimensions will be the elements of the matrix

$$\Gamma = (Z - G)Q$$

with the covariance matrix

$$\Omega = \Gamma^t \Gamma n^{-1} = Q^t H Q = Q^t R Q - Q^t E^2 Q = (\omega_{pq}).$$

Accordingly, the real variances of latent dimensions will be diagonal elements of matrix Ω ; denote those elements as ω_p^2 . Based on the formal definition of reliability coefficients of some variable

$$\rho = \sigma_t^2 / \sigma^2$$

where σ_t^2 is the real variance of some variable, and σ^2 is the total variance of that variable, that is, the variance which includes the error variance, the coefficients

of reliability of latent dimensions, if the reliability coefficients of variables from which those dimensions have been derived are known, will be

$$\gamma_p = \omega_p^2 / s_p^2 = 1 - (q_p^t E^2 q_p)(q_p^t R q_p)^{-1} \quad p = 1, \dots, k$$

Proposition 1.

Coefficients γ_p vary in the range of (0,1) and may adopt the value 1 when and only when $P = I$, that is, if all the variables are measured without errors, and the value 0 when and only when $P = 0$ and $R = I$, that is, if the total variance of all the variables consists only of the variance of measurement error and variables from V have spherical normal distribution.

Proof:

If the total variance of each variable from some set consists only of the variance of measurement error, then it is obligatory that $E^2 = I$ and $R = I$, so all the coefficients γ_p equal zero. The first part of the proposition is obvious from the definition of coefficients γ_p ; which means that the reliability of each latent dimension, regardless of the manner of determining that latent dimension, equals 1 if the variables from which that dimension has been derived are measured without error.

However, the matrix of reliability coefficients $P = (\rho_i)$ is frequently unknown, so the matrix of variances of measurement error E^2 is as well unknown. But, if the variables from V are selected so that they may represent some universe of variables U with the same field of meaning, the upper limit of variances of measurement errors is defined by the elements of the matrix U^2 (Guttman, 1945; 1953), that is by the unique variances of those variables. Consequently, in that case, the lower limit of the reliability of latent dimensions may be estimated by the coefficients

$$\beta_p = 1 - (q_p^t U^2 q_p)(q_p^t R q_p)^{-1} \quad p = 1, \dots, k$$

which are derived from the procedure identical to the procedure by which the coefficients γ_p have been derived with the definition $E^2 = U^2$, therefore in the same way as Guttman derived his own measure λ_6 .

Proposition 2.

Coefficients β_p vary in the range of (0,1), although they cannot reach the value 1.

Proof:

If $R = I$, then $U^2 = I$, so all the coefficients β_p are equal to zero. Though, since $U^2 = 0$ is not possible if the matrix R is regular, all the coefficients β_p are necessarily less than 1 and tend to 1 when the unique variance of variables, from which the latent dimensions are derived, tends to zero.

By applying the same technology, it is simple to derive measures of the absolute lower limit of reliability of latent dimensions defined by this procedure in the same way as Guttman derived his measure λ_1 . For this purpose, set $E^2 = I$. Then

$$\alpha_p = 1 - (q_p' R q_p)^{-1}$$

will be the measures of the absolute lower limit of reliability of latent dimensions, since, naturally,

$$Q'Q = I.$$

Proposition 3.

All the coefficients α_p are always less than 1.

Proof:

It is obvious that necessarily all the coefficients α_p are less than 1, and tend to 1 when m , the number of variables in the set V , tends to infinity, since then every squared form of matrix R tends to infinity. If $R = I$, then, evidently, all the coefficients α_p are equal to zero. However, the lower value of coefficients α_p doesn't have to be zero, since it is possible, although not for all coefficients α_p , that variance s_p^2 of some latent dimension is less than 1. Of course, the latent dimension which emits less information than any variable, from which it is derived, has no sense, and that could probably be the best revealed on the basis of the values of coefficients α_p .

