

## Peculiarities of Music Performance in the Flow State



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**Abstract:** The study purpose is to conduct a comparative analysis of the level of performance and psychophysiological indicators of violinists playing musical compositions in the flow state and according to the standard methodology. The study was conducted in 2019 at Minzu University of China (PRC) among 92 students who studied violin in the conservatory. The experimental group was also better at musicality ( $p \leq 0.05$ ) and intonation ( $p \leq 0.05$ ). The results obtained can be recommended as a method for improving musicians' skills while training in conservatories and other music universities in different countries.

**Keywords:** Composition. Flow state. Intonation. Musicians. Rhythm. Performance technique.

**Resumo:** O objetivo do estudo é realizar uma análise comparativa do nível de desempenho e indicadores psicofisiológicos de violinistas tocando composições musicais no estado de fluxo e de acordo com a metodologia padrão. O estudo foi realizado em 2019 na Minzu University of China (PRC) entre 92 alunos que estudavam violino no conservatório. O grupo experimental também foi melhor em musicalidade ( $p \leq 0,05$ ) e entonação ( $p \leq 0,05$ ). Os resultados obtidos podem ser recomendados como um método para aprimorar as habilidades dos músicos durante o treinamento em conservatórios e outras universidades musicais em diferentes países.

**Palavras-chave:** Composição. Estado de fluxo. Entonação. Músicos. Ritmo. Técnica de performance.

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## Introduction

The generally accepted definition of flow state is as follows: it is an elevated feeling of flight that appears during creative activity, which an individual associates with pleasure and ease of performance (MARIN and BHATTACHARYA, 2013). This condition is common to representatives of different kinds of activities - athletes engaged in extreme sports, musicians, actors, etc. (KUTEPOVA-BREDUN, 2018). In many studies on the physiology of sport, the flow state is attributed to a high probability of achieving maximum performance during sporting events (ANDREU-SÁNCHEZ et al., 2021). The flow state is characterized by the best athletic (or intellectual, depending on the activity) form, as well as a purposefulness that derives from the utmost concentration ("detachment") (RIQUELME-ROS et al., 2020). Another peculiarity of the flow state is that, for example, when one moves while competing, only the muscles that are necessary for the movement are engaged, the remaining muscles are in a state of relaxation (HERHOLZ and ZATORRE, 2012). Thus, many researchers associate flow state with intellectual and physical wellness. Intellectual qualities, first of all, are best manifested in the form of high rates of learning (XU et al., 2020).

For musicians engaged in music professionally, achieving a flow state is one of the priorities of their career. In such a case, the musician must make a considerable psychophysiological effort to achieve his or her peak abilities, as shown in many works (FORNARI, 2012; PERLOVSKY, 2014; SOLÁ, 2014). In order to play a piece at the highest level of skill, a musician must have a wide range of degrees of freedom, which are manifested in the combination of several factors: the time factor, the factor of the right sequence of movements when playing, as well as the factor of the precise trajectories of these movements (ALTENMÜLLER et al., 2015).

It has been found that in order to play a piece of music at a level appropriate to the flow state, a musician needs precise, coordinated finger movements that can simultaneously engage in

