

The Effect of the Soundtrack on the Audience Through Salivary Cortisol Testing

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Abstract

Since variations in cortisol hormone indicate the level of stress in humans, numerous studies are conducted to reduce or increase stress levels when necessary. There are 19 participants in this study. A sequence of a movie is present to the participant in three audio situations, the salivary cortisol test is performed after the end of each situation, and the results are recorded. Finally, it was found that cortisol could be adjusted with the movie soundtrack at each stage.

Keywords: Salivary Cortisol; listening Habit; Soundtrack; Hormone

Introduction

Cortisol, called the stress hormone, is secreted by the adrenal glands. Both deficiency and excess of this hormone causes problems. The adrenal glands secrete the cortisol hormone. Chronic stress affects the functioning and mechanism of the stress hormone. Chronic stress and high secretion of this hormone causes some sleep disorders, immune system malfunction and abnormalities in blood sugar levels. Another problem is that increased cortisol secretion is one of the causes of weight gain in the abdomen. This stress hormone helps to regulate blood pressure and the immune system in the face of a crisis. It does not matter whether the experienced crisis is an emotional event or a specific physical condition; however, the first one i. e. sensory and emotional connection is discussed here. Since music is related to human emotions, it affects this hormone. As music is inherently abstract, understanding its meaning depends on an element called the auditory habit. Since auditory habit is a concept with literal meaning, it can have a complex structure that certainly reflects the cultural and social perspective on music and music psychology (Hargreaves 2003). Auditory habits, such as eating and other habits, depend on factors such as repetition, ethnicity, religion, and geographical location, each of which can affect music and musical structures. In the music of Central Asian countries, such as Iran and Arab states, there are microtone intervals that are absent in European music. This has created a different auditory habit for the people of this land. Melodic music was slowly replaced by the atmospheric music in Hollywood until the late 1990s. This trend can be seen in comparing the music of Schindler's list movies and John Williams' artificial intelligence. In any case, the beauty of a work of art must have some effects logically. Although music evokes strong emotions because of its connection to memory, it can react to memories or listening habits. As music stimulates strong emotions, it can play an important role in creating memories, which is now called musical memory (Junk, 2008). With the gradual evolution of the visual arts, music also became an important part of visual activities to the extent that movie music is distinguished from other types of musical works and plays an important role in preparing the context and characterization (Sun, 2014). Each person's heartbeat changes according to the music he is listening. Music can regulate heart rate, blood pressure, and even respiration (De la Torre, 2017). Physically, sounds in music and colored dots in paintings are the main elements of a work, but sounds cannot play a role in conveying meaning unless they are systematized. The smallest part of these elements is in motif music and in the dramatic arts. Motif in music is as important as a term in statement in terms of expression. In musical terms, the larger element is the statement. The expressive equivalent of melodic sentence in the linguistics is a sentence and signifier in drama. The fluid movement of a dramatic

