Minimizing the influence of coronavirus in a built environment

MICROBE

O2/A6. Testing and Improvement of the MICROBE Method

1. Testing MICROBE Method

MICROBE Method integrates coronaviruses and stress management techniques, Damasio's somatic marker hypothesis (Damasio, 1994); Russell's circumplex model of affect (Russell, 1980); emotional, affective, biometrics and the surrounding environment (pollution, noise, etc.) (pollution, noise, etc.) data; neuro-decision and neuro-correlation matrices; biometric and opinion mining methods; spatial analysis of categorical data by means of built environment analysis and multiplecriteria methods, for example, generation of human affective, emotional, biometrical states and the surrounding environment (pollution, noise, etc.) maps; neuro-questionnaire method; affective computing. It also involves statistical analysis (LOGIT, KNN, MBP, RBP), recommender technique and Web-based opinion analytics technique, as well as five methods for multiple-criteria analysis.

The MICROBE Method was tested. The major interest groups, residents, municipal employees and representatives of business companies tested and applied the Method. We developed a survey in order to collect stakeholders responce. The survey results are presented below.

The survey involved 25 respondents ranging in age from 40 to 49 years and more than 50 years (Fig. 1). The vast majority of respondents (68%) were from educational institutions. Other respondents were from a business company, a municipal, and a public-private foundation. Also, the vast majority of respondents (84%) had more than ten years of experience.

Figure 1. Informatio about respondents

We also asked general questions about the MICROBE method (Fig. 2). The vast majority of respondents rate the MICROBE method very well. The average of the evaluations is 91%. Also, respondents singled out the following advantages of the method:
- Providing recommendations (60%)
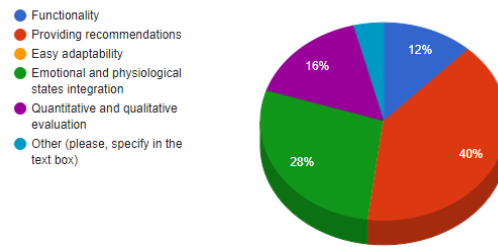- Integration of emotional and physiological state (28%).

One respondent also singled out science validity rationality as an advantage of this method (in other option). Analyzing the shortcomings of the method, the main weaknesses were identified by the respondents as:
- Ease of use (32%)
- Integration costs (24%)
- Adaptation (16%)

4. How would you rate the MICROBE Method?

5. What do you like most about the MICROBE Method?

- Functionality
- Providing recommendations
- Easy adaptability
- Emotional and physiological states integration
- Quantitative and qualitative evaluation
- Other (please, specify in the text box)

6. What do you like least about the MICROBE Method?

- Functionality
- Adaptability
- Optimization
- Ease of use
- Integration costs
- Other (please, specify in the text box)
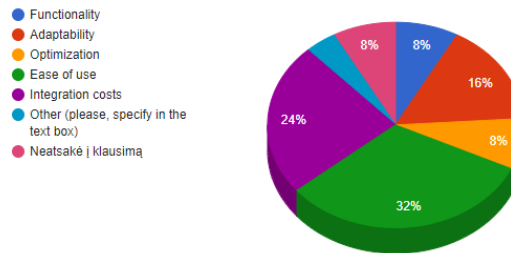- Neatsakė į klausimą

Figure 2. General questions about the MICROBE method.

Another group of questions was related to the MICROBE method stages (Fig. 3). Respondents were asked whether each stage was appropriate and necessary. According to the answers received, 80-92% of the respondents answered that the stages are appropriate and necessary. Based on the responses received, these stages will not be adjusted.
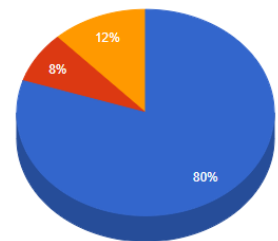
7. Is the Stage 1: Formulation of the Research Problem appropriate and necessary?
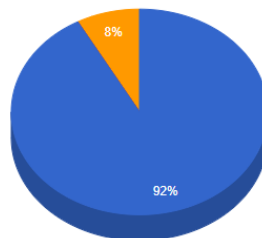
- Yes
- No
- Maybe
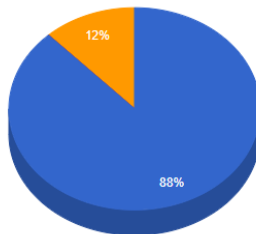
8. Is the Stage 2: Literature Review appropriate and necessary?
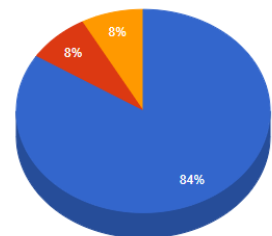
- Yes
- No
- Maybe

