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Research Paper

Meditation, Music, and Flow: A Comparison of the Effects of Meditation and Music in Inducing "Flow" and Impacting Computer Game Performance in Indian Teenagers

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ABSTRACT

The research topic of we studied was the experience of flow, which refers to a state of total ab-sorption in an activity, and how to induce it in order to optimize performance. The overall re-search aim was to conduct an in-depth analysis of the impact of meditation and music in induc-ing a flow state for Indian high school students and the concomitant effect on their perfor-mance. Using an experimental approach, we divided participants into 3 groups: Control Group, Meditation Group, and Music Group. We measured he effects of the interventions on the partic-ipants' performance based on the changes between the scores of two rounds of playing Temple Run (an online game). We measured the game timings during the first and second rounds using a stopwatch provided by the game. The results were statistically insignificant for all three groups; the interventions had a minuscule effect on average performance and flow experience. There also wasn't any indication of a positive relationship between flow experience and game performance. However, individual analysis showed a positive relationship between frequent meditation and performance and flow. There was also evidence of attentional focus and music between 50 and 80 BPM improving performance and inducing a flow experience. Performance pressure causing stress for participants negatively impacted both performance and flow, and so did inexperience with meditation. Also, music with lyrics and distance from the 50-80 BPM range had a similarly negative effect on both performances. This study has implications in clin-ical diagnoses regarding the customized prescription of therapeutic interventions and experi-mental fields concerning person-activity fit.

Keywords: *Meditation, Music, Flow, Performance, Indian Teenagers, Psychology, Positive Psychology*

In a world as fast-paced as ours, the one thing we do not have an abundance of is time. Whether in terms of studies or work, our modern existence is characterized by excessively high workloads. High school students have been found to experience higher stress levels and mood disturbances when there is more time spent on homework, according to Kouzma and Kennedy (2002). The percent of obese adults around the country is

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increasing, as work pressures leave barely any time for recreational activity (Anjana et al., 2014).

This is why we would all benefit greatly from optimizing our work efficiency, thus ensuring that our efforts produce the best possible outcomes within the shortest period of time. A high level of productivity can be achieved when one is immersed completely in one's work, without any time expended due to distractions. This state of immersion — being able to perform tasks with full concentration — is what we call a state of "flow".

As defined by Csikszentmihalyi (1990), "flow" describes a profound state of concentration that is tantamount to absolute absorption in an activity. When people are experiencing flow, they typically feel strong, alert, unself-conscious, and at the peak of their abilities (Csikszentmihalyi, 1990). Both a sense of time and emotional problems seem to disappear, and there is an exhilarating feeling of transcendence (Csikszentmihalyi, 1990). As such, they feel in effortless control, which enables them to perform any activity at hand with ease (Csikszentmihalyi, 1990).

The flow state can be achieved while doing a wide range of activities, from swimming to baking. Studies on diverse populations and activities have highlighted the benefits of flow for performance. For example, a 10-year study done by McKinsey (n.d.) asked executives how much more productive they felt when in a flow state. According to their report, top executives responded that they are five times more productive in the workplace when in flow. Music players who experience total absorption in their activity and achieve flow are able to perform effortlessly (Chirico, Serino, Cipresso, Gaggioli, & Riva, 2015). The flow experience is also extremely common among athletes. Flow allows athletes to feel a sense of control and clarity, and can even be motivational for some (Moore, 2020). It can also be induced while gaming, which is why gamers can go for hours without moving from one position (Houston, 2020).

So, what is the physiological process that takes place when flow occurs? First, the release of norepinephrine (important for concentration) leads to an increase in heart rate, the sharpening of focus, and improvements in pattern recognition, while the dopamine produced provides a feeling of engagement (BrainBiz, n.d.). The brain shifts to subconscious processing from fast beta waves to slower and calmer alpha waves, enabling one to link ideas without any internal obstructions or filters, and thus act automatically. With the "inner critic" in the prefrontal cortex shutting down, one is able to think in creative, child-like ways without self-judgement (Monq, 2019). A sense of time distortion and effortlessness is created. Next, the release of endorphins and anandamide frees one from feelings of pain or distress, while improving lateral thinking to facilitate creative problem-solving. After the experience, oxytocin and serotonin kick in to provide the afterglow feelings of trust, security, creativity, and well-being (Meloncelli, n.d.).

While we have clearly established the benefits of flow in optimizing performance, it is easier said than done to attain such a state of being. This is because there are four stages of flow: the struggle phase, the release phase, the flow stage, and the brain rewiring and memory consolidation phase (Meloncelli, n.d.). The struggle phase of achieving flow is why many of us don't get there; it requires us to challenge ourselves and push ourselves to the furthest that we can go (Meloncelli, n.d.). Because many of us are not willing to do this, we are unable to experience a flow state. Stage two, the release phase, is initiated when we embrace

the struggle instead of fighting it (Meloncelli, n.d.). This is when the brain begins to undergo subconscious processing that triggers the flow state (Meloncelli, n.d.). The experience of flow is a part of the third state, whereby we experience a low-grade or peak flow (Meloncelli, n.d.). Low-grade flow is achieved by doing any minimal task, while the peak flow state — also called superfluidity or ecstasy — is generally achieved when there is risk or danger involved (Meloncelli, n.d.). During this phase, we feel confident, in control, productive, and strong. Finally, the brain rewiring and memory consolidation phase is experienced, when the brain and body engage in the process of reverting to their original higher speed of processing. Sleeping or meditating is recommended during this time.

Before trying to achieve flow, a few conditions should be met. The activity we are engaging in should be compatible with our skill level so that we do not get bored or frazzled (Csikszentmihalyi, 1990). Therefore, having clear, achievable goals is critical. We should also be feeling completely energized with all our basic physiological needs met (Roomer, 2019).

In addition, there are a few strategies that we can use to achieve a flow state. One such strategy is meditation. First, it is important that we be able to focus deeply for at least 10-15 minutes before we can enter a flow state. This can be a challenging task when faced with distractions, both internal and external (Nakamura & Csikszentmihalyi, 2009). Meditation that makes the mind more present and aware without getting carried away by "sticky" thoughts is helpful for achieving flow (HeadSpace, n.d.).

