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Influence of classical background music on children's cognitive ability

Junting Chen[1]

Abstract. At present, the methods evaluating the learning ability applied for the cognitive ability of most children are the traditional methods. Even though the algorithm method is applied in this paper to evaluate, the evaluation result can not be reflected truly, for the reason that the simplex mode is applied and the different evaluation methods are not taken against different objects. This paper designs a kind of analysis model for the influence of classical background music on children's cognitive ability based on geometric-flow hierarchical tree. Aiming at the problem that there is few significant coefficients in the wavelet decomposition result of geometric regularized data, the regularity direction is represented with two-dimensional vector field, and obtaining the approximation of these directions by spline representation method. Finally, based on the directional decomposition of geometric-flow children's cognition ability, the multilevel tree Bandelet partition encoding way is built by utilizing the M-band discrete wavelet transform, and achieving the Bandelet coefficient calculation improvement. The experimental result shows that, the method can effectively improve the calculation efficiency of data evaluation method for the children's cognitive ability of classic background music.

Key words. Classic background music, Cognitive ability, Geometric flow, Wavelet transform, Discrete.

1. Introduction

Children's cognitive ability influenced by classic background music refers to that the children know their own mental status through the observation on their own behaviors, namely, the perception, understanding and evaluation process of children on their own. As the primary school students are at the integrated body and heart development phase, only if they know their own condition, determine the complete self concept and be aware of their own roles in the group living, they can make their behaviors be adaptive to the requirement of education environment, so as to exert the learning initiative and creativity. The children's self cognition is gradually formed through the mutual influence with other people. From 3 years old, the children

[1]School of music, The University of Western Australia, Perth, Australia

begin to have the self-awareness and can be aware of the surrounding existence and others' needs. At this time, the adult shall note the cultivation of their self cognitive ability. For example: a 3-year-old little child shall firstly know his gender, his status in the family (grandparents, parents or brothers and sisters), how to get along with the family members and kindergarten children, and which behaviors can be allowed and affirmed by others. The early living environment and parents' parenting style of the children has a great influence on the formation of good self cognitive ability of the children.

Classic background music is an effective way to cultivate the children's cognitive ability, which can reflect the ability of teacher to manage and organize the classroom teaching on the one hand, and also reflect the self-control ability of the students on the other hand. Moreover, the self-control ability is an important part of children's self cognition, which directly influences the students' learning effect. It comprises the children's self-control on apparent behaviors, like the control on impulsive behaviors, also includes the control on the covert behaviors, like the control on the learning motivation and consciousness. On account of individual difference, the students show different self-control abilities in the same classic background music environment. The students with poor self-control ability are easy to have classroom problems, like talk, do the actions, and even break the rule for no reason to be in the way of others' learning. Some students have no patient with refusal or concentrated thinking of difficult problems under the classical background music. By contrast, some students show strong self-control ability, who can calmly handle with the difficulties and frustrations in learning, restrain the whiny emotion even facing their uninterested teaching contents and remain the status of continuous learning. So to speak, they are of high emotional intelligence. Therefore, cultivation of the students' good nonintellectual factor from childhood can facilitate the development of their intellectual factors. The development of student' self-control ability has the close relation with his/her gender, temperament, character cognition and attribution style, etc. For example, the traditional culture has different socialization standards on the boys and girls, that the boys are encouraged to be brave, fearless and independent, while the girls are required to be obedient and submissive, which have certain influence on the self expectation of male and female students. The teachers can be more receptible to the behavior lacking of self-control shown by the male students than the same behaviors shown by the female students. Besides, the physiological and psychological development of the female students at the primary school stage is matured for one to two years than that of the male students, so that their self-control ability is stronger than that of the boys, and their learning altitude and school record are better than that of the boys in general. Therefore, to a certain degree, the girls are easier to form the self-control ability at the primary school. The foreign research on the influence of classical background music on the children's self-control ability mainly starts with the impulsiveness, including the control on the movement and exercise, control on cognitive activity and control on emotions. We can not simply boil down the primary students' lack of self-control ability to that they suffer from the congenital ADHD, or have the idea that it will get better with the growth of their age. It may obtain certain effects if the teachers pay attention to them in the emotion, and give the training and guidance in the behaviors.