9. Is the Stage 3: The Big Picture appropriate and necessary?
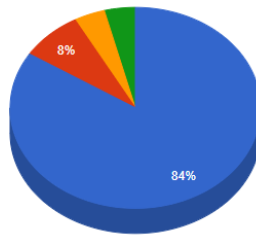
- Yes
- No
- Maybe

10. Is Stage 4: Scanning a Human-Centered Built Environment and Collecting Data understandable and necessary?
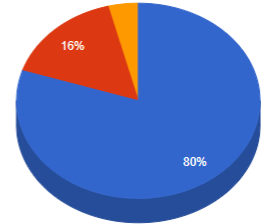
- Yes
- No
- Maybe

11. Is the Stage 5: The Integrated MICROBE Method understandable and necessary?

- Yes
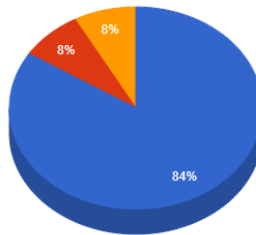- No, should be more detailed
- Maybe
- Neatsakė į klausimą

8%

84%

12. Is the Stage 6: Development of the MICROBE System understandable and necessary?
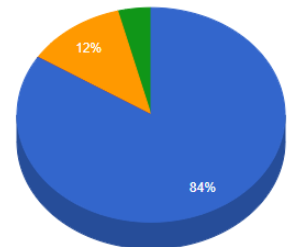
- Yes
- No, should be more detailed
- Maybe

16%

80%

13. Is the Stage 7: Multiple-Criteria Analysis of Alternatives understandable and necessary?

- Yes
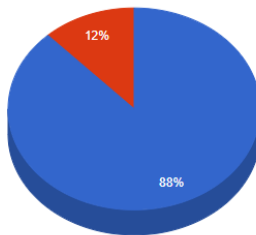- No, should be more detailed
- Maybe

8%

8%

84%

14. Is the Stage 8: The MICROBE Correlation Subsystem (Correlation Metrics Subsystem) understandable and necessary?

- Yes
- No, should be more detailed
- Maybe
- Neatsakė į klausimą

12%

84%

15. Is the Stage 9: Real-time negative emotions and possible COVID-19 indices in Vilnius understandable and necessary?

- Yes
- No, should be more detailed
- Maybe

12%

88%

16. Is the Stage 10: Assessing the Accuracy of the MICROBE through Verification and Validation understandable and necessary?

- Yes
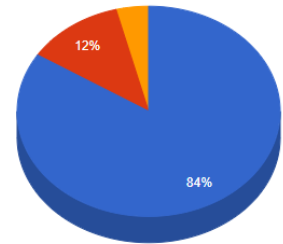- No, should be more detailed
- Maybe

12%

84%

Figure 3. Questions about MICROBE method stages.

The last group of questions was related to suggestions and feedback (Fig. 4). The aim was to find out how the MICROBE method should be improved and the respondents' feedback. The vast majority of respondents (84%) had no suggestion to supplement the stages of the MICROBE method. Also, as many as 89% of respondents were satisfied with integrating the MICROBE Method with other services, and 84% of respondents would recommend the method to others. Respondents' suggestions for improving the method are presented:

- Descriptions are clear, comprehensive, seem very promising, innovative, and relevant. Just look at the grammar and punctuation in the description.
- To make its application user-friendly.

17. Do you have to suggest an additional stage for the MICROBE Method?

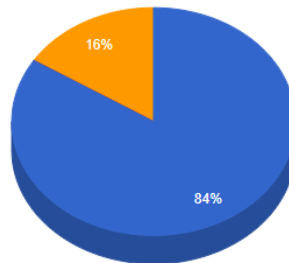- Yes (if yes, please enter you suggestions in the text box)
- No
- Maybe

8%

8%

84%
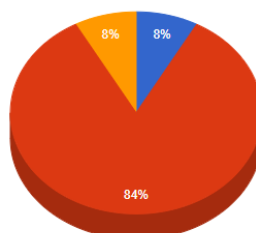
18. How satisfied are you with the ability to integrate MICROBE Method with other services?