Second, creating a mental cue that is repeated right before entering the flow state can help one to achieve the same experience again and again. This is because a neuro-association is being created over time that tells the brain to be prepared for the flow experience, which makes it easier for us to get into flow (Roomer, 2019). For instance, listening to music can help one focus and be productive, especially if the music is repetitive and familiar (Roomer, 2019). First, it blocks external noise and distractions and helps minimize internal distractions. Second, it allows us to be engaged with the music, while remaining present in any other task. So, listening to the right kind of music can help us enter into a distraction-free, focused flow state.

Nonetheless, even though previous studies had researched the effects of meditation and music on performance, such as tasks requiring attention, they had not linked these strategies to the participants' state of flow (Norris, Creem, Hendler, & Kober, 2018). Since flow can help us to achieve peak performance, this study could also reveal how we can perform to the best of our ability even when doing daily tasks. For instance, the ability to enter into a state of flow could be useful for students who have a heavy workload and need to complete as much work as possible within a limited period of time. Therefore, the use of such mental tools could be effective for optimizing performance.

The overall research aim was to conduct an in-depth analysis of the effectiveness of meditation and music in inducing a flow state for Indian high school students and the concomitant impact on their performance in a video game. We instructed three different groups of participants — a control group, a meditation group, and a music group — to play a popular game called *Temple Run*. We then compared the changes in participants' performances and their flow states before and after the interventions (none, meditation, or music) to evaluate their impact.

The hypotheses tested are as follows:

1a. **Null Hypothesis**: There is no difference in the mean timings between the two rounds for each group.
1b. **Alternative Hypothesis**: There is a difference in the mean timings between the two rounds for each group.

2a. **Null Hypothesis**: There is no difference in the mean ratings of the flow between the two rounds for each group.
2b. **Alternative Hypothesis**: There is a difference in the mean ratings of the flow between the two rounds for each group.

3a. **Null Hypothesis**: There is no difference in the mean changes of the timings between the 3 groups.
3b. **Alternative Hypothesis**: There is a difference in mean changes of the timings between the 3 groups.

4a. **Null Hypothesis**: There is no difference in the mean changes of the ratings of the flow between the 3 groups.
4b. **Alternative Hypothesis**: There is a difference in mean changes of the ratings of the flow between the 3 groups.

We also conducted follow-up, one-on-one interviews with the participants to obtain qualitative data.

Sample

We instructed eighteen 14–18-year-old high schoolers living in Delhi participated in the experiment in which they to play an online version of the popular game, *Temple Run*. It is a 3D phone game in which the player plays the role of an explorer running away from evil monkeys that are chasing him/her. The game includes obstacles that the player must dodge by jumping, turning, ducking, etc. Once the player "dies", the duration of their survival in the game is recorded, and they can restart/play again. We used his game, a test of attention and flexibility, as a means to evaluate the performance of the participants. We gave all participants 3 trial runs so that they could get comfortable with the game and familiarize themselves with the controls related to each movement. They played two rounds of *Temple Run* and we recorded the duration of their survival in the game.

Instruments

One measure was used in this study,
Flow Short Scale: The Flow Short Scale measures experience of flow and was developed by Rheinberg, Vollmeyer, & Engeser (2003). The scale contains 10 items. Items 1–10 measure the components of flow experience. The flow items could be separated into two factors: (1) fluency of performance (items 2, 4, 5, 7, 8, 9) and (2) absorption by activity (items 1, 3, 6, 10). Participants were asked to rate their agreement on a 7-point scale ranging from *Not at All* to *Very Much*.

Procedure

The experiment was implemented as follows: we divided the 18 participants into three groups under different experimental conditions. Each group then took part in three separate

Zoom sessions during which we were monitoring them. Apart from the Control Group, that received no intervention, there were two other groups — the Meditation Group and the Music Group. The Meditation Group listened to a 5-minute meditation audio — *Breathing Meditation* — produced by the UCLA Mindful Awareness Research Centre, after playing one round of the game. After the meditation, they played the game a second time. The Music Group participants selected a song that they liked, and listened to it during the second round of the game.

Furthermore, we asked all participants to complete an adapted version of the Rheinberg et al. (2003) Flow Short Scale in order to determine their level of flow before and after the flow-inducing interventions (see Appendix B). The items are divided into two categories, i.e., (1) "fluency of performance" (items 2, 4, 5, 7, 8, 9) and (2) "absorption by activity" (items 1, 3, 6, 10). We compared he total flow of the different groups, based on their fluency of performance and absorption of activity.

Finally, we interviewed all participants over the phone after the experiment to gain insights on how they felt while playing the video game and why they performed better or worse in the second round.

We used descriptive statistics to compare the changes in the game timings and flow scores for the Control, Meditation, and Music groups between the two rounds and the three groups. We also ran paired t-tests and one-way ANOVAs to determine whether the results are statistically significant. We compared the changes in the flow and the performances of the participants in the groups to determine whether there were any relationships. We used the Flow Short Scale as well as the timings in the game to compare the level of flow and determine whether the hypotheses were proven.

Finally, we analyzed the interview responses of the participants within the context of the quantitative data to offer rich and complex insights into the unique experiences of the participants.

Control (C) Group

In this study, we compared the game timings and flow scores of all participants of the Control Group in Round 1 with the timings and scores of Round 2 to see if there is any significant difference. We begin with the game timings. The Control Group participants' mean timing in Round 1 (M = 75.5 sec, SD = 47.02 sec) is 2.05 seconds lower than their mean timing in Round 2 (M = 77.55 sec, SD = 43.57 sec; see Table 1). Thus, they showed a slight improvement in their performance, even without any intervention.

Table No. 1 Descriptive Statistics for Control Group's Game Timings

Round 1 time		**Round 2 time**	
Mean	75.5	Mean	77.55
Standard Error	19.19842007	Standard Error	17.78913058
Median	59.8	Median	58.45
Standard Deviation	47.02633305	Standard Deviation	43.57429288
Count	6	Count	6

However, to determine whether the difference in mean timings between the two rounds is statistically significant, we ran a paired t-test. The result is statistically insignificant: $t(5) = 0.07$ (lower than the critical value 2.57), $p = .94$ (See Table 2). Given that the mean difference between the Round 1 and Round 2 timings is very minor, it is not surprising that the result was not statistically significant. At the same time, as this was a Control Group, the statistical insignificance of this extent of change also provides a baseline for evaluating the performances of the other groups.