Aiming at the problem that there is less significant coefficient in the wavelet decomposition result of geometric regularized data, this paper uses the two-dimensional vector field to represent the regularity direction, and obtain the approximation of these directions by spline representation method. Finally, based on the directional decomposition of geometric-flow children's cognition ability, build the multilevel tree Bandelet partition encoding way by utilizing the M-band discrete wavelet transform, achieve the Bandelet coefficient calculation improvement and obtain the good cognitive ability evaluation model.

2. Detailed analysis ability of cognitive power evaluation scheme

According to the knowledge classification result proposed by the famous US psychologist Bloom, in general, all knowledge is divided into 6 categories: memorization ability, understanding ability, analysis ability, application ability, comprehensive ability and evaluation ability. In accordance with this classification method, the emphasis in investigation of these abilities is different for the same questionnaire, namely the difference of their proportion in the children's cognitive ability of classical background music, and the calculated results are different, as shown in the Table 1.

Table 1. Example for evaluation scheme result of cognitive power

Question No.	Full score	Actual score	Type of cognitive ability
1	10	8	Understanding
2	10	6	Memorization
3	10	7	Analysis
4	10	8	Comprehensive
5	10	5	Evaluation
6	10	7	Application
7	10	8	Analysis
8	10	3	Evaluation
9	10	2	Memorization
10	10	10	Understanding

Following constantly deepening teaching reform, the evaluation method for records also develops constantly. In the past, the influence of classical background music on children's cognitive ability is evaluated through the questionnaire. The different questionnaire ways are applied in accordance with different learning content and form, but on account of the individual difference, some are good at the memory, some are good at understanding and some are good at operation, so the evaluation on real ability is different. While for the same course, although the same questionnaire is applied, the cognitive ability cannot be reflected truly due to different demands and questionnaire emphases, so that the evaluation cannot be made. At present, the methods applied in the most questionnaire systems to evaluate the learning ability are the traditional methods. Even though apply the algorithm method in this paper to evaluate, the evaluation result cannot be reflected truly, for the reason that the simplex mode is applied and the different evaluation methods are not taken against different objects.

3. Sparse geometric-flow multilevel-tree Bandelet coding cognitive power evaluation model

3.1. Geometry optimization for data approximation of children's cognitive ability

For the approximation of children's cognitive power data, the optimal geometry approximation is the f_A approximation for the elements in A, so as to obtain the $\|f - f_A\|$ minimum deviation. In the Bandelet approximation, make f_A calculation by virtue of the element A including Bandelet coefficient, and assign the regional geometrical element flow for data partitioning of children's cognitive ability. For the purpose of the element representation for the data partitioning of children's cognitive ability and the identification of optimal partition, the children's cognitive ability data is divided into different binary direction areas. The binary square data partitioning area of children's cognitive ability is divided into four sub-square areas in small width. The binary square data partitioning of children's cognitive power with quad-tree is represented, as shown in Fig.1.

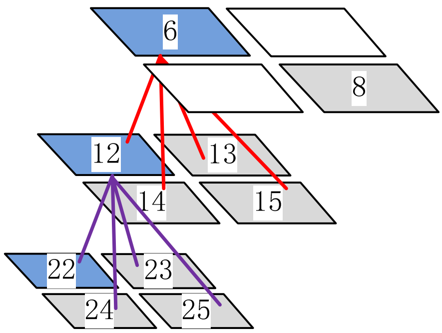

Fig. 1. Quad-tree representation of binary square children's cognitive power data