100

50

0

Satisfaction (the higher the score, the better)

19. Would you recommend the MICROBE Method to others?

- Yes
- No
- Maybe

16%

84%

Figure 4. Suggestions and feedback.

2. Testing measurement and analysis of events during

2.1. February 16, Restoration of the independent state of Lithuania

February 16 is the restoration of the independent state of Lithuania. It is a national event of Lithuania dedicated to commemorating the Lithuanian Independence Act signed in 1918 by the signatories of the Lithuanian Council. This important document was signed by 20 signatories. This historical date is mentioned every year in Lithuania. This year Lithuania celebrated the 100th anniversary of Independence Day.

Researchers have examined the dependency between emotions and events. Researchers argue that positive/negative events contribute to positive/negative human emotions. The measurements for this study taken at Pilies Street have produced similar results. For instance, on 16 February 2018, Lithuania celebrated the centenary of its independence. Comparisons of valence percentages recorded between November and February (see Fig. 5) show a spike on February 15 and 16, the main two days of festivities. Figure 5 also shows a higher valence in December compared to November and January. The likely cause of December being the month of better moods and higher valence is the festive season of a Catholic Christmas and New Year in Lithuania.

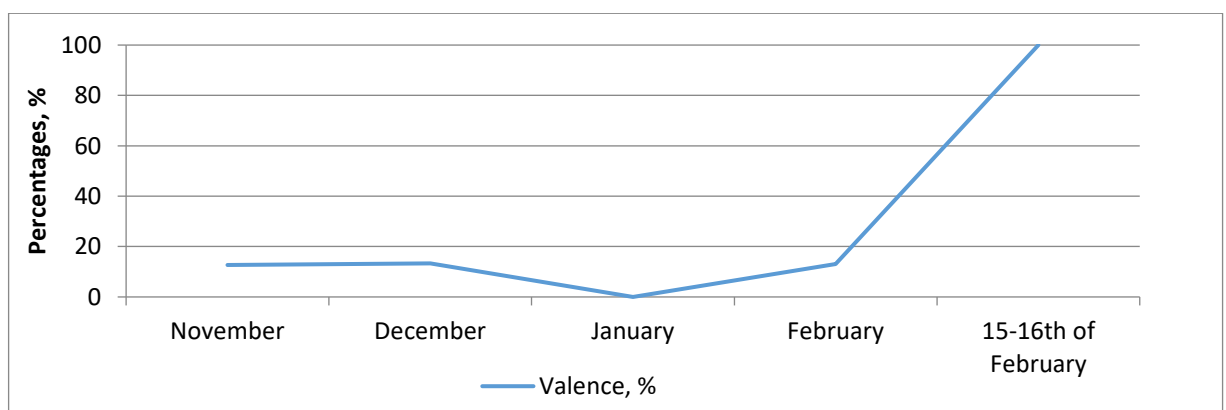**Figure 5**. Changes in the month under analysis mean monthly valence between November 2017 and February 2018 with a spike noted on February 15 and 16, the two days of main centenary celebrations

Measurements of anonymised passer-by emotions and physiological states returned similar results. The passer-by affective mode measured in Pilies Street (see Table 4.16) and Gedimino Avenue (Table 1), for

instance, was higher than the February average. This is due to improved happiness, surprise, valence and arousal values, and lower sadness and anger values.

Table 1. On February 16, when Lithuania celebrated its Restoration of the State Day, the emotional state of passers-by in Pilies Street was above the February mean.

Happiness value	The average level of happiness during the month in question	Sadness value	The mean level of sadness during the month in question	Anger value	The average level of angry during the month in question	Surprise value	The mean level of surprise during the month in question	Valence	The average level of valence during the month in question	Arousal	The mean level of arousal during the month in question
0,1610	0,1537	0,1531	0,2119	0,0829	0,1086	0,0820	0,0495	-0,0242	-0,1126	0,3276	0,3528
0,00075	0,073079	0,011167	0,180993	0,424871	0,119631	0,007771	0,036484	-0,42412	-0,20482	0,050958	0,334975

