

Development of a Method to Measure Mood Rapidly - Trial Use in the Music Therapy Experiment -

Takamasa KOBAYASHI

Postgraduate Student, Kogakuin University
1-24-2 Nishi-Shinjuku Shinjuku, Tokyo 163-8677, Japan

Ryunosuke SHIGA

Postgraduate Student, Kogakuin University
1-24-2 Nishi-Shinjuku Shinjuku, Tokyo 163-8677, Japan

Azusa SAKAGUCHI

Postgraduate Student, Kogakuin University
1-24-2 Nishi-Shinjuku Shinjuku, Tokyo 163-8677, Japan

Hirotooshi HISHIDA

Faculty of Engineering, Kogakuin University
1-24-2 Nishi-Shinjuku Shinjuku, Tokyo 163-8677, Japan

ABSTRACT

In the music therapy experiments conducted at public concerts, where the time must be matched with the flow of the concert, a method that can be done in a short time instead of time-consuming POMS is desired. And if a method that does not take much time can be developed, it will be practical for checking the mental and physical condition of the driver.

In this laboratory, a color evaluation method was devised. The newly proposed color evaluation method is intended to analyze the subject's feelings based on the colors selected by this two-stage color selection method. During analysis, the selected color is decomposed into red, green, and blue components. The color evaluation method was tested on a trial basis at the 2022 Music Therapy Experimental Meeting. Then, the red and blue components clearly indicate the subject's feelings, suggesting the possibility of using the color evaluation method as a quantitative evaluation one for music therapy. On the other hand, the method of interpreting the green component was unclear and inconclusive. In order to solve the weak points of the proposed method, it will be added improvement, such as making it a form that anyone can use easily on the Web.

Keywords: Music therapy experiment, Driver's safety check, Mental and physical state, Color selection, Color components of red and green and blue.

1. INTRODUCTION

There is some method that measures your current mood, and POMS is one of the established methods in the form of a questionnaire. Our laboratory conducts basic research on music therapy, in which POMS is used to quantitatively measure the effects of music [1,2]. In addition, the authors are trying to use it to measure the driver's stress state before, during, and after driving. POMS was created in the United States, and based on it, a Japanese version was officially created by Japanese scholars.

This method is non-invasive, which is one of its strengths. On the other hand, it is a disadvantage of POMS that it takes time to be

carried out. In our laboratory, whenever there is a good opportunity, music therapy experiments were conducted participating in concerts which were open to the public [1-3]. At that time, since an actual concert is used, the time which can be used for measurement is limited. Since POMS is time-consuming, there is a strong need for an alternative means of measuring the psychological state of the subjects.

Therefore, in our laboratory, an alternative method that can measure the same level as POMS and can be performed in a short time has begun to be developed. Methods for measuring the psychological state include direct measurement of biological information values such as blood pressure and alpha waves, as well as indirect measurement methods such as methods using words [4] and methods using diagrams and pictures [5], etc. Among them, the authors focused on the indirect measurement method using color [6]. In this paper, a POMS alternative method using color is proposed, whose outline and possibility are reported.

2. HOW TO USE IN A MUSIC THERAPY EXPERIMENT

Overview

In 2021, a music therapy experiment was conducted using public concerts [2]. The results of the experiment concluded that music had an overall calming effect on the subject's state of mind, where various biological information values such as pulse wave and blood pressure were measured. At that time, a color evaluation method was also carried out on a trial basis. The results of the color evaluation method were not referenced in the discussion of whether music therapy was effective. It was planned to discuss how well the conclusions drawn by this color evaluation method matched those conclusions.

Method

A specific implementation method is described below. This method will have to be practically improved in the future.

The number of colors to choose: The color evaluation method proposed in the present study is one in which

a plurality of colors that match the current mood is selected from among various colors. How many colors to choose here depends on the contents of the survey. If the subject's feelings are clear, one choice should suffice. Conversely, if it is ambiguous, it is better to have several choices. Since the principles and uses of music therapy are still unclear, the number of colors to choose was decided to be 4. That is, first two colors, A and B, are selected from the pure colors of the 18-color wheel, and then two more colors, A1, A2, B1 and B2, are selected from each related color [3].

Color pattern media: Since the experiment was conducted in a concert hall where the lighting was generally dark, there was concern that the subjects would not be able to judge the colors accurately if they were given a piece of paper on which a color pattern was printed. Therefore, a notebook PC was prepared and a color pattern created in Excel was projected onto the display, which the subject looked at to choose a color. This method does not yet work over the Internet.