An important condition for geometric flow representation is that, the region representation of children's cognitive ability data shall be compact, so that the minimum compressed expenditure can be achieved. In order to achieve the parameter flow representation and obtain the smooth flow characteristic, the geometric flow direction can be approximated by the one order $B(u)$ of the B spline function, in form of:

$$c'[u] = \sum_{n=l}^{2^{k-I}} \alpha_n B(2^{-l}u - n)\,. \tag{1}$$

Where, $\alpha_n(n = 1, \cdots, 2^l)$ is the nth time of spline expansion coefficient of the scale factor 2^l; 2^k is the width of square area; u is the spline index $u \in \{x, y\}$. B spline function is in form of [14]:

$$B = \begin{cases} 1 - |u|, \; if \;\; |u| < 1 \\ 0, \; otherwise \end{cases} \tag{2}$$

It shows that the geometric regular flow can make data recovery through the stored spline curve control points.

3.2. Quad-tree construction of binary square children's cognitive ability data

Input the children's cognitive ability data $f(x, y)$, and firstly obtain the wavelet decomposition sub-band through the two-dimensional bi-orthogonal wavelet transformation. Every layer of wavelet transform decomposes the input into four spatial frequencies. The low-pass sub-band approximation a_j is the coarse version of original children's cognitive ability data, while other sub-bands d_j^H, d_j^V and d_j^D respectively signifies the high frequency details at the horizontal, vertical and diagonal direction.

$$\begin{cases} a_j(x, y) = \langle f(x, y), \phi_j(x)\phi_j(y)\rangle \\ d_j^H(x, y) = \langle f(x, y), \psi_j(x)\phi_j(y)\rangle \\ d_j^V(x, y) = \langle f(x, y), \phi_j(x)\psi_j(y)\rangle \\ d_j^D(x, y) = \langle f(x, y), \psi_j(x)\psi_j(y)\rangle \end{cases} \tag{3}$$

Where, $\phi_j(x, y)$ represents the zoom function, $\psi_j(x, y)$ represents the wavelet function, and j represents the scale factor. Approximate the low-pas sub-band through the iteration decomposition, which contains most energy. Divide the obtained wavelet-transform children cognitive ability data into different binary square areas. The binary square area S can be decomposed into four sub-square areas in equal size 2^k through the recursion of children's cognitive ability. The quad-tree can be used to represent the binary children's cognitive ability data partitioning.

For every square area S_i, build the geometric flow of children's cognitive ability by using the children's cognitive ability data sample value along the flow line. The geometric shape feature of children's cognitive ability data is represented by the vector field, and geometric flow shows the regularity of the gray-level direction change of children's cognitive ability data. In the discrete frame, the geometric flow of the area S_i is a vector field $\boldsymbol{v}(x, y)$, which is determined by the sampling grid of children's cognitive ability data. In case of the geometric flow parallel to the vertical direction, $\boldsymbol{v}(x, y) = \boldsymbol{v}(x)$. For the fixed value y and variable x, the flow vector is normalized as $\boldsymbol{v}(x) = (1, c'(x))$, of which, $c'(x)$ represents the mean relative measurement displacement of gray level of children's cognitive ability data from the direction x to $x{-}1$ in the area S_i. In order to translate the flow direction into the actual geometric regularity, it is required to work out the flow line. The flow line is a complete curve, with its tangent line parallel $\boldsymbol{v}(x)$, which can be represented by the wavelet basis along the regular direction. On account of that the flow line is parallel to the vertical direction, for the fixed value y and x, the discrete flow line in the area S_i can be represented as the coordinate $(x, y + c(x)) \in S_i$ of a group of points, where:

$$c_i(x) = \sum_{p=a_i}^{x} c_i'(p)\,. \tag{4}$$

In addition, $a_i = \min_x \{(x, y) \in S_i\}$. The coordinate of flow line is stored in a sampling grid array. If $(x, y + c_i(x)) \in S_i$, it can be defined as:

$$G_i(x, y) = (x, y + c_i(x))\,. \tag{5}$$

In case of the geometric flow paralleling to the horizontal direction, $\boldsymbol{v}(x, y) = \boldsymbol{v}(y) = (c'(y), 1)$. For the fixed value y and variable x, every flow line can be defined as:

$$G_i(x, y) = (x + c_i(y), y)\,. \tag{6}$$

If $G_i(x, y)$ is a non-integral value, it is required to carefully sample the data point. In the proposed methods, the nearest interpolation technology is used to avoid the data loss during the sampling process. In order to achieve the parameter flow and obtain the smooth flow, the flow direction can be approximate by virtue of B spline function.

3.3. Calculation of bending wavelet coefficient

In every binary area, the wavelet matches the children's cognitive ability data. In such way, the wavelet coefficient basically twines the margin of children's cognitive ability data, rather than across them. This process significantly reduces the number of large wavelet coefficient, and cause higher compression ratio. The bending wavelet coefficient can be calculated by virtue of sub-band filter and crossed partitioning border of children's cognitive ability data. When making wavelet coefficient calculation by using the filter group, it is required to perfectly rebuild the filter row and column of children's cognitive ability with combination of sampling, and calculate the wavelet coefficient. The wavelet coefficient is the inner product of $f(x, y)$ and discrete separable wavelet [15]:

$$\left\{ \begin{array}{l} \phi_j^{m_I}(x)\psi_j^{m_2}(y) \\ \psi_j^{m_1}(x)\phi_j^{m_2}(y) \\ \psi_j^{m_1}(x)\psi_j^{m_2}(y) \end{array} \right\}_{j,m_1,m_2} \tag{7}$$

The separable wavelet in the Formula (7) bends along the flow line, of which the operator can be defined for the vertical parallel flow:

$$W(f(x, y)) = f(x, y + c(x))\,. \tag{8}$$

By rebuilding the geometric flow, the gray level of children's cognitive ability data changes regularly along these flow lines, so that the bending children's cognitive ability data $W(f(x,y))$ are along the direction of horizontal line against the fixed value y and variable x. Therefore, for every fixed value y, $\psi(x,y)$ is the wavelet function of multiple vanishing moments along x, and the inner product can be represented as $\langle Wf, \psi \rangle = \langle f, W^{*}\psi \rangle$, which has one small amplitude. The bending operator W is a orthogonal operator:

$$W^{*}f(x,y) = W^{-1}f(x,y) = f(x, y - c(x)) . \tag{9}$$

On account of $W^{*} = W^{-1}$, the bending wavelet basis can be obtained by adding W^{-1} at every separable wavelet basis:

$$\left\{ \begin{array}{l} \phi_j^{m_1}(x)\psi_j^{m_2}(y - c(x)) \\ \psi_j^{m_1}(x - c(y))\phi_j^{m_2}(y) \\ \psi_j^{m_1}(x - c(y))\psi_j^{m_2}(y) \end{array} \right\}_{j,m_1,m_2} \tag{10}$$

The bending wavelet basis of horizontally-parallel children's cognitive ability data flow can be calculated in the same way, and its operator is:

$$W(f(x,y)) = f(x + c(y)) . \tag{11}$$

Then, the bending wavelet basis can be defined as:

$$\left\{ \begin{array}{l} \phi_j^{m_1}(x - c(y))\psi_j^{m_2}(y) \\ \psi_j^{m_1}(x - c(y))\phi_j^{m_2}(y) \\ \psi_j^{m_1}(x - c(y))\psi_j^{m_2}(y) \end{array} \right\}_{j,m_1,m_2} \tag{12}$$

Based on the bending wavelet transform, build the bandelets coefficient. If $\psi(x,y)$ has the vanishing moment for every y along the x direction, the bending wavelet coefficient $\langle f, W^{-1}\psi \rangle$ is very little.