2.2. March 11, Lithuanian Independence Day

Similar research results were also gained when interviewing residents. The Kantar TNS Study, performed by a commission from the Century of the Restoration of the State Secretariat, showed that three-fourths of Lithuania's residents believe February 16 [Independence Day] is the third most significant holiday. This holiday holds third place by personal importance, following Christmas and Easter. A representative survey of Lithuania's residents by questionnaire was performed on 13-19 March 2018. The Human Study Center has been performing annual studies on the psychological climate in Lithuania and people's feelings since 2008. These indicate that the country experienced improved public moods with the arrival of Lithuania's 100 years on independence commemoration. The view of Lithuania's residents of their own lives also improved: at the end of 2017, 69 percent felt "happiness" or "rather happiness" in comparison to 65 percent who felt this way in 2016. Those who were proud of being Lithuania's citizens grew from 69 percent to 82 percent in one year. Such data indicate that, little by little, the identity crisis in Lithuania is ending, and the stronger identification with Lithuania allows an expectation of a lower flow of emigration. G. Chomentauskas, a psychotherapist, directs attention to the indicator of suicidal intentions. Although it remains high, this indicator is lower than it was during the previous year and it is the lowest since 2010. The psychotherapist claims that the figure allows an expectation of fewer suicides in 2018. Baltijos Tyrimai conducted this national representative survey from 20 November to 04 December of 2017. There were 1,108 respondents aged 15 years and over interviewed.

Lithuanian Independence Day 1990 March 11 The Supreme Council of the Republic of Lithuania signed the Act on the restoration of Lithuania's independence, which states that the exercise of sovereign powers of the State of Lithuania, which was abolished in 1940, is restored and Lithuania is now an independent state. The Act refers to the 1918 February 16 signed by the Lithuanian Independence Act, which never ceased to have legal effect.

Measurements of anonymised passer-by emotions and physiological states returned similar results. This is due to improved surprise, valence and arousal values, and lower sadness and anger values (see Table 2).

Table 2. On March 11, Lithuanian Independence Day, the affective mode of passers-by in Vilnius was over the March average.

Sadness value	The mean level of sadness during the month in question	Anger value	The average level of angry during the month in question	Surprise value	The mean level of surprise during the month in question	Valence	The average level of valence during the month in question	Arousal	The mean level of arousal during the month in question
0,1575	0,1905	0,0970	0,1236	0,1106	0,0670	-0,0849	-0,1170	0,3816	0,3594
0,392918	0,154858	0,093201	0,09727	0,00707	0,039045	-0,281237	-0,13873	0,324297	0,352669

2.3. Impact measurement and analysis of events during the December 24-25 Christmas and December 31 New Year

Christmas is an annual festival commemorating the birth of Jesus Christ, observed primarily on December 25 as a religious and cultural celebration among billions of people around the world. A feast central to the Christian liturgical year, it is preceded by the season of Advent or the Nativity Fast and initiates the season of Christmastide, which historically in the West lasts twelve days and culminates on Twelfth Night; in some traditions, Christmastide includes an octave. Christmas Day is a public holiday in many of the world's nations, is celebrated religiously by a majority of Christians, as well as culturally by many non-Christians, and forms an integral part of the holiday season centered around it.

In the Gregorian calendar, New Year's Eve, the last day of the year, is on 31 December which is the seventh day of Christmastide. In many countries, New Year's Eve is celebrated at evening social gatherings, where many people dance, eat, drink alcoholic beverages, and watch or light fireworks to mark the new year. Some Christians attend a watchnight service. The celebrations generally go on past midnight into New Year's Day, 1 January.