Table No. 2 Paired t-test for Pre- and Post-Intervention Game Timings for Control Group

	Round 2 time	**Round 1 time**
Mean	77.55	75.5
Variance	1898.719	2211.476
Observations	6	6
Pearson Correlation	-0.1614355913	
Hypothesized Mean Difference	0	
df	5	
t Stat	0.07269227038	
P(T<=t) one-tail	0.4724346537	
t Critical one-tail	2.015048373	
P(T<=t) two-tail	0.9448693074	
t Critical two-tail	2.570581836	

The Control Group's mean flow rating after Round 1 ($M = 43.5$ pts, $SD = 9.77$ pts) is 0.23 points lower than their mean rating after Round 2 ($M = 43.34$ pts, $SD = 14.73$ pts) (see Table 3).

Table No. 3 Descriptive Statistics for Control Group's Flow Scores

Flow total before		**Flow total after**	
Mean	43.5	Mean	43.33333333
Standard Error	3.989569735	Standard Error	6.01479657
Median	45	Median	41
Standard Deviation	9.772410143	Standard Deviation	14.7331825
Count	6	Count	6

We ran a paired t-test to determine whether the difference in flow scores between the two rounds is statistically significant. The result is statistically insignificant: $t(5) = -0.03$ (lower than the critical value of 2.57), $p = .97$ (See Table 4). Given that the difference between the mean scores of Round 1 and Round 2 is minuscule, an insignificant result is also not surprising. The result is also expected, given that the Control Group was not exposed to any intervention, and it provides a good baseline for evaluating scores of the other two groups.

Table No. 4 Paired t-test for Pre- and Post-Intervention Flow Ratings for Control Group

	Flow total after	**Flow total before**
Mean	43.33333333	43.5
Variance	217.0666667	95.5
Observations	6	6
Pearson Correlation	0.5639723015	
Hypothesized Mean Difference	0	
df	5	
t Stat	-0.03331483023	
P(T<=t) one-tail	0.487356274	
t Critical one-tail	2.015048373	
P(T<=t) two-tail	0.9747125481	
t Critical two-tail	2.570581836	

Nonetheless, to get a more in-depth picture underlying the Control Group's performance, we also studied closely the performance of the individual participants. As shown in Figure 1, the differences between the mean timings of the two rounds are not large for Participants C1, C2, and C5, although their Round 2 timings are consistently higher than their Round 1 timings. However, Participants C3, C4, and C6 had great differences in their timings between the two rounds. While Participant C3's Round 2 performance is drastically better than her Round 1 performance, Participants C4 and C6 had unexpected performances: their Round 1 timings are far better than their Round 2 timings. The huge dips in the performances of these two participants in their Round 2 timings essentially result in the elimination of the differences between the mean performances of the two rounds for the whole group, with the scores cancelling each other out.

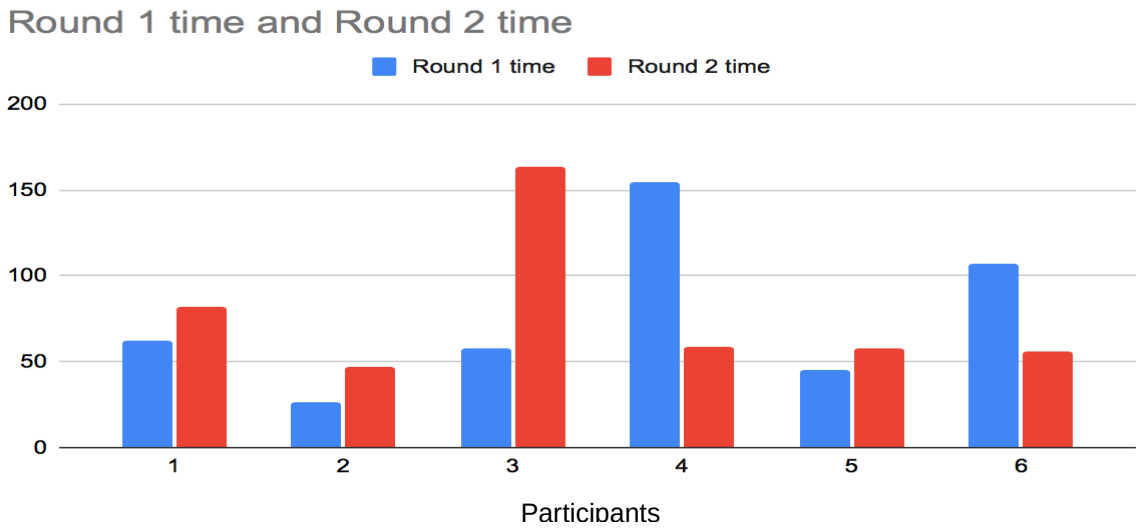

Figure 1. Round 1 and Round 2 timings of Control Group.

Interviews with the individual participants offer additional insights into the underlying causes for their performance. Specifically, Participant C3 and C5 identified "focus" and "attention" to be the pivotal factors in enhancing their game:

There wasn't much that changed between the two rounds. I just focused more in Round 2. (Participant C3) I decided to pay more attention to the game and focus harder, so my score increased. (Participant C5)

It is important to point out that without any intervention, these two participants were able to achieve the desired focus and attention — entering into a state of flow simply by making the decision to do so.

In contrast to Participants C3 and C5, Participant C6 explained that she performed worse in Round 2 due to stress: "I felt more stressed and pressured to perform well in Round 2, and that affected my performance." This finding thus corroborates studies that link pressure to a decrease in performance (Baumeister & Showers, 2006). Therefore, Participant C6's stress prevented her from entering into a state of flow and also undermined her performance severely.

Given the vast differences in the Round 1 and Round 2 timings for half of the participants, including two unexpected directional outcomes, we can see that performances in this game seem to be highly tied to the state of mind of the individual participants. As such, the average performance as a baseline would not likely be sufficient as an indicator for evaluating the performances of the participants. Therefore, it would be more important to factor in individual differences.