adjusting the music volume, as well as the timing of its sound and emotional conveyance (ZABIELSKA-MENDYK et al., 2018). The “flow state” technique is a technique of performing musical material, which is characterized by the flow of melody, which occurs instantly and spontaneously, while the performer does not use ready-made memorized melodies and movements, but acts spontaneously. The “flow state” technique is characterized by such 6 parameters as technique (level of technical performance of musical material), rhythm (features of alternation of sounds and pauses), sound quality (features of quality of musical material), musicality (ability to feel music, ability to create musical texts and melodies), intonation (a set of such prosodic characteristics as tone, tempo, volume, rhythm, etc.) and originality (the ability of the performer to create their own original melodies). All this is achieved by the fact that there must be control between the previous and the subsequent sensation, and there must be a connection of the reverse order. At the same time, the movements should not be relaxed but free. Imagination, self-perception, and the ability to foresee one’s movements is also important for a musician (JEUNET et al., 2016). These sensations are identified with flight, which allows one to achieve the flow state much more quickly. The fundamental difference between the flow state (and learning to achieve it) and traditional methods of teaching music is that in the latter, mastery is achieved by showing an example, and by having the students repeat it (BERNARDI et al., 2013a). Thus, there is a lack of awareness of a student’s own abilities and opportunities to apply them. The essence of the flow state is that a student must acquire such qualities as simultaneous concentration on his/her feelings, and the ability to improvise when playing a musical instrument. In addition, an important quality for the beginning musician is to perform his/her movements naturally and at ease (KUTEPOVA-BREDUN, 2018).

The disadvantage of the available publications on the flow state is that they are descriptive, without any specific data. In this context, psychological tests for athletes and music professionals have been conducted, as well as sociology studies (ANDREU-SÁNCHEZ et al.,

2018; NAKAMURA and CSIKSZENTMIHALYI, 2009; SINNAMON et al., 2012). There is still no clear picture of which psychophysiological parameters determine the flow state. On the other hand, studies that have covered aspects of psychophysiology during active instrumental playing during a performance or concert are quite well represented (ARSHAVA and KUTEPOVA-BREDUN, 2015; HART and DI BLASI, 2015; LAMONT, 2012). This was the actual reason for conducting the present study. The general organism's reaction is a decrease in the tone of muscles that do not take part in the performance and an increase in the frequency of alpha waves on EEG (BUTKOVIC et al., 2015; GOFFIN, 2014). Along with an increase in alpha frequencies, cognitive abilities also increase. In addition, other indicators such as academic performance, thinking outside the box, and short-term memory also increased (MORAL-BOFILL et al., 2020). Among the physiological indicators are increased concentration, control over one's actions, as well as a relaxed tone of muscles that do not take part in the movement (playing a musical instrument) (WRIGLEY and EMMERSON, 2013). Another interesting study was devoted to finding a relationship between musicality and the assimilation of photo stimuli, which are related to the range of high alpha frequencies and brain waves (above 18 Hz). A direct correlation was found. In contrast, low delta frequencies between 2 and 6 Hz were associated with weak nervous system organization, with accompanying photo stimuli, and with greater sensitivity to music perception (NAKAMURA and CSIKSZENTMIHALYI, 2009). On the other hand, EEG data in another study allowed establishing a connection between the occurrence of potentials in the brain with a certain frequency and the recognizability of the musical fragment (BERNARDI et al., 2013a). Thus, the breadth of the alpha range is directly related to the development of above-average abilities, including in musicians.

The authors hypothesize that the quality of musical performance while entering the flow state will have statistically significant differences from music-making based on standard teaching methods. The second hypothesis is that there will be

reliable differences between groups of musicians in terms of alpha rhythm frequency - musicians in the flow state will have higher alpha rhythm frequency. The study aim was to investigate the skill level and psychophysiological indicators of violinists performing musical works in the flow state and during standard play. The study objectives were: a) comparing skill level of musicians using flow state techniques and musicians who received standard training; b) comparative psychophysiological analysis of musicians using the flow state techniques and musicians using standard techniques of playing.

## Materials and methods

### Sampling

The study was conducted in 2019 at Minzu University of China. The study involved 92 violin students of the Beijing Music Conservatory. The average age was  $22.1 \pm 2.3$  years. There were 45 female and 47 male students. The average age of women was  $21.7 \pm 1.9$  years, men  $23.1 \pm 2.6$  years. All respondents were senior students, i.e. they already had quite significant experience of playing a musical instrument (violin). The whole group of respondents was divided into two equal groups of 46 people each. Group 1 consisted of students who used flow state techniques when playing music (23 women and 23 men). Group 2 consisted of students who studied in a standard educational program (22 women and 24 men). Thus, both groups were comparable in gender composition and had the same age.