Figure 6 shows the happiness values per day recorded between 15/12/2017 and 01/01/2018 with happiness peaking on 24 December 2017 (Christmas Eve) and on 31 December 2017 (New Year's Eve). The holiday season also produced higher respiratory rates (see Figure 7). The values measured in Pilies Street between November and February presented in Figure 7 show higher respiratory rates on December 24–26 and December 31 and throughout the month of December.
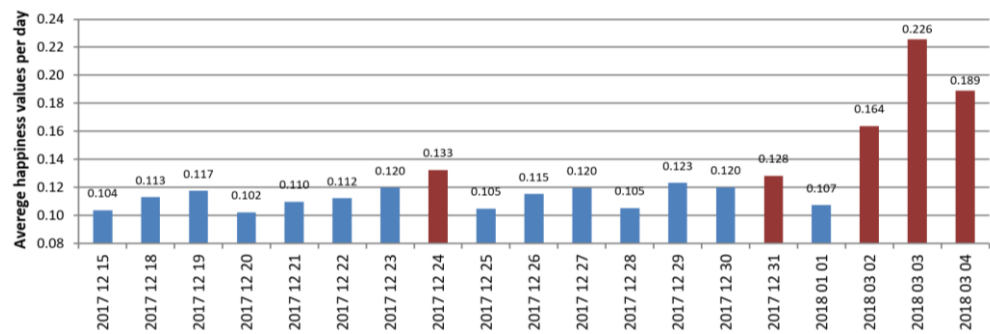
Figure 6. The changes in happiness per day between 15/12/2017 and 01/01/2018. Compared to the months analysed, residents were happier during the December 24-25 Christmas and December 31 New Year.
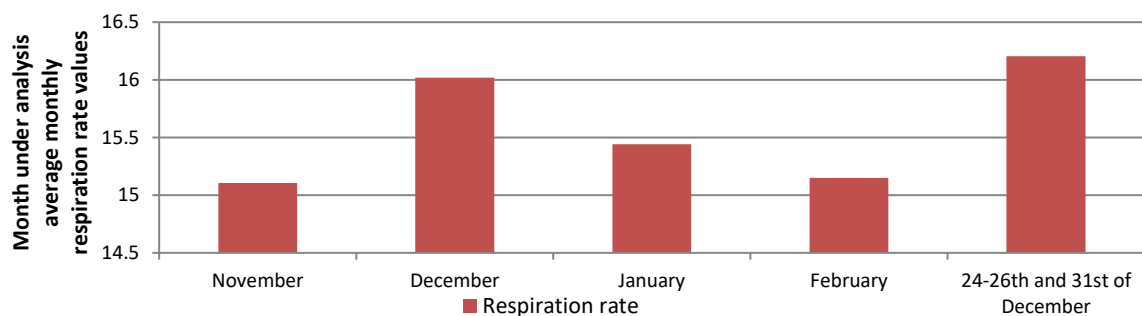
Figure 7. The month under analysis average monthly values measured in Pilies Street between November 2017 and February 2018 show higher respiratory rates on December 24–26 and December 31 and throughout the month of December.

Gomez and Danuser (2007) have stated that the respiratory rate increased, as did the subjective arousal. Other scientists examined this relationship as well (Briefer et al., 2015; Gomez et al., 2016; Gomez et al., 2008; Ritz et al., 2005; Vlemincx et al., 2013; Schmidt, 1984; Lane et al., 2009; Napadow et al., 2008; Birn et al., 2009).

2.4. March 2-4, 2018, Kaziukas Fair

Kaziukas Fair is an annual folklore fair organized in Lithuania in which people sell their folk products. The fair is usually organized on the closest Sunday until St. Casimir's Day, March 4. Kaziukas Fair in Vilnius is the opening of the spring and the largest fair of handcrafted creators from around the country in Vilnius, attracting thousands of visitors. This fair has a special spirit, here the tradition and authenticity are very important, since Kaziuk is not only the biggest but also the oldest event of this kind in Vilnius. The most important attribute of the fair is a verb, made from dried racemes of flowers and grasses.

Figure 8. The changes in happiness per day between 15/12/2017 and the St. Casimir's Fair. Compared to the months analysed, residents were happier during the St. Casimir's Fair.

2.5. January 1, Flag day
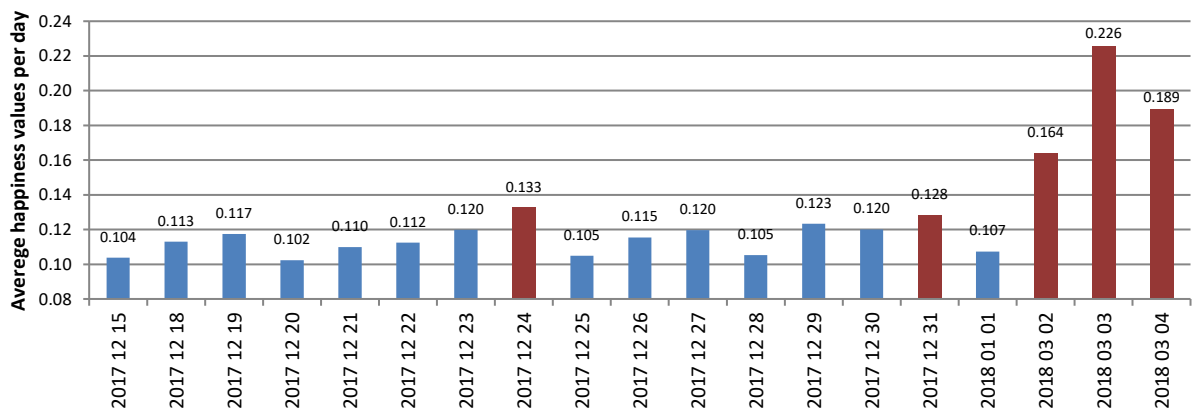
On the 1st of January, at the Lithuanian National Museum, in the Gediminas Hill Castle Tower, Lithuanian soldiers raise the Lithuanian flag during a solemn ceremony. Every year, therefore, we commemorate the day of the Lithuanian flag, remembering and honoring Lithuanian volunteers, which, thanks to the January 1, 1919, for the first time in Lithuania, the tricolor of Lithuania was flamed in Gediminas Castle Tower - a symbol of a free Lithuania.