Similarly, to gain a more in-depth analysis of the flow scores of the Control Group, we looked at individual responses. In the Control Group, Participants C1, C2, and C4 experienced more flow in Round 1, while Participants C3, C5, and C6 experienced more flow in Round 2 (see Figure 2). As such, the total decrease of scores between the rounds almost equal to the total increase.

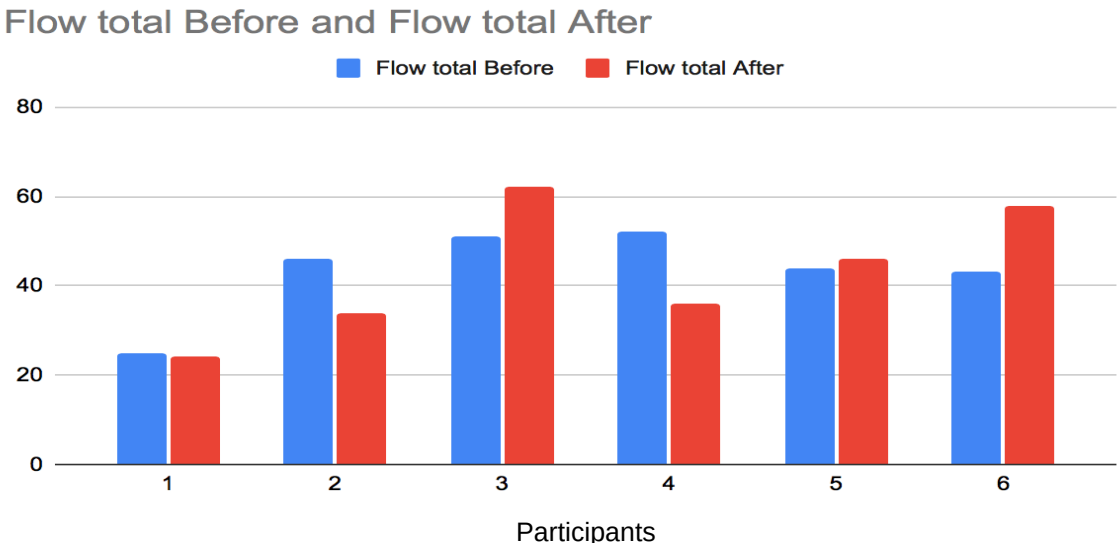

Figure 2. Round 1 and Round 2 flow scores of Control Group.

There seems to be no correlation between the game timings and experience of flow for the participants of the Control Group. Participants C1 and C2 had higher game timings in Round 2, but better flow scores in Round 1. Participants C3 and C5 performed better and had a higher flow scores in Round 2, while Participant C4 had lower game timings and flow scores in Round 2. Finally, Participant C6 performed better in the game in Round 1, but experienced more flow in Round 2. The results of Participants C1, C2, and C6 seemingly contradict various studies linking experience of flow to better performance (Bian et al., 2020; Shüler, 2008; Sumaya & Darling, 2018).

Meditation (Me) Group

In this study, we compared the game timings and flow scores of all participants of the Meditation Group in Round 1 with the timings and scores of Round 2 to see if there is any significant differences.

The Meditation Group participants' mean timing in Round 1 (M = 62.4 sec, SD = 35.2 sec) is just 2.6 seconds lower than their mean timing in Round 2 (M = 64.8 sec, SD = 34.8 sec; see Table 5). This difference is hardly more than the Control Group.

Table No. 5 Descriptive Statistics for Meditation Group Game Timings

Round 1 time		**Round 2 time**	
Mean	62.41666667	Mean	64.81666667
Standard Error	14.36415485	Standard Error	14.19303624
Median	54.55	Median	56.75
Standard Deviation	35.18484996	Standard Deviation	34.76569669
Count	6	Count	6

We ran a paired t-test to determine whether the difference in mean timings between the two rounds is statistically significant. The result is statistically insignificant: $t(5) = 0.15$ (lower than the critical value 2.57), $p = .88$ (See Table 6), which is expected considering that the difference between the two means is small.

Table No. 6 Paired t-test for Pre- and Post-Intervention Game Timings for Meditation Group

	Round 2 time	**Round 1 time**
Mean	64.81666667	62.41666667
Variance	1208.653667	1237.973667
Observations	6	6
Pearson Correlation	0.406925408	
Hypothesized Mean Difference	0	
df	5	
t Stat	0.1543254661	
P(T<=t) one-tail	0.4416944812	
t Critical one-tail	2.015048373	
P(T<=t) two-tail	0.8833889624	
t Critical two-tail	2.570581836	

The Meditation Group flow ratings after Round 1 (M = 49.7 pts, SD = 9.56 pts) were 1.8 points lower than their mean ratings after Round 2 (M = 51.5 pts, SD = 10.4 pts; see Table 7). This difference, though minuscule, was greater than the mean change in flow scores of the Control Group.

Table No. 7 Descriptive Statistics for Meditation Group Flow Scores

Flow total before		**Flow total after**	
Mean	49.66666667	Mean	51.5
Standard Error	3.904413457	Standard Error	4.256367779
Median	49.5	Median	54.5
Standard Deviation	9.563820715	Standard Deviation	10.42592922
Count	6	Count	6

We ran a paired t-test to determine whether the mean difference in flow scores between the two rounds is statistically significant. The result is statistically insignificant: $t(5) = 0.56$ (lower than the critical value 2.57), $p = .60$ (See Table 8). Essentially, even though the mean difference between the two flow scores exceeds that of the Control Group, it is still not statistically significant.

Table No. 8 Paired t-test for Pre- and Post-Intervention Flow Ratings for Meditation Group

	Flow total after	**Flow total before**
Mean	51.5	49.66666667
Variance	108.7	91.46666667
Observations	6	6
Pearson Correlation	0.681965987	
Hypothesized Mean Difference	0	
df	5	
t Stat	0.5606119106	
P(T<=t) one-tail	0.299626073	
t Critical one-tail	2.015048373	
P(T<=t) two-tail	0.599252146	
t Critical two-tail	2.570581836	

We delved into the performances of the individual participants. As depicted in Figure 3, the Round 2 timings of the scores of Participants Me1, Me2, and Me6 are slightly higher than their Round 1 timings, while Me3 did not record any change in the timings. With Me4 and Me5, the former performed far better in Round 1, while the latter performed far better in Round 2. The timings of these two participants thus cancel each other out in terms of the mean difference between the two rounds for the whole group.