The measures of type β_6 (Momirović, 1996) defined by the functions α_1 and α_2 will be, for the result defined by function h ,

$$\beta_{61} = \gamma^2 \lambda^{-2}$$

and

$$\beta_{62} = 1 - \delta^2\lambda^{-2}.$$

It is not difficult to show that, for the regular sets of particles, measures of type α_1 are the estimates of the lower limit of reliability of measures of type λ_6 and β_6 , and that the measures of type α_2 are the estimates of the upper limit of reliability of measures of type λ_6 and β_6 .

3. Results and discussion

In order to determine the characteristics of the basic space of conative variables, transformation and condensation of data in the intercorrelation matrix have been accomplished, and thus the features of measuring instruments are obtained.

Examining the structure of the matrix of intercorrelations among conative variables, it may be noticed that most of the intercorrelations are at a high level. (table 1).

The matrix is structured so that it forms a few blocks for which it could be said that they have decent intercorrelations. However, a real insight into the structure of personality traits could be gained after the factor extraction (table 2). According to the Gutman-Kaiser criterion, two latent dimensions with the total of 73.70% of the common variance have been isolated.

THE FIRST PRINCIPAL COMPONENT exhausts 55.10% of the total variance of the whole system of variables and it acts as a general factor of personality traits. All the variables that define this factor have very high correlations except the variable for estimating activity.

THE SECOND PRINCIPAL COMPONENT exhausts still decent 18.70% of the remaining variability and behaves as a single factor. It is defined by the activity regulator.

In order to obtain a simple structure, the initial reference system is rotated to the oblimin position and afterwards three more matrices are obtained: the pattern matrix, the structure matrix, and the correlation matrix of oblimin factors (tables 3, 4, and 5).

By parallel analysis of the pattern matrix and structure matrix, it may be noticed that the first latent dimension best of all defines the test for the evaluation of the system for integration of regulatory functions, and then, equally well, the test for the evaluation of the system for coordination of regulatory functions and regulation of defensive reactions, and then the test for the evaluation of regulation of organic functions and regulation of offensive reactions.

Considering that it is a discipline which requires a high degree of coordination abilities and their control with coordinated muscle tone and timely processing of the sensory musical stimulus as well as visual control of the space and elements in the visual field, i.e. it is necessary to harmonize the coordination of all movements with the partner and to take into account the whole space and other dancers who are performing dancing elements on the same dance floor. That, certainly, imposes at the same time the need for efficient functioning of the system for integration of regulatory functions, coordination of regulatory functions, defence regulation, regulation of organic systems and regulation of offensive reactions.

The second latent dimension is defined by the variable for estimating the excitatory-inhibitory processes. That dimension is similar to the second factor in the research of Momirović (1982.) and the third latent dimension of Popović (1990.). Since the regulation of the activating function of the reticular formation is the most probable physiological basis of variability and covariability of the test which defines it, presumably it is most adequate to interpret this factor as a measure of the efficiency of the mechanism for regulation of activity or regulation of processes of irritation and inhibition in accordance with some researches of Popović (1995, 1996).

It should be mentioned that in some researches thus obtained factor may be interpreted as a measure of extraversion (Aizenk) and even as a measure of Cattell's ehvia.

Considering the significance of this dimension, that is, the significance of the mechanism for activity regulation, it is, apparently, very well expressed in dancers engaged in standard and Latin American dance.

INTERCORRELATION MATRIX

Table 1.

Variable	EPS	XI	ALF	SIG	DEL	ETA
EPS	1.00					
XI	.04	1.00				
ALF	-.14	.56	1.00			
SIG	.09	.33	.65	1.00		
DEL	-.01	.21	.59	.75	1.00	
ETA	.28	.63	.63	.58	.71	1.00

MATRIX OF PRINCIPAL COMPONENTS

Table 2.

Variable	FAC1	FAC2	h^2
EPS	.09	.97	.95
XI	.64	.08	.42
ALF	.84	-.28	.79
SIG	.83	-.05	.69
DEL	.82	-.11	.69
ETA	.88	.26	.85
LAMBDA	3.30	1.12	
%	55.10	18.70	
CUM %	55.10	73.70	

PATTERN MATRIX

Table 3.

Variable	FAC1	FAC2
EPS	.00	.97
XI	.63	.10
ALF	.87	-.25
SIG	.83	-.02
DEL	.83	-.08
ETA	.85	.29

STRUCTURE MATRIX

Table 4.