effect is formed by putting the signifiers and deciphering them. However, music is still an abstract work that must be deciphered by the listener. This is true in all branches of art. Like a map guide, there must be signs so that it can be a guide for reading the map. The same is true for music. Sometimes, the meanings and concepts of music, apart from poetry and words, are conveyed by the image, or the listener himself makes a concept based on his situation, feelings and thoughts, and due to repetition, a concept is adapted to a specific music for the listener that the same concept is determined for the same specific music. The repetition pattern is another factor after signifying in music, which stabilizes it over time. Repetition means that music with a specific signification over time - the pattern of repetition_ strengthens the concept of music with the same specific meaning. George Thomas et al. (2018) measured physiological response to art in people with Alzheimer's or dementia that singing in a high-stress situation (with the audience) increased cortisol and cortisone, while singing in low-stress conditions decreased both factors. Finally, whenever music is heard based on the auditory habit, it will influence the physiological states as well. This study will address the cortisol hormone. Hoecner et al. (2011) in their study entitled "the effect of movie music on how viewers react to movie characters" examined the powerful aesthetic effects of movie music on the understanding of the screen contents and showed that music transmits thinking between the creator of the work and the viewer. Lerdi et al. showed that music affects cortisol in people who have undergone surgery. This effect is greater when the music is chosen by the patient himself. Implicitly, music influences a person based on his auditory habits. Since music contains different parts, the need for systematic attention to music as well as auditory habit of each person in each region and ethnicity is confirmed. Merna Luis et al. (2019) in another study titled "The effect of performing live music with Oud instrument on physiological and psychological parameters" of patients undergoing heart surgery. In the intervention group, the pain scores and respiration rate were significantly reduced after listening to music. Moreover, the heart rate, anxiety, and serum cortisol levels showed a significant decrease as well. It should be noted that the played music was performed at the request of the patient and it included auditory habit implicitly. Another study, entitled "The Effect of Music Therapy on Cortisol as a Biomarker of Stress in Children with Intravenous Injection" was conducted by Idyatul Hasanah et al (2020). This study found no statistically significant effect of music therapy on cortisol levels in children with leukemia during an intravenous injection. However, the results show the clinical effect of music therapy in reducing cortisol levels. In this study, not paying attention to auditory habits systematically and ignoring proper music playback may have led to incorrect conclusions. Haccoun et al (2020) conducted a study titled "Positive and Negative Performance Thoughts: the prediction of daily cortisol production in college music students". The results indicate that two days after a solo performance, music students who report more negative performance thoughts have significantly higher daily cortisol output than music students who report less negative performance thoughts.

Materials and Methods

This test was performed by the field and experimental method that after showing a part of a movie for several times and each with changes in conditions, saliva was sampled and collected in special containers in the same and reliable place and time. The samples, which were four for each person, were transferred to the laboratory and monitored in completely isolated conditions. Saliva sampling is naturally in the laboratory-sampling container and its volume varies according to the physique and ability of each person. , the samples should not be so thick that is separated in the laboratory by centrifugation. These samples were isolated in the laboratory and tested by a cortisol kit.

Results and Discussion

In Table 1, the first column is related to the base cortisol level, which means that each person has a unique cortisol level at the arrival to the cinema, which is measured in this situation. The amount of this condition varies according to the mental and physical condition of each person. The normal amount of cortisol in the morning and evening is given in Table 2. It should be noted that because the amount of cortisol in each person is measured according to his records, this measure would be unique.

To investigate this issue, a statistical population of 19 people consisting of 8 women and 11 men was addressed. The participants in the cinema were 395 spectators with different visual and auditory tastes. The participants were a group of students, technical engineers, marketers, and artists whose average age was 35 years and their habits were examined according to their age status and implicit

interviews before and after the experiment. The day before the test, all people were asked to fast and not take pills, but some samples indicated the lack of observance of this case, and because the cortisol level was measured in the initial status of the person himself, not following the test instructions did not interfere with the test process. Moreover, interfering factors such as test location, test time, sampling method, events such as meeting old friends by chance were ignorable by analysing the results.

The opening sequence of the “Hide & Seek” movie was played in silent status, with selected music, and original music for the participants and after each stage, saliva was sampled. There was an average of 10-minute interval between each experiment including the sampling time. Upon entering the hall, they were sampled to determine the base cortisol status of each individual so that its increase or decrease could be understood in the next three stages. In this test with 4 sampling stages, the first stage was at the time of entering the cinema. The second stage of the movie was shown in silent mode, in the third stage, movie was shown with non-original music, and the fourth stage of the movie was screened with original music. The selected music in stage 3 was the Beethoven moonlight sonata. The melody movement is almost in line with the auditory habit of the people of the East. For this reason, monophonic music was chosen so that the effect of the orchestra and the color of the orchestra sound were not effective in the audience and only the auditory habit was considered in this section. However, the work in the fourth stage was played with the same structure as the original orchestra. According to the analysis for the selection of piano sonatas, significant and debatable results were obtained and interviews were conducted according to the results. In this experiment, the auditory habit means the complete adaptation of music to the meaning of the image. Clearly, the participants in the experiment were unaware of the systematic and technical structure of the music and reacted involuntarily only according to the signifiers that matched their auditory habits. In many cases, the performance of music is about an act in the scene or denotes the time of an event. Music in the same performance highlights the drama scenes and the same specific music can be a symbol of the emotions of that movement by repeating a movement title. In general, if the movie has internal and psychological symptoms, music could be very important as the expression of those states when the director wants to make the audience aware of things about the character that are not clearly seen orally or in gestures. Other psychological functions of the soundtrack include the spectator’s deception, which could be a signifier on an internal subject.