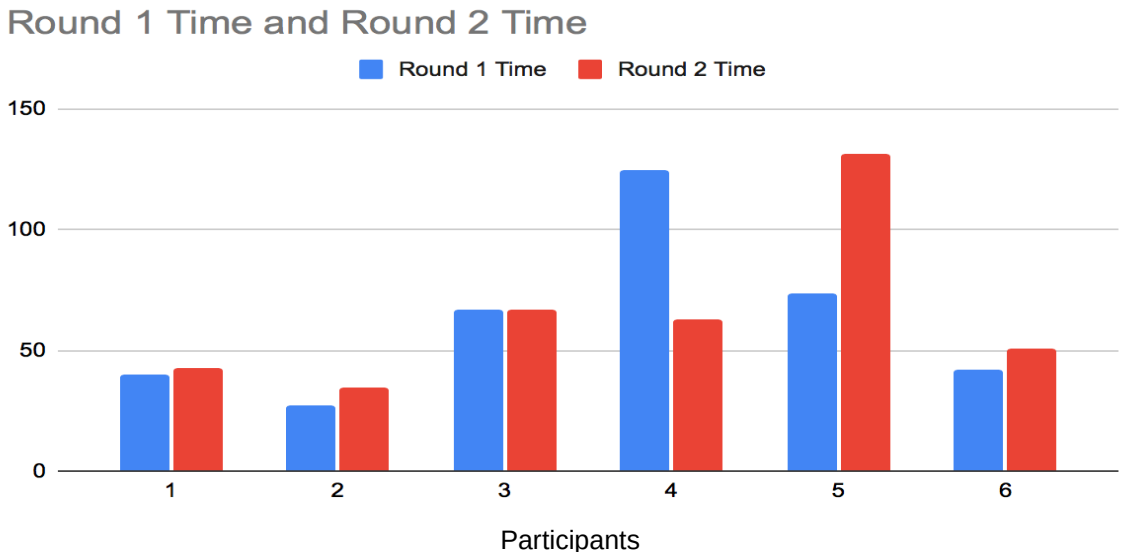

Figure 3. Round 1 and Round 2 timings of Meditation Group.

The critical factor in influencing the performance of this group of participation, as revealed in interviews with the participants, appears to have been the regularity of the practice of meditation in their life. In the case of Participant Me5 whose game timing increased by 57.7 seconds between Round 1 and 2, she revealed: "I meditate often… Even the short meditation clip before playing the second round of the game honed my attention and made it easier for me to face the obstacles in the game." Frequent meditation has been linked to improved cognitive performance and attention (CyberAhletiks, n.d.), which is also represented by Participant Me5's results. Singh (2015) explains how even a few moments of meditation can relax, rejuvenate, and focus frequent meditators, which likely reflects Participant Me5's

experience of being able to slip into a focused state with only 5 minutes of meditation. Studies of how mindfulness changes the brain show that meditation increases activity in the anterior cingulate cortex, allowing meditators to resist distractions and practice self-control (Fox et al., 2014). This evidence could thus explain why it was easier for Participant Me5 to feel calmer and more focused almost instantly.

In contrast, Participants Me1, Me2, Me3, and Me4 reported meditating "occasionally". Participants Me3 did not show any changes in timing between the two rounds; Participants Me1 and Me2 performed slightly better in Round 2. In sharp contrast, Participant Me4's timing fell substantially in Round 2. It can be concluded that 5 minutes of meditation did not produce a substantial change in performance for beginners.

With regards to Participant Me4, who performed much worse in Round 1, he explained, "The game almost felt slower, and I felt zoned out," which is almost opposite to Participant Me5's response. This implies that meditation doesn't have standard effects across individuals, and it doesn't always have positive effects. Studies have shown adverse effects, such as feelings of being "disoriented" and "spaced out", after meditating (Shapiro, 1992), which resemble Participant Me4's description of his performance in Round 2.

The changes of the flow ratings of the individual participants were also examined. For the participant who meditated "frequently", Participants Me5, flow scores increased by 11 points. The subject claimed that meditation made her feel "calmer", "quieter", and "more focused". Participant Me5 said, "I found it easier to concentrate and felt more engaged." Studies give evidence of a direct relationship between meditation and the flow state (Aherne, Moran, & Lonsdale, 2011; Scott-Hamilton, Schutte, & Brown, 2016), potentially explaining why Participant Me5's flow score increased substantially in Round 2.

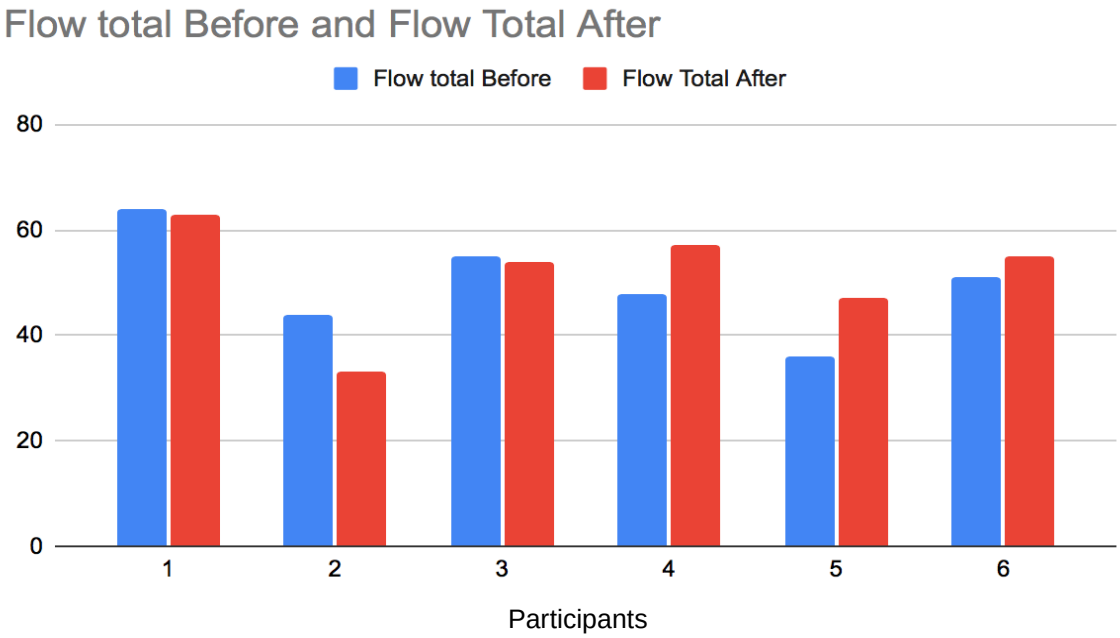

Figure 4. Round 1 and Round 2 flow scores of Meditation Group.