### Research design

Written consent to participate in the experiment was signed with all respondents, since they were of legal age. The existence of a contract and the absence of serious diseases of the nervous,

cardiovascular, and musculoskeletal systems served as the basis for including the respondents in the study. On the contrary, the absence of a contract and the presence of serious diseases served as grounds for exclusion from the study. All respondents who took part in the study were guaranteed adherence to internationally accepted ethical and moral standards, as well as anonymity and confidentiality. The study did not take gender into account.

## Methods

For the group of respondents using the flow state techniques, the following training methodology was applied. 1) The need to establish contact with the musical instrument. It is necessary to develop a feeling of the instrument (in this case, the violin) when playing it. At the same time, it is necessary to choose from one's own sensations the one which will correspond to the best contact with the instrument. When this contact is obtained, one should concentrate attention on the sensation that corresponds to this optimal contact. 2) Feeling the contact with the best sound performance. The following was suggested. Regardless of the musical composition being played, its tempo and rhythm, the respondent should be completely satisfied with the sound coming out of the instrument when playing. It is not necessary to focus on how they were taught to play correctly, just that the respondent should be satisfied with the sound. 3) Ease of movement when playing a musical instrument. It is necessary to develop the feeling that the sound of the played musical composition came from the musician's body, while playing and feeling can be helped by certain movements, such as swaying. One needs to be able not to give one's body tension, but to find an area that corresponds to a comfortable feeling. 4) When playing, one should use associations with the material one has been learning. To do this, one must retrieve from memory any harmonies associated with the material one has learned. However, when learning a new song, it is not necessary to try to play it correctly, according to existing canons.

It is necessary to move from one note to another when playing it, but with the condition of extracting the sound that the respondent likes.

Each of the students underwent a mandatory audition, which was recorded on video. After the audition was completed, all respondents were randomly divided into a control group (2) and an experimental group (1). All musicians in both groups were equally divided not only by gender but also by the level of music they played.

After that, students were asked to learn (within 20 minutes) a piece of music (Vivaldi) offered to them. The duration of the fragment is 2 minutes. After learning the fragment, students from Group 1 played it using the flow state, while students from Group 2 played it using standard musical skills. The performance of each of the respondents was filmed on video.

The quality of the respondents' performance was evaluated by five jurors, who were independent music experts from different regions of China. All of them were professors in conservatories. The experts did not know whether a respondent belonged to a certain group; in addition, they did not know in what state the fragment was played - in the flow state or with the use of standard skills. The jurors evaluated respondents' performance in an international scoring system from 0 to 10. They considered such factors as rhythm, technique, the respondent's level of musicality, and creativity. Intonation and sound quality were also considered. All respondents played identical musical instruments to eliminate possible differences in sound quality. EEG recording was performed in three states in all respondents, in the resting state, during the first listening, during the second listening. There were 21 electrodes, of which 1 was a reference electrode and 1 was a ground electrode. They were placed according to the international scheme of 10-20%. The attached electrodes, according to the musicians, had no influence on the level of their psycho-emotional processes and did not cause any discomfort. The electrodes were attached in the following lead zones - P (parietal), C (central), F (frontal). Accordingly,

C3, C4 are given as the central electrode lines, F3, F4 - frontal, and P3, P4 - parietal.