<i>Persons</i>	<i>Cortisol</i>			
	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>
Person1	24.6	15	15.4	11.5
Person2	4.2	3.9	11.9	5.6
Person3	22.8	26.8	28	26.7
Person4	12.9	8.6	10.4	9
Person5	18.4	9.7	14	10
Person6	21.3	24.8	14	10
Person7	19.6	10	32.4	30
Person8	15.7	16	18.3	16.1
Person9	24.4	20	18.7	16.1
Person10	9.1	7	10.6	19.2
Person11	16.8	16.1	11.3	19.1
Person12	4.8	8.4	6.6	9.5
Person13	8.1	5.8	6.5	10
Person14	11.8	9.2	9.4	10
Person15	11.7	16.4	10	9.3
Person16	2.7	3.3	2.1	2.8
Person17	10	5.6	11.6	5.2

Person18	23.4	20	23.8	4.7
Person19	16.9	15.3	15.3	12.9

Table 1: Information on 4 test modes.

3-10 ng/ml	AM
0.6-2.5 ng/ml	PM

Table 2: Cortisol Measurement Reference.

The second column is related to the amount of cortisol when playing the movie in silent mode. In this case, the music was played without any sound and then the amount of hormone was measured.

The third case column is related to the amount of cortisol when playing the movie with irrelevant music. In this case, the movie was selected with a selected music according to the factors mentioned in the third chapter, and after completing this section, the cortisol was measured.

The fourth mode column is related to playing the movie with the original music. In this mode, cortisol was measured after the movie was played.

In the first stages of the experiment, the subjects were sampled after sitting in the cinema hall. The reason for this sampling was the base amount of cortisol in each person so that the later stages could be compared with it. As mentioned, the amount of cortisol in individuals varies according to their physical, occupational, and mental condition, and since the test was performed in a situation close to reality, the presence of interfering factors in this test will not cause a disorder. The obtained values in the third column of Table 1 are given below the first case column.

In the second stage of the experiment, the movie was shown silently in such a way that the movie was played without any music or sound. In this case, the values obtained are given below the second case according to Table 1. These values are presented in Table 3 by isolating separating the people who had increased cortisol.

Row	Gender	Initial State	Silent image
1	M	22.8	26.8
2	F	11.7	16.4
3	M	2.7	3.3
4	M	21.3	24.8
5	M	4.8	8.4

Table 3: Increase in cortisol.

Five subjects experienced an increase in cortisol, which caused this problem after examining the interfering factors. It should be noted that the interfering factors cannot be prevented and controlled and they largely depend on the psychological and physiological personality of the person. On the other hand, as each person is tested according to his own records, it can be concluded that the interfering factors do not interfere with the studies. The increase in hormones in this section, in addition to the factors interfering with the experiment, is due to the audience's visual habit of seeing the image with sound, which has not happened and caused stress in the person. Finally, in this case, people react based on the auditory and visual regime that the interviews conducted with these subjects proves this claim.

Since changes in the hormone cortisol occur rapidly in the body and its return to the original state occurs between 60 and 90 minutes, cortisol fluctuations under the influence of visual elements are very significant because the interval between the experiments of this study was about 8 to 15 minutes.

According to the obtained results in the first and second stages, it is seen that 26% of subjects has an increase in cortisol in the second stage in which the silent movie was screened, which is related to the interfering factors and hearing habits in the individual.