Exhilaration was characteristic to residents of Vilnius walking in Gedimino Avenue on January 1, the Flag Day (see Table 3). The passer-by emotional state measured in Gedimino Avenue (Table 3), for instance, was higher than the January mean. This is due to improved happiness, surprise and valence values, and lower sadness and anger values.

Table 3. Exhilaration was characteristic to residents of Vilnius walking in Gedimino Avenue on January 1, the Flag Day.

Happiness value	The average level of happiness during the month in question	Sadness value	The mean level of sadness during the month in question	Anger value	The average level of angry during the month in question	Surprise value	The mean level of surprise during the month in question	Valence	The average level of valence during the month in question
0,1146	0,1113	0,1672	0,1733	0,0919	0,0925	0,1768	0,1630	-0,0997	-0,1107
0,497827	0,09979	0,115551	0,107013	0,040617	0,198812	0,055564	0,021674	0,253238	-0,20139

2.6. January 25, The birthday of Vilnius

The birthday of Vilnius On January 25, 1323, Grand Duke Gediminas of Lithuania wrote a letter to the residents of Lübeck, Zund, Bremen, Magdeburg, Cologne and other cities, in which he announced that he was ready to accept the Christian faith. In this letter, Gediminas first mentioned Vilnius, so the 25th of January is considered the birthday of Vilnius.

Table 4. On the birthday of Vilnius on January 25, the affective mode of passers-by in Vilnius was above the January mean.

Sadness value	The average level of sadness during the month in question	Anger value	The mean level of angry during the month in question	Surprise value	The average level of surprise during the month in question	Valence	The mean level of valence during the month in question
0,1180	0,1642	0,0792	0,0871	0,1739	0,1713	-0,0405	-0,1047
0,073212	0,096648	0,315781	0,209789	0,012199	0,030652	-0,303398	-0,21576

2.7. May 9, European day

9 May by the European Union which recognise the peace and prosperity within Europe both have achieved since their formation. On the main street of Vilnius, Gediminas Avenue, there were concerts and fairs of the European Union members' traditional cuisine.

Table 5. Exhilaration was characteristic to residents of Vilnius walking in Gedimino Avenue on May 9, European day.

Happiness value	The average level of happiness during the month in question	Sadness value	The mean level of sadness during the month in question	Anger value	The average level of angry during the month in question	Valence	The mean level of valence during the month in question	Heart rate	The average level of heart rate during the month in question
0,1989	0,1387	0,1725	0,1955	0,0881	0,1232	-0,0133	-0,1256	77,3981	75,8897
0,088974	0,096533	0,086718	0,167261	0,340723	0,111968	-0,300543	-0,17463		71,51425

2.8. July 1-6, 2018, Lithuania's centenary song celebration

The fundamental parts that form its programme are: Folklore Day, devoted to the traditional culture; Ensembles' Evening, consisting of colourful, theatrical, stylized performances of folklore ensembles, combining music, song and dance; Dance Day, an interpretation of Lithuanian customs, traditions, and symbols through professionally created dance choreography. The festival's programme is complimented by the Folk Art Exhibition; the afternoon of Kanklės (traditional Lithuanian string instrument) music; performances by wind orchestras and amateur theatre groups; professional art exhibitions as well as the colourful and emotional parade of all festival participants. The celebration is crowned by the Song Day uniting thousands of singers into a colossal choir. The 2018 Song Celebration is dedicated to the centenary anniversary of the restoration of the independent state of Lithuania. "In the name of..."