3.4. Multilevel tree partition encoding

Based on the bending wavelet transform, obtain the bandelets coefficient by virtue of multilevel-tree complex wavelet decomposition and build: complex switching signal $f(t)$, expand parent wave $\varphi(t)$ and scaling function $\phi(t)$. Of which, the signal $f(t)$ can be defined as:

$$f(t) = \sum_{l \in Z} s_{j0,l}\phi_{j0,l}(t) + \sum_{j \geq j0} \sum_{l \in Z} c_{j,l}\varphi_{j,l}(t) . \tag{13}$$

Where, $s_{j0,l}$ is the zoom coefficient and $c_{j,l}$ is the complex wavelet coefficient, of which $\phi_{j0,l}(t)$ and $\varphi_{j,l}(t)$ are expressed as follows:

$$\begin{cases} \phi_{j0,l}(t) = \phi^r_{j0,l} + i\phi^i_{j0,l} \\ \varphi_{j0,l}(t) = \varphi^r_{j0,l} + i\varphi^i_{j0,l} \end{cases} \tag{14}$$

Where, $\varphi^r_{j0,l}$ and $\varphi^i_{j0,l}$ are real wavelet each, and the complex wavelet transform is the mixture of two real wavelet transform. The schematic diagram for frequency-domain two-level decomposition of binary-tree complex wavelet transform is given in the Fig.2.

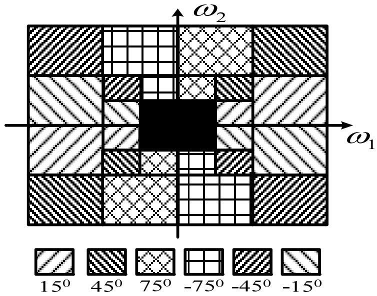

Fig. 2. Frequency domain decomposition of binary-tree complex wavelet

The binary-tree wavelet transform can be similar to the two-dimensional wavelet transform and achieve the separable wavelet transform. The frequency-domain two-level decomposition result of binary-tree complex wavelet transform is as shown in the Fig.2, with corresponding angle information of $\left[\pm 15^0, \pm 45^0, \pm 75^0\right]$.

Based on two M-band discrete wavelet transforms, M-band binary-tree complex wavelet algorithm is achieved through the Hilbert transform, and the M-band binary-tree complex wavelet filter structure is given in Fig.2 with an example of $M = 6$. Explaining with example of 6-band binary-tree complex wavelet structure in Fig.3, the filter, in essence, is a group of band-pass filter bank with optional direction and frequency. At the filter stage, in accordance with different directions and resolutions, decompose the texture children's cognitive ability data into M×M channel by utilizing the bi-orthogonal wavelet, and give out the pulse response of one-dimensional M-band ($M = 6$) wavelet filter by φ_l and its corresponding transfer function, in form of h_l, $l = 0, 1, \cdots, 5$. Of which, $l = 0, 1, \cdots, 5$ is the low-pass filter, and other $\varphi_l\,(l \neq 1)$ is the corresponding wavelet function. In this work, we achieve the two-dimensional separable transform through the tensor product of M-band one-dimensional DT-CWT filter. Upon $M = 6$, the children's cognitive ability data is decomposed into $M \times M = 36$ channels.

3.5. Algorithm calculation process

The specific steps for evaluation algorithm for children's cognitive ability data of multilevel-tree Bandelet partitioning encoding based on sparse geometric flow are as follows:

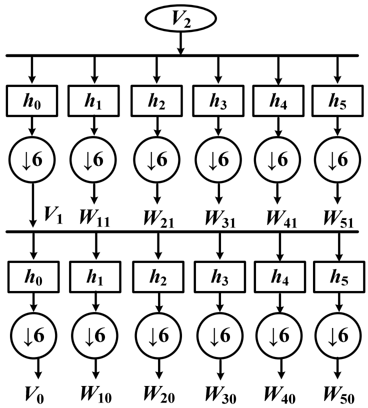

Fig. 3. 6-band binary-tree complex wavelet

Input: Children's cognitive ability data; **Output:** Bandelet wavelet coefficient.