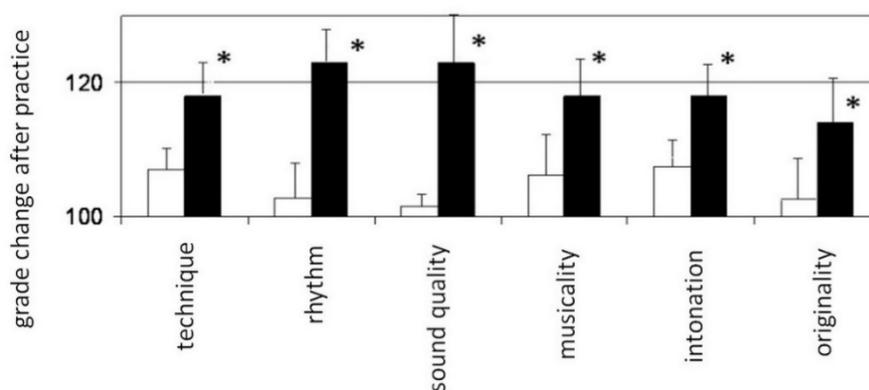
## Statistical analysis

All data were entered into Excel 2016 (Microsoft Corp.). Next, an analysis of variance was performed. This is necessary to be able to identify possible correlations between the parameters and musical practices used in the experimental and control groups. In order to identify significant differences between the averages of the studied parameters, Student's t-test was used. Mann-Whitney test, which is a nonparametric statistical criterion, was used to analyze the reliability of differences between the groups. The minimum level of significance of differences corresponded to  $p \leq 0.05$ .

## Results

The results showed that group 1, on average, more successfully performed musical excerpts, according to the jury (Figure 1). Significant differences were found between all the investigated traits.

Figure 1 - Results of assessment by jury members (in % of initial level) of playing musical fragments in control (white columns) and experimental (black) groups of students.



Note. Significant differences are indicated by asterisks  
Source: own development

Thus, as for the level of technique, the musicians from group 2 (control) scored on the average only 105 points, which is inferior to the result of group 1 (experiment) who scored 118 points ( $p \leq 0.05$ ). Even greater difference between the experiment and control (in favor of the experiment) was obtained for the rhythm parameter - 103 points vs. 125 ( $p \leq 0.03$ ). The quality of the extracted sound showed large reliable differences - 101 points vs. 125 ( $p \leq 0.02$ ). The musicality parameter showed smaller, but also reliable differences - 104 points vs. 118 ( $p \leq 0.05$ ), as did intonation (106 points vs. 118,  $p \leq 0.05$ ). Finally, the smallest differences between the groups, but also in favor of the experimental group, were obtained for the originality parameter - 104 points vs. 112 ( $p \leq 0.05$ ). This implies that all significant differences between the two groups were in favor of the experimental group.

Significantly different results were also obtained when comparing the parameters within each of the groups. For the parameters of rhythm and sound quality, the experimental group musicians made the same progress ( $p \geq 0.05$ ); they differ from the parameters of technique, musicality, and intonation ( $p \leq 0.05$ ) for the better. At the same time, the last three parameters also had no reliable differences among themselves ( $p \geq 0.05$ ). However, the last of the parameters, originality of performance, was less in comparison with musicality, intonation, and technique ( $p \leq 0.05$ ).

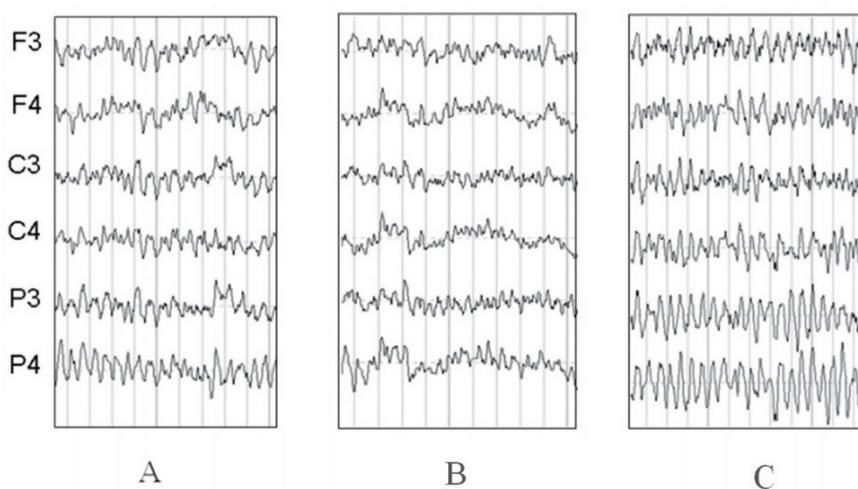
Different results were obtained for control group musicians. While their highest proficiency was in such parameters as technique, intonation, and musicality ( $p \geq 0.05$ ), the weakest were rhythm and originality ( $p \geq 0.05$  between themselves and  $p \leq 0.05$  with the previous parameters). The lowest was the sound quality parameter ( $p \leq 0.05$  with rhythm and originality). That is, for the control group, strengths and weaknesses during violin playing manifested differently compared to the experimental group.