Exhilaration was characteristic to residents of Vilnius walking in Iceland Street on the July 1-6, 2018, Lithuania's centenary song celebration (see Table 6).

The passer-by affective mode measured in Iceland Street (see Table 6), for instance, was higher than the July mean. This is due to improved surprise, valence and arousal values, and lower sadness and anger values.

Table 6. Exhilaration was characteristic to residents of Vilnius walking in Iceland Street on the July 1-6, 2018, Lithuania's centenary song celebration.

Sadness value	The average level of sadness during the month in question	Anger value	The mean level of angry during the month in question	Surprise value	The average level of surprise during the month in question	Valence	The mean level of valence during the month in question	Arousal	The average level of arousal during the month in question
0,1420	0,1774	0,1202	0,1342	0,0603	0,0549	-0,0518	-0,1018	0,3656	0,3431
0,077629	0,081348	0,161977	0,12779	0,025837	0,029018	-0,135588	-0,103292	0,344213	0,331411

2.9. September 3

2018 September 3 is the beginning of the new academic year in all Lithuanian educational institutions. On the new academic year, the emotional state of passers-by in Iceland Street was above the September mean (see Table 7: a) entrance to Iceland Street; b) exit from Iceland Street). This is due to improved happiness, surprise, valence and arousal (heart rate) values, and lower sadness and anger values.

Table 7. On the new academic year, the affective mode of passers-by in Iceland Street was over the September average (a) entrance to Iceland Street; b) exit from Iceland Street)

a)

Happiness value	Happiness month under analysis month under analysis mean	Sadness value	The average level of sadness during the month in question	Surprise value	The mean level of surprise during the month in question	Valence	The average level of valence during the month in question	Heart rate	The mean level of heart rate during the month in question
0,2527	0,1988	0,1355	0,1563	0,0828	0,0744	-0,0339	-0,0762	81,7270	76,6846
		0,08037	0,08037	0,024538	0,024538	-0.133749	-0,133749		

b)

Happiness value	The average level of happiness during the month in question	Anger value	The mean level of angry during the month in question	Surprise value	The average level of surprise during the month in question	Valence	The mean level of valence during the month in question	Arousal	The average level of arousal during the month in question
0,1680	0,1225	0,1214	0,1284	0,0629	0,0578	-0,0996	-0,1345	0,3634	0,3461
0,188543	0,188543	0,256581	0,256581	0,024538	0,024538	-0,133749	-0,133749	0,33346	0,33346

Row Labels	Happiness value	The average level of happiness during the year
2019		
2019-01-01 (New year)	0.13417	0.11677
2019-01-25 (the birthday of Vilnius)	0.1955	0.11677
2019-02-16 (Lithuania Restoration of the State Day)	0.16061	0.11677
2019-03-01/03 (folklore event 'Kaziukas Fair')	0.16343	0.11677
2019-03-11 (Lithuanian Independence Day)	0.36389	0.11677
2019-05-09 (European day)	0.05714	0.11677
2019-06-14 (event 'Culture Night')	0.16161	0.11677
2019-09-01 (the beginning of the new academic year)	0.16148	0.11677
2020		
2020-01-01 (New year)	0.0856	0.12677
2020-01-25 (the birthday of Vilnius)	0.21766	0.12677
2020-02-16 (Lithuania Restoration of the State Day)	0.11851	0.12677
2020-03-06/08 (folklore event 'Kaziukas Fair')	0.14059	0.12677
2020-03-11 (Lithuanian Independence Day)	0.12288	0.12677
2020-05-09 (European day)	0.14717	0.12677
2020-09-01 (the beginning of the new academic year)	0.09176	0.12677
2020-09-25 (event 'Culture Night')	0.11636	0.12677
2021		
2021-01-01 (New year)	0.49783	0.12033
2021-01-25 (the birthday of Vilnius)	0.05176	0.12033
2021-02-16 (Lithuania Restoration of the State Day)	0.00075	0.12033
2021-03-11 (Lithuanian Independence Day)	0.16441	0.12033
2021-05-09 (European day)	0.10075	0.12033
2021-09-01 (the beginning of the new academic year)	0.18854	0.12033

Happiness value: 2019–2021