Person in charge of implementation: If this method could be used via the Internet, it would have been possible for each subject to perform the test using, for example, a smartphone. There, one person in charge of the color evaluator interrogated each of the thirty-one subjects and recorded their answers. The fact that it took a lot of time is an issue which should be improved in the future.

Measurement timing: Measurements were performed four times. The first measurements were taken during a pre-meeting. The second measurement was taken at the seats in the concert hall before the concert started. The third measurement was taken at the seats in the concert hall during the intermission between the first and second parts. The final measurement was taken at the seats in the concert hall after the concert. From other measurement results, it is known how the stress state of the mind was at each time. The reason why the selected color changed in time series and the like can be considered.

Table 1: Example of the color selection.

	The 1st selected			The 2nd selected		
	Pure color		Co-related color	Pure color		Co-related color
	A	A1	A2	B	B1	B2
R component		R _{A1}	R _{A2}		R _{B1}	R _{B2}
G component		G _{A1}	G _{A2}		G _{B1}	G _{B2}
B component		B _{A1}	B _{A2}		B _{B1}	B _{B2}

Example of RGB Calculation

Since a plurality of colors are selected in this experiment, it is necessary to determine the weight of each color. For example, for a subject who selects the colors listed in Table 1, the red index V_R , the green index V_G , and the blue index V_B are calculated by Eqs. (1a), (1b), and (1c), respectively:

$$V_R = w_{11}R_{A1} + w_{12}R_{A2} + w_{21}R_{B1} + w_{22}R_{B2} \quad \cdots \cdots \cdots (1a)$$

$$V_G = w_{11}G_{A1} + w_{12}G_{A2} + w_{21}G_{B1} + w_{22}G_{B2} \quad \cdots \cdots \cdots (1b)$$

$$V_B = w_{11}B_{A1} + w_{12}B_{A2} + w_{21}B_{B1} + w_{22}B_{B2} \quad \cdots \cdots \cdots (1c)$$

where w_{ij} is the weight for the j -th selected color in the i -th pure relational color, respectively. For example, if all w_{ij} are set to 1, all the various impressions of the subject are reflected, and

ambiguity can be given. Also, with w_{11} set to 2 and others set to 0.5, the subject's first intuition is heavily prioritized. Possibly, the same weight should not be used for V_R , V_G , and V_B . Rather, it may be more appropriate to think of it as a matching coefficient for matching with reality.

For organizing this report, $w_{11} = 6$, $w_{12} = 2$, $w_{21} = 3$, $w_{22} = 1$ as an example. That is, the pure colors were prioritized over the related colors by a ratio of 3:1, and the first pure color was weighted twice as much as the second pure color.

3. RESULTS OF MEASUREMENT IN THE MUSIC THERAPY EXPERIMENT

Overview

A detailed discussion of the results of the color evaluation method in experiments will be given in a later paper. In this paper, a primitive discussion is made based on the mean values of each index value for each subject at each measurement timing for each group.

Tables 1(a), (b), and (c) show the color selection results of all subjects at each measurement timing. Here, Group A is a group of subjects who like music and know the pieces played in the concert, Group B is that of subjects who like music but do not know the pieces played, and Group C is that of subjects who do not like music but know the pieces played, and Group D is that of subjects who do not like music and do not know the pieces played.

Subjects Belonging to Group D

The reaction of the subjects belonging to Group D, which was observed as a result of various biometric measurements, is really interesting. All music seemed to be heard as mere sounds. It may be possible to prescribe sounds for them, but it would be impossible as music.

The value of the red index V_R was overwhelmingly lower than that of subjects in other groups. Furthermore, it went up and down violently. Combining red with active states of enthusiasm, excitement, anticipation, etc. is very much in line with reality. Before the beginning of the first half and after the end of the concert, the value is significantly lower. For the subjects who did not like music and had never heard the pieces played, the concert may not have any special meaning. The reason why the red index V_R is high even during the intermission may be because they were released from the concert, but it is necessary to examine it in the future. There is no time when all of the indexes red V_R , green V_G , and blue V_B were low, so it cannot be said that their hearts have become closed.

The change in blue index V_B is very noticeable, being lowest before the concert and increasing throughout the concert. It is suggested that the color component blue may be associated with boredom and pain relief.

The green index V_G was less straightforward. It takes a high value from before the start of the concert to the intermission of the concert. These facts would be referred to when discussing other subjects.

Subjects Belonging to Group A

The pair of subjects belonging to Group D was the subject belonging to Group A.

Table 2: Results of color selection of the music therapy experiment in 2022.

(a) Red component value.

RED	Pre Session	Before Concert	Intermission	After concert
Group A	141.7	155.0	99.2	104.0
Group B	118.9	123.3	72.3	65.8
Group C	116.8	107.2	104.1	33.1
Group D	80.2	32.9	89.3	18.9

(b) Green component value.