The main difference between the experimental and control groups is that the former made progress in rhythm and sound quality parameters. The basic parameters associated with the compositional integrity of the played musical fragment contributed

primarily to the improvement of professionalism. On the other hand, for the control group musicians, the main, although lower in scores compared to the experimental group, parameters were technique and intonation. These parameters are also very important for music theory, but even they were lower compared to the same parameters in experimental group musicians. This means that the achievement in the experimental group was better in absolutely all parameters, but these achievements manifested themselves differently among the musicians of both groups.

Interesting results were obtained when analyzing the obtained EEGs (Figure 2). It was found that in the experimental group, there was a greater amplitude of alpha rhythms compared to rest.

**Figure 2 - Indicators of the changes observed using EEG, which were recorded when playing at rest (A), in the control group using standard methods (control, B), as well as in the flow state (C).**



*Source: own development*

This indicates that there is a greater automatism in the process of playing the violin during the flow state, as well as a control of playing the instrument that is not related to consciousness. It may also indicate that external and internal stimuli have become less significant for musicians, while playing. This was more evident among the musicians in the experimental group playing in the flow state. Thus, disconnection from external and internal stimuli may

be, along with emotional uplift, a key factor in the success of using the flow state while playing the violin.

In addition, musicians' movements while playing in the flow state were more relaxed compared to the control group. Another evidence of greater automatism of movements, which leads to optimal effort during play-related movements, is a longer length of alpha waves on the EEG (Figure 2). Jury scores were related to parameters such as alpha-wave width and power (correlation 0.87 and 0.89, respectively,  $p \leq 0.05$ ), as well as to the peak frequency corresponding to the maximum (0.79,  $p \leq 0.05$ ) and alpha-wave length (0.81,  $p \leq 0.05$ ).

The obtained changes in the frequency of alpha waves for the musicians who played in the flow state indicate that their additional cognitive abilities activated during the performance. This is indicated by strong correlations between the quality of playing (manifested through jury evaluations) and psychophysiological parameters, in the form of alpha wave frequency. Cognitive processes, in turn, influence not only the quality of playing and extracted sound, but also the quality of improvisation. This was evident when comparing the parameters (rhythm, sound extraction, etc.) in the experimental and control groups. Observed changes of alpha waves frequency in frontal lobes indicate search and estimation of possible constructive ideas during improvisation.

## Discussion

The obtained results convincingly demonstrated the advantage of experimental group musicians over control group musicians who used standard methods. However, the peculiarities of playing a musical instrument manifested themselves differently in the two groups. While experimental group musicians performed best in rhythm and sound quality, control group musicians achieved the maximum (although lower than in the experimental group)

results in intonation, musicality, and technique. The control group musicians coped with the quality of sound extraction the worst, while in the experimental group it was one of the best results. This indicates a radical difference in the approaches to playing in the experimental and control groups - if the musicians in the flow state "felt" their instrument, the control group musicians apparently did not have such sensation. The experimental group musicians had a much better sense of rhythm compared to the control group. The state of the flow when playing the violin is characterized by the ability of the performer to create a melody independently and spontaneously, without using ready-made musical lyrics, when musical movements are created by themselves. Students in the "flow state" group came to the flow state without performing special techniques, but created spontaneously in a state of inspiration. The ability to achieve a flow state means many things to a musician. First, a state of equilibrium of psychophysiological processes is achieved. Secondly, judging by high results of experimental group musicians, there is such ratio of inhibition and excitation at which it is possible to assert about optimality of occurring processes. There is also a combination of movements' automatism and the minimum level of energy consumption.