Variable	FAC1	FAC2
EPS	.06	.97
XI	.64	.14
ALF	.85	-.20
SIG	.83	.02
DEL	.82	-.03
ETA	.87	.34

MATRIX OF INTERCORRELATIONS OF OBLIMIN FACTORS

Table 5.

Variable	OBL1	OBL2
OBL1	1.00	
OBL2	-.06	1.00

4. Conclusion

The research was conducted in order to determine the structure of personality characteristics of dancers, engaged in standard and Latin American dances.

For determining the structure of personality characteristics, 267 dancers, aged from 11 to 13, actively engaged in standard and Latin American dances were involved.

For estimating personality dimensions, measuring instruments were selected to cover the dimensions of the model of the functioning of conative regulatory mechanisms. The model implies hierarchical organization of the mechanisms for regulation and control of the behavioural modalities, and it is constructed so as to avoid artificial dichotomy to normal and pathological conative factors.

The selected measuring instruments are: an activity regulator (EPSILON), a regulator of defensive reactions (ALFA), a regulator of offensive reactions (SIGMA), a system for coordination of regulatory functions (DELTA), a system for integration of regulatory functions (ETA).

All the data collected in this research were processed in the Multidiscipline Research Centre of the Faculty of Sports and Physical Education, the University of Priština, supported by the system of data processing programmes developed by D. Popović, 1980, 1993, K. Momirović and D. Popović 2003.

In order to determine characteristics of the basic space of conative variables, transformation and condensation of the data into an intercorrelation matrix were performed and thus characteristics of the measuring instruments were obtained.

By examining the structure of the intercorrelation matrix of conative variables, it may be noticed that most of the intercorrelations are at a high level. The matrix is structured so that it forms a few blocks for which it could be stated that they have decent intercorrelations. Based on the Gutman-Kaizer criterion, two latent dimensions with the total of 73.70% of the common variability are isolated.

The first principal component exhausts 55.10% of the total variance of the whole system of variables and it acts as a general factor of personality traits. The second principal component exhausts still decent 18.70% of the remaining variability and it acts as a single factor. It is defined by the activity regulator.

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Evagelia Boli, Dragan Popović & Jasna Popović

*Faculty of Sports and Physical Education, the University of Priština
temporarily based in Leposavić, Serbia*

e-mail: evagelia.boli@pr.ac.rs

Summary

The research was conducted in order to determine the structure of personality of dancers, engaged in standard and Latin American dances, 267 dancers, aged from 11 to 13, were involved. For estimating personality dimensions, measuring instruments were selected to cover the dimensions of the model of the functioning of conative regulatory mechanisms. The model implies hierarchical organization of the mechanisms for regulation and control of the behavioural modalities, and it is constructed so as to avoid artificial dichotomy for normal and pathological conative factors. The selected measuring instruments are: an activity regulator (EPSILON), a regulator of defensive reactions (ALFA), a regulator of offensive reactions (SIGMA), a system for coordination of regulatory functions (DELTA), a system for integration of regulatory functions (ETA). All the data collected in this research were processed in the Multidiscipline Research Centre of the Faculty of Sports and Physical Education, the University of Priština, supported by the system of data processing programmes developed by D. Popović, 1980,

1993, K. Momirović and D. Popović 2003. In order to determine characteristics of the basic space of conative variables, transformation and condensation of the data into an intercorrelation matrix were performed, and thus characteristics of measuring instruments were obtained.

By examining the intercorrelation matrix of conative variables, it can be seen that the majority of intercorrelations is at an acceptable level. The matrix is structured so that it forms a few blocks for which it could be stated that they have decent intercorrelations. Based on the Gutman-Kaiser criterion, two latent dimensions are isolated with the total of 73.70% of the common variability. The first principal component exhausts 55.10% of the total variance of variables of the whole system and it acts as a general factor of personality traits. The second principal component exhausts still decent 18.70% of the remaining variability and it acts as a single factor. It is defined by the activity regulator.

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Evagelia Boli

Faculty of Sports and Physical Education, the University of Priština temporarily based in Leposavić, Serbia

e-mail: evagelia.boli@pr.ac.rs