GREEN	Pre Session	Before Concert	Intermission	After concert
Group A	122.8	106.4	170.0	129.8
Group B	121.0	120.3	108.3	117.8
Group C	64.0	72.3	45.6	165.5
Group D	89.9	165.0	165.0	92.8

(c) Blue component value.

BLUE	Pre Session	Before Concert	Intermission	After concert
Group A	87.4	96.7	66.2	56.6
Group B	88.7	110.2	92.2	98.0
Group C	62.9	56.5	80.2	95.9
Group D	64.4	32.9	89.3	165.5

The blue index V_B showed exactly opposite behavior in both groups, that is, the value of the blue index V_B of the subjects belonging to Group A decreased throughout the concert, which is a consistent and acceptable result. Perhaps, as mentioned above, the color component blue is not unlikely to be associated with negative mental responses to music, which means boredom, analgesia, etc. in this case. However, it should be noted that the color component blue does not necessarily mean only negative impressions, and that it can sometimes mean positive impressions such as freshness and tranquility. Interpretation of blue may differ between music therapy experiments and simple surveys of drivers.

The red index V_R for subjects belonging to Group A also moved in the opposite direction to that for Group D. And the absolute values are also very different. The color component red is also associated with impressions that are not positive, such as hot and intense, but in music therapy, the color component red could be thought to be associated with impressions of vitality and liveliness.

4. DEVELOPMENT OF MEASUREMENT TECHNIQUE

On Principle

From the above results, it is considered that the color components red and blue are likely to be used in music therapy. On the other hand, the interpretation of the color component green should be examined in detail in the future. Originally, the reason for using this method in music therapy experiments was that it could be an alternative to POMS. Therefore, in the future, it would hopefully be that the accuracy of the color evaluation method will be improved by conducting both at the same time and comparing the

results not only in the music therapy experiment meeting but also in various basic experiments. In particular, this time, the color components red and blue alone were considered. In the future, it will also be discussed that the principle of how multiple colors are referenced and interpreted simultaneously.

Improvement Proposal as a Method

On the whole, the value and significance of the presently proposed method were found out. On the other hand, some points for improvement were also pointed out.

Number of Colors to Choose: A total of 4 colors were selected this time. Considering the results with only the first color the subjects selected, it might have been able to infer to some extent what would happen if only one color were to be selected. This consideration is one of the few remaining things that can be done. The more number the subjects have to select, the greater the burden on the subject, and also, the relationship will become more blurred. Conversely, the fewer numbers they have to select, it may be more difficult to identify relationships, and the greater the error involved in selection. (These two events are completely separate issues.) It is desired to decide the number according to the intended use.

Weight Balance: This time it proceeded by assuming a certain set of values, but there is no guarantee that this value is correct. On the other hand, weights alone can only be pursued at least after the principle has been clarified in considerable detail. While accumulating data, discussions on what to do with the weights will proceed in parallel.

The Time Required: As a result, the proposed method, introduced to shorten the time since POMS takes time this time, generally took about 20 minutes per measuring timing. It took a too long period of time that is unclear whether it could be done during the intermission, so it can't be said that the method was successful. It seems that it was wrong to share one display with all subjects. Constructing this measurement method in the form of Excel data is a hindrance to an experiment with a large number of subjects. In the future, it will be essential to develop tools that allow measurement via the Web, for example. If anyone can use it easily, the amount of data will increase and it will be able to discuss the principle.

5. CONCLUSIONS

In a music therapy experiment using a public concert conducted in 2022, the color evaluation method which was newly proposed was experimentally implemented. In this paper, its contents were introduced, and the primitive analysis and consideration of the results were made. The findings are listed as follows:

- 1) There is a possibility that the color evaluation method can be used in music therapy experiments. As a result, it is expected that more information could be obtained from music therapy experiments.
- 2) In order to improve the accuracy as an alternative to POMS, the results obtained from the color evaluation method will be compared with the results of POMS, which were carried out in the Music Therapy Experiment. Also, more basic music therapy experiments, besides those using public concerts, will be conducted, where both approaches will be compared.

- 3) On the other hand, the current method is time-consuming. Since the Excel format implementation is not good, other implementations should be devised. By creating a form that anyone can use on the web, it will be possible to use it smartly in music therapy experiments.
- 4) The method of analyzing with the three primary color components of red, green, and blue showed the possibility as an analysis principle. Detailed studies on the principle will be continued in the future, and it is hoped that the precision of this three-primary color analysis method will be improved. Also, if other better analytical methods are found, they will be considered in parallel.

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