As is known, alpha waves, or rather their characteristics are indicators of a high level of cognitiveness, successful coping with the set tasks, including while performing musical compositions (DEBNATH et al., 2019; PELS et al., 2018; SRINIVASAN and GINGRAS, 2014). According to some results, alpha waves are directly related to such characteristics as psycho-emotional perception of music, as well as its processing. Activation of alpha waves occurs even when respondents listen to the works of L. van Beethoven (NEUSER, 2015). According to other studies, power and frequency of alpha waves can increase when listening to calm or dynamic music (HORWITZ et al., 2021).

In general, the flow state is characteristic of various activities (BILALIC, 2017). Music is only one of the components of this state, which is confirmed by the current study results. Similar data

were obtained not for the “exam” situation (as was in the current study) but during improvisation. A post-facto survey of musicians using improvisation techniques during performance revealed that they all felt a sense of “flow” associated with positive emotional experiences (BERNARDI et al., 2013b). At the same time, the tempo of the melody as well as its stylistics (within the framework of classical music) had no influence on the emergence of improvisation or flow state. Another study recorded the activation of occipital brain regions (NISO et al., 2013). Moreover, the excitation occurring in these areas corresponded to high readings not only of alpha waves but also of other bands. The conclusion of another study was that when the intensity and power of alpha waves in the respondent’s brain increases, information from their image memory is released, resulting in the detachment of consciousness from the external stimuli (SETH et al., 2015). The same applies to internal stimuli. It has been found that a decrease in alpha wave indicators in the temporal areas of the brain is associated with hearing related images.

At the same time, in the case of increasing the power of alpha waves in the low frequency range, positive emotions are registered, and in high frequencies - also, but when listening to a different part of the same classical work (MAGYARÓDI & OLÁH, 2015). The present study shows that when using the flow state, the frequency and amplitude of alpha waves are unambiguously maximal in musicians from the experimental group.

## Conclusions

It was established for violin musicians that in the flow state they achieve deliberately better results in comparison with the control group. Control group musicians used standard techniques of music education learned in a conservatory. Correlations were obtained between the playing quality of experimental group musicians and such parameters as width and power of alpha waves (0.87 and

0.89 respectively), the value of alpha wave peak (0.79), as well as with the length of alpha wave (0.81).

Comparison of the parameters among the respondents of each group showed that there are reliable differences. In particular, the parameters of rhythm and sound quality for experimental group musicians were approximately the same ( $p \geq 0.05$ ), but these parameters were significantly superior to such parameters as performance technique, musicality, and intonation ( $p \leq 0.05$ ). There were no significant differences between this second group of parameters ( $p \geq 0.05$ ). The lowest of the parameters studied in the experimental group was the originality of performance, which was inferior to the second group of parameters ( $p \leq 0.05$ ). Perhaps this is due to the fact that the memorized material belonged already to a well-known work, so the musicians were put in advance in a framework, making it difficult to implement their originality.

Prospects for further research are based on opportunities to practice flow state as a way to increase musical training of musicians. This recommendation is related to the optimal results obtained for a group of musicians playing musical fragments in the flow state. Thus, the use of the flow state in terms of practical relevance can yield better results for musicians, including not only performance quality but also career outcomes in general. This study needs to be continued, particularly in terms of the effectiveness of the flow state for musicians of other specialties, such as pianists, conductors, drummers, etc. It is interesting to compare the flow state's impact on the performance of musicians playing different styles, not only classical but also rock, folk music, etc.

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