Step 1: Load the children's cognitive ability data, transform into the gray-level children's cognitive ability data (if it is RGB), and then make two-dimensional wavelet transform. Extract the binary square area feature and make geometric flow calculation according to Section 3.1, and make bending wavelet coefficient calculation in accordance with Section 3.3.

Step 2: Execute M-band binary-tree complex wavelet, and execute the fractional Fourier transform for every sub-band of M-band binary-tree complex wavelet; output the response data of fractional Fourier M-band binary-tree complex wavelet.

Step 3: Based on above sub-wave, insert the bending wavelet basis, and obtain the Bandelet basis form as:

$$\left\{\begin{array}{l}\phi_j^{m_1}(x-c(y))\psi_j^{m_2}(y)\\ \psi_j^{m_1}(x-c(y))\psi_l^{m_2}(y)\\ \psi_j^{m_1}(x-C(y))\psi_j^{m_2}(y)\end{array}\right\}_{j,l>j,m_1,m_2} \tag{15}$$

Step 4: According to the hierarchical tree encoder, obtain the Bandelet wavelet coefficient encoding process:

$$s_n\left(u_m\right)=\left\{\begin{array}{l}1, \max\left|B_{x,y}\right|\geq 2^n\\ 0, otherwise\end{array}\right. \tag{16}$$

Of which, $s_n\left(u_m\right)$ is a group of coordinate concept, representing the Bandelet wavelet coefficient on the coordinate (x, y), and $B_{x,y}$ is the bending wavelet coefficient.

4. Experimental analysis

The experimental data come from the sampling data of one primary school in domestic, involving 1,000 students at age within 6 – 8 years old. The aim of evaluation is to judge the student's cognitive ability through the final evaluation value. Therefore, it is regulated: it is excellent upon $Y \leq 1\&\&Y \geq 0.8$, good upon $Y < 0.8\&\&Y \geq 0.7$, medium upon $Y < 0.7\&\&Y \geq 0.6$, qualified upon $Y < 0.6\&\&Y \geq 0.5$ and disqualified upon $Y < 0.5$. Assuming that an accurate evaluation value is obtained through the proposed algorithm, whether it is excellent and good is judged in accordance with this value. Therefore, the output of the proposed algorithm can be only one node, with the calculation result in this scheme as shown in the Table 2.

It can be known from the Table 7 that the theoretical evaluation value and practical evaluation value obtained by applying this scheme are almost similar, with mean error at just 0.0014. After verification through 10 groups of test data, the test result has an error at just 0.001. Because this scheme is rapid and simple in high accuracy, this scheme is applied.

Select the algorithm in Literature [5] as the comparing algorithm, and the comparison condition of evaluation accuracy and calculation time is as shown in Table 3.

Table 2. Evaluation on students' cognitive ability

Knowledge	0.7	0.9	0.9	0.6	0.9	0.6
Understanding	0.9	0.9	0.9	0.6	0.9	0.8
Analysis	0.7	0.9	0.4	0.78	0.9	0.9
Application	0.8	0.9	0.5	0.9	0.5	0.7
Comprehensive	0.9	0.9	0.5	0.2	0.5	0.4
Evaluation	0.7	0.8	0.3	0.5	0.3	1.
Theoretical evaluation value	0.80	0.89	0.56	0.61	0.64	0.57
Practical evaluation value	0.8004	0.8897	0.5600	0.6100	0.6401	0.570
Error	-0.0004	0.0103	0	0	-0.0001	0