For the remaining 4 members of the group (Participants Me1, Me2, Me3, and Me4) who reported meditating "occasionally", flow scores decreased by an average of 1 point. They also reported that meditation made them feel "relaxed", "calmer", "slower", and "sleepy". Participant Me4 reported that the meditation made him feel "less in control" and diverted his attention. Participant Me3 said, "The meditation made me feel sleepy so I made careless errors in the game"; both these reports are consistent with findings from studies investigating negative effects of meditations in some people (Shapiro, 1992). Once again, the results of this study imply that a 5-minute meditation was not enough to induce a flow state, especially in beginners.

The data collected from participants of the Meditation Group gives inconclusive results about the correlation between game timings and flow scores. Only the game timings and flow scores of Participants Me5 and Me6 increased. Participants Me1, Me2, and Me3's game timings increased, even though their flow scores decreased. While Participant Me4's flow score increased, his game timing decreased. Since four of these participants show a negative correlation between flow and performance, contrary to other research done in the field, and two show a positive correlation, the relationship between flow and performance is shown to be inconclusive in this study.

Music (Mu) Group

In this study, we compared the game timings and flow scores of all participants of the Music Group in Round 1 with the timings and scores of Round 2 to see if there were any significant differences.

The Music Group participants' mean timing in Round 1 (M = 35.6 sec, SD = 4.84 sec) is just 0.9 seconds lower than their mean timing in Round 2 (M = 36.5 sec, SD = 40.1 sec) (see Table 9). This change was even smaller than the change in timings of the Control Group.

Table No. 9 Descriptive Statistics for Music Group Game Timings

Round 1 time		**Round 2 time**	
Mean	35.6	Mean	36.5
Standard Error	1.978046174	Standard Error	16.37589692
Median	34.75	Median	20.8
Standard Deviation	4.845203814	Standard Deviation	40.11259154
Count	6	Count	6

We ran a paired t-test to determine whether the difference in mean timings between the two rounds is statistically significant. The result is statistically insignificant: $t(5) = 0.06$ (lower than the critical value 2.57), $p = .95$ (See Table 10). The small difference between the mean timings of both rounds makes this outcome unsurprising.

Table No. 10 Paired t-test for Pre- and Post-Intervention Game Timings for Music Group

	Round 2 time	**Round 1 time**
Mean	36.5	35.6
Variance	1609.02	23.476
Observations	6	6
Pearson Correlation	0.8188473651	
Hypothesized Mean Difference	0	
df	5	

	Round 2 time	**Round 1 time**
t Stat	0.0608116437	
P(T<=t) one-tail	0.4769325517	
t Critical one-tail	2.015048373	
P(T<=t) two-tail	0.9538651033	
t Critical two-tail	2.570581836	

The Music Group's flow ratings after Round 1 (*M* = 43.3 pts, *SD* = 4.03 pts) were 2.3 points lower than their mean ratings after Round 2 (*M* = 45.6 pts, *SD* = 5.71 pts; see Table 11). This is greater than the difference between the Round 1 and Round 2 flow scores of both the Control Group and the Meditation Group.

Table No. 11 Descriptive Statistics for Music Group Flow Scores

Flow total before		**Flow total after**	
Mean	43.33333333	Mean	45.66666667
Standard Error	1.646545205	Standard Error	2.333333333
Median	43.5	Median	46
Standard Deviation	4.03319559	Standard Deviation	5.715476066
Count	6	Count	6

We ran a paired t-test to determine whether the difference in flow scores between the two rounds was statistically significant. The result was statistically insignificant: $t(5) = 1.05$ (lower than the critical value 2.57), $p = .34$ (see Table 12). The difference between the mean flow scores is very little, despite being the greatest out of the three groups, suggesting that listening to music while performing a task was not able to induce a flow state in participants.

Table No. 12 Paired t-test for Pre- and Post-Intervention Flow Ratings for Music Group

	Flow total after	**Flow total before**
Mean	45.66666667	43.33333333
Variance	32.66666667	16.26666667
Observations	6	6
Pearson Correlation	0.422240515	
Hypothesized Mean Difference	0	
df	5	
t Stat	1.052899466	
P(T<=t) one-tail	0.1702932304	
t Critical one-tail	2.015048373	
P(T<=t) two-tail	0.3405864608	
t Critical two-tail	2.570581836	

Were also compared the individual performances of the members of the Music Group to gain a more in-depth picture. As depicted in Figure 5, Participants Mu1, Mu2, Mu3, Mu4, and Mu5 all performed slightly better in Round 1 than in Round 2, highlighting the adverse impact of music on performance. It is only thanks to Participant Mu6's extraordinarily strong performance in Round 2 that the mean score of the entire group increased slightly in Round 2.