In the third stage of the experiment, the image was played with Beethoven's first Moon Light movement. This music is sharp minor in the second scale and its melodic movement corresponds to the auditory habit of the people of the East. The music was chosen as a monologue so that the effect of the orchestra and the color of the orchestra's sound would not affect the audience, and only the auditory habit was considered in this section. It should be noted that both sounds are the same in terms of sound and mix volume and the whole frequency range is full. The test results are given in Table 1 below the third column related to the third case and shown separately in Table 4. These results show that 12 of the subjects had increased cortisol at this stage and 6 had decreased cortisol, among which one did not change. Twelve people who experienced an increase in hormones are those who often pay attention to the harmony of music and image and pay attention to the structure of music and its combination with visual factors, so that they did not consider the music played in the third stage suitable for the image. It is obvious that the moonlight sonata did not fit their imagery habits.

<i>Row</i>	<i>Gender</i>	<i>Initial State</i>	<i>Image with irrelevant music</i>
1	F	24.6	15.4
2	M	4.2	11.9
3	M	22.8	28
4	M	12.9	10.4
5	M	18.4	14
6	M	21.3	14
7	M	19.6	32.4
8	F	15.7	18.3
9	F	24.4	18.7
10	M	9.1	10.6
11	F	16.8	11.3
12	M	4.8	6.6
13	F	8.1	6.5
14	F	11.8	9.4
15	F	11.7	10
16	M	2.7	2.1
17	M	10	11.6
18	M	23.4	23.8
19	F	16.9	15.3

Table 4: Increasing and decreasing trend of cortisol in Experiment 3.

However, 6 of the subjects had a drop in cortisol in the meantime and they were not included in Table 3. That is, those who had a drop in cortisol with irrelevant sonata or music in the third state also had a drop in cortisol in the first stage; i. e. these people communicated with each image and sound separately and have interfered with their visual and audio habits separately, albeit subconsciously.

In the last stage, the image was played with the main music. The data from this experiment are given in Table 1 below the fourth case column and the results of this stage of the experiment are available in Table 5 according to which 73.6% drop in cortisol is visible and can be calculated as follows:

Row	Gender	Initial State	Image with original music
1	F	24.6	11.5
2	M	4.2	5.6
3	M	22.8	26.7
4	M	12.9	9
5	M	18.4	10
6	M	21.3	10
7	M	19.6	30
8	F	15.7	16.1
9	F	24.4	16.1
10	M	9.1	19.2
11	F	16.8	19.1
12	M	4.8	9.5
13	F	8.1	10
14	F	11.8	10
15	F	11.7	9.3
16	M	2.7	1.8
17	M	10	5.2
18	M	23.4	4.7
19	F	16.9	12.9

Table 5: Increasing or decreasing trend of experiment 4.

According to Table 1 and the fourth case column, 14 people are faced with an increase and 5 people are faced with a decrease in cortisol. In this case:

These people thought of combining image and music, and it is clear that because music is based on their dominant pattern, it is in line with their auditory habit. As a result, it enriches the sense of hearing and cortisol is reduced in saliva inevitably. However, since 26.3% of people were focused on music and the music was in line with stress-based auditory habits, cortisol levels increased in the saliva. In this way, the harmony in the music is based on unpleasant intervals and the orchestra sounds stressful. Therefore, all the subjects have been affected by this issue. In the meantime, some subjects have adapted this music to the image in terms of auditory patterns and the enrichment of the ear causes relaxation and consequently a decrease in cortisol in saliva. Others (6 people) are also affected by the music, harmony, and sound of the stressful orchestra, which causes an increase in cortisol in their saliva.

Accordingly, regardless of the decrease or increase of cortisol hormone, physiological effects of a work of art is observed and changes in hormone level indicate physiological changes in the body of the audience that culture, society, academic level and so on are very important. Here is a memoir by Leonard Roosenan in *A Neglected Art: A Critical Study of Music in Films* stated by Prendergast. There are friendly exchanges as symbiotic catalytic between the film and the accompanying music. The common people who are excited by hearing unpleasant music on a movie, their reaction was between indifference to rejecting it with determination when I performed the same music for them without telling them that the music was from a movie. This is proven experimentally in this research.

Conclusion

In this research, it is clear that audio and visual patterns play a significant role in the secretion of endocrine hormones, here cortisol.

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