Table 3. Comparison of evaluation accuracy & calculation time

Experimental subject	Comparing algorithm	Evaluation accuracy	Computing time (s)
Image a	Literature [5]	0.92	5.2
	Proposed algorithm	0.95	3.8
Image b	Literature [5]	0.93	4.6
	Proposed algorithm	0.96	3.1
Image c	Literature [5]	0.89	6.5
	Proposed algorithm	0.94	4.8
Image d	Literature [5]	0.91	5.9
	Proposed algorithm	0.95	4.7

From the data in the Table 1, it can be known that, in the evaluation precision, the proposed algorithm is higher than the comparison algorithm of Literature [5] selected, with mean evaluation precision higher about 15.3%. In the computing time index, the mean time of children's cognitive time in the proposed algorithm is about 20% lower than that of the Literature [5]. The above experimental results verify the advantages of proposed algorithm in the compression performance and efficiency.

5. Conclusion

This paper designs a kind of analysis model for the influence of classical background music on children's cognitive ability based on the geometric-flow multilevel tree. Aiming at the problem of less apparent coefficients in the wavelet decomposition result of geometric regularization data, the regularization direction is represented by the two-dimensional vector field, obtaining the approximation of these directions with the spline representation method. Finally, based on the direction decomposition of geometric-flow children's cognitive ability data, the multilevel Bandelet partitioning encoding way is built by virtue of M-band discrete wavelet transform, and the Bandelet coefficient calculation is improved, so as to solve the problem that learning ability evaluation method in the children's most cognitive abilities is too simplex and realize the good evaluation result.

References

[1] N. Biedinger: *Early Ethnic Inequality: The Influence of Social Background and Parental Involvement on Preschool Children's Cognitive Ability in Germany*[J]. Child Indicators Research *3* (2010), No. 1, 11–28.

[2] N. Biedinger: *The Influence of Education and Home Environment on the Cognitive Outcomes of Preschool Children in Germany*[J]. Child Development Research *2* (2011), No. 2, 2014–2018.

[3] X. Zhang, L. Leng, H. Chen, et al.: *Parental Rearing Pattern Mediates the Association between Social Economic Status and Cognitive Ability of Migrant Children*[J]. Psychoogical Development & Education (2017).

[4] M. Stievenart, I. Roskam, J. C. Meunier, et al.: *The Reciprocal Relation between Children's Attachment Representations and Their Cognitive Ability.*[J]. International Journal of Behavioral Development *35* (2011), No. 1, 58–66.

[5] M. Stievenart, I. Roskam, J. C. Meunier, et al.: *The Reciprocal Relation between Children's Attachment Representations and Their Cognitive Ability.*[J]. International Journal of Behavioral Development *35* (2011), No. 1, 58–66.

[6] S. Phillipson, S. N. Phillipson: *Generalizability in the Mediation Effects of Parental Expectations on Children's Cognitive Ability and Self-concept*[J]. Journal of Child & Family Studies *26* (2017), No. 12, 3388–3400.

[7] V. K. Ivanov, J. G. Geake: *The Mozart Effect and primary school children*[J]. Psychology of Music *31* (2003), No. 4, 405–413.

[8] Thompson, W. F. Schellenberg, E. G. Letnic, A. Katharine: *Fast and Loud Background Music Disrupts Reading Comprehension* [J]. Psychology of Music *40* (2012), No. 6, 700–708.

[9] K. Evangelista, M. Rla, B. Capili, et al.: *Effects of Classical Background Music on Stress, Anxiety, and Knowledge of Filipino Baccalaureate Nursing Students*[J]. Int J Nurs Educ Scholarsh *14* (2017), No. 1.

[10] K. S. Ryu, S. C. S. Jang: *The effect of environmental perceptions on behavioral in-*

tentions through emotions: the case of upscale restaurants.[J]. Journal of Hospitality & Tourism Research *31* (2007), No. 1, 56–72.

[11] F. Franco, J. S. Swaine, S. Israni, et al.: *Affect-matching music improves cognitive performance in adults and young children for both positive and negative emotions*[J]. Psychology of Music *42* (2014), No. 6, 869–887.

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