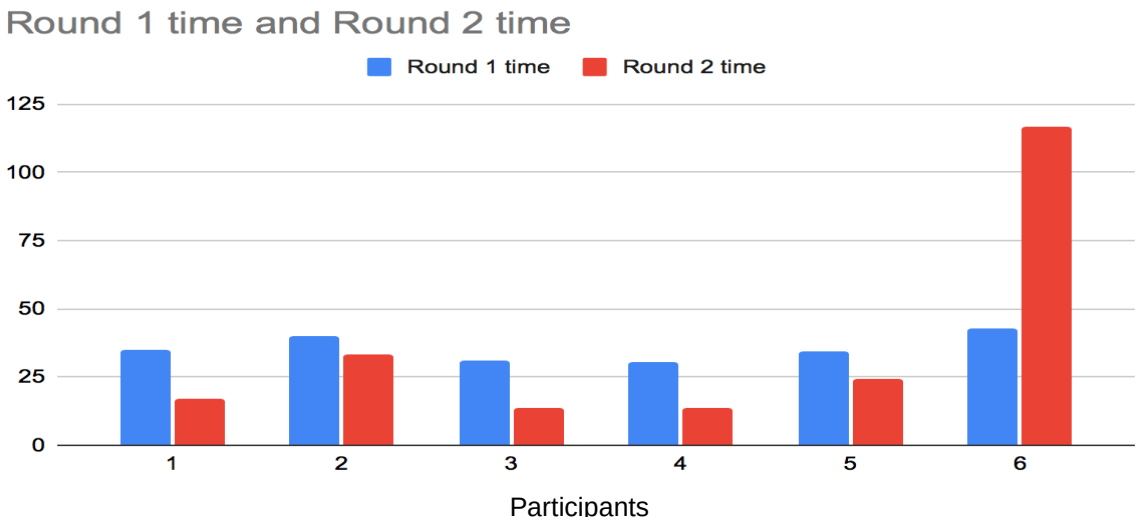

Figure 5. Round 1 and Round 2 timings of Music Group.

Responses given by members of the Music Group suggest that music has different effects on different people, and the concept of "fit" seems like an appropriate explanation for the presented data. During the second round, all participants listened to songs of their choice with lyrics. In fact, Participant Mu1 said, "I performed worse in the second round because there were two things to concentrate on, so I got a bit confused." Studies suggest that music with lyrics likely reduces attention and performance (Shih & Chiang, 2012), explaining Participant Mu1's experience.

Furthermore, familiarity with music seems to have had an interesting effect on the participants. In the case of Mu1, she stated, "If I wasn't familiar with the song that was playing, I think I would have been less distracted." This is in contrast with Participant Mu6's observation: "If I was listening to a song that I hadn't heard before, I don't think I would be as focused." Research supports Participant Mu6's perception: listening to familiar music is less distracting than listening to unfamiliar music (Roomer, 2019).

Yet another factor we could consider is the BPM (beats per minute) of the song. Studies claim that songs with a BPM between 50 and 80 enhance focus because they put the brain into an alpha state, which is also what happens during a flow experience (Monq, 2019), allowing us to be more receptive (Patel, 2019). Participant Mu6's song (84 BPM) is the only one that has a BPM (beats per minute) close to this range. Interestingly, he is the sole participant in the Music Group whose score increased dramatically in Round 2.

However, despite data from various research studies claiming that music helps focus attention (Roomer, 2019), the results of this experiment failed to demonstrate any significant changes, perhaps due to the small number of participants and unregulated choices of music.

The participants of the Music Group experienced about the same amount of flow in both rounds (see Figure 6). The participants' comments about playing music produces contradictory conclusions. With regards to Participant Mu1, she remarked, "I was unable to focus and concentrate." Participant Mu6 was not at all distracted:

I played better in the second round because the music helped me focus. I felt slightly more in control and I wasn't aware of how much time was passing. I wasn't distracted because I often listen to music while working and I recognize that I don't need to pay much attention to the song.

Several articles support the idea that music, the right kind of music, can induce a flow state, even equating the effects of listening to music to those of meditation, which research shows increases flow (McFayden, 2018; Roomer, 2019; Sherman, 2020). Participant Mu5, too, reported listening to music while working; data show that she felt more flow in Round 2

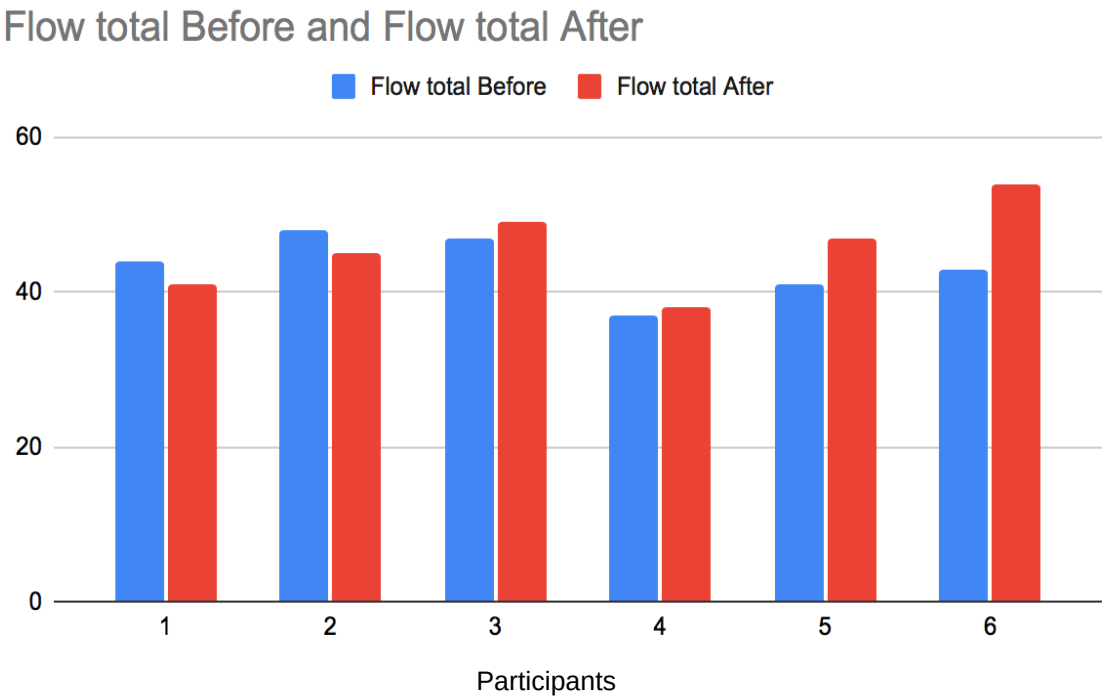

Figure 6. Round 1 and Round 2 flow scores of Music Group

Comparing the game timings and flow scores of the participants across the two rounds, there doesn't seem to be any significant correlation between them, despite data from other studies showing otherwise (Sklett, Lorås, & Sigmundsson, 2018). Participants Mu3, Mu4, and Mu5's game timings decreased in Round 2, even though their flow scores increased. Participants Mu1 and Mu2 performed worse in Round 2 in tandem with the decrease in their flow scores. It is interesting to note that Participant Mu6 experienced the most amount of flow in Round 2 and also performed much better in the game in the same round. This correlation indicates a promising effect of flow on performance, supported by various studies (Sklett et al., 2018). Data from half the participants in this group show a negative correlation between flow and timings, while the other half show a positive correlation, giving inconclusive results about the relationship between flow and performance.

Mean Differences of Changes in Timings Across the Groups

We used descriptive statistics to derive the mean differences between Round 1 and Round 2 game timings for all three groups. The mean difference of the Meditation Group is the greatest (M = 2.4 sec, SD = 38.09 sec), followed by the Control Group (M = 2.05 sec, SD = 69.08 sec) and then the Music Group (M = 0.9 sec, SD = 36.25 sec) (See Table 13).

Table No. 12 Descriptive Statistics for Differences in the Round Timings Across the Three Groups

Control		**Meditation**		**Music**	
Mean	2.05	Mean	2.4	Mean	0.9
Standard Error	28.20107267	Standard Error	15.55154869	Standard Error	14.7997973
Median	16.2	Median	5.05	Median	-13.35
Standard Deviation	69.07823825	Standard Deviation	38.093359	Standard Deviation	36.25195167
Count	6	Count	6	Count	6

To determine whether the mean differences of the changes in the timings between the 3 groups is statistically significant, we ran a one-way ANOVA. The result is not statistically significant: F (2,15) = 0.00, p = 0.99. (see Table 14). Ultimately, the differences between the mean changes between the three groups is still too small to be significant, implying that the meditation and music interventions did not affect participants' game timings.

Table No. 14 One-way ANOVA for Differences in the Round Timings Across the Three Groups

Source of Variation	**SS**	**df**	**MS**	**F**	**P-value**	**F crit**
Between Groups	7.39	2	3.695	0.001470722668	0.9985305023	3.682320344
Within Groups	37685.555	15	2512.370333			
Total	37692.945	17				

Mean Differences of Changes in Flow Scores Across the Groups

We used descriptive statistics to find the mean difference between flow scores between the two rounds across the groups. The Music Group had the greatest mean difference (M = 2.34 pts, SD = 5.43 pts) followed by the Meditation Group (M = 1.34 pts, SD = 8.01 pts). The Control Group, interestingly, had a negative mean difference (M = -0.17 pts, SD = 12.25 pts), indicating that participants felt more flow in Round 1 than Round 2. (See Table 15). It is also notable that the group that performed the best in terms of increase in game timings in Round 2, the Meditation Group, didn't experience the most amount of flow in the same round (see Tables 13 and 15).

Table No. 15 Descriptive Statistics for Differences in the Round Timings Across the Three Groups

Control		**Meditation**		**Music**	
Mean	-0.1666666667	Mean	1.833333333	Mean	2.333333333
Standard Error	5.002777007	Standard Error	3.270236145	Standard Error	2.216102685
Median	0.5	Median	1.5	Median	1.5
Standard Deviation	12.25425096	Standard Deviation	8.010409894	Standard Deviation	5.428320796
Count	6	Count	6	Count	6

A one-way ANOVA run for flow scores showed that the difference between the three groups is not statistically significant, $F(2,15) = 0.13$, $p = 0.87$ (see Table 16). This result demonstrates that there is no significant change in flow scores by either of the interventions.

Table No. 16 One-way ANOVA for Differences in the Round Timings Across the Three Groups

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	21	2	10.5	0.1292042658	0.879761907	3.682320344
Within Groups	1219	15	81.26666667			
Total	1240	17				

The overall research aim was to conduct an in-depth analysis of the impact of different interventions on inducing a flow state for Indian high school students. We adopted a mixed method approach that involved the gathering of experimental data and qualitative data. The results were not statistically significant, and we cannot reject the null hypotheses. However, the analysis of the individual participants in the Meditation Group suggests that frequent meditation could lead to better performance and greater flow scores, as in the case of one participant. Results from the study also indicated that two participants in the Control Group performed better on both dimensions when choosing to actively focus on the task at hand. Finally, the performance in the Music Group was strong when participants listened to songs between 50 and 80 beats per minute. On the other hand, performance declined when there was pressure to do well and participants felt stressed. This was also the case for "occasional" and inexperienced mediators in the Meditation Group.

Although this research study did not yield results that could be generalized to a larger population, or supported the connection between flow and performance, it pinpoints specific ways in which future studies could be conducted to improve the outcomes. Here are some suggestions for future studies:

- A larger sample size is required to present statistically significant and accurate results.
- Extraneous variables such as age, sex, demographics, etc. should be controlled.
- A person-activity diagnostic test should be administered before participants can be divided into groups. This would give researchers a sense of which activity each person would respond better towards, and groups can be made to control the fit variable.
- Experimental conditions should be required to conduct the activity. This would ensure that participants aren't disturbed or distracted during the course of the experiment. It would also allow researchers to control environmental conditions, such as weather and noise.
- The participants of the Meditation Group should be made to listen to a longer meditation tape of at least 15 minutes, based on literature.
- The participants of the Music Group should be divided into two groups. While the first group should listen to a pre-decided classical song during Round 2, the other could listen to a pre-decided rap song. The music the participants listened to would therefore allow for a controlled comparison of the effects of different types of music.

At the same time, through a close examination of the individual performances of the participants in the different groups, one can see that the impact of the intervention on the performance and the flow is largely shaped by the individuals. In all instances, we could not derive any conclusive evidence about the efficacy of the intervention or the connection between flow and performance. Nonetheless, this research study did find that the participant who responded well to meditation and the one who also responded well to music both increased their flow and performance. Therefore, the improved understanding of person-activity fit has important clinical implications that can be used when prescribing therapy practices, as well as implications in research, when studying the effect of any intervention.

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Conflict of Interest

The author declared no conflict of interest.

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