COLLECTIVE STATES IN RHYTEMIC CLAPPING

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Lab oriented Project

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December 2020

Acknowledgements

We would like to take this opportunity and express our gratitude to **Dr. Gaurav Dar**, for his patient guidance, enthusiastic support, and significant critiques for this term paper. We wholeheartedly thank him and acknowledge that this project would not have turned out to be fruitful without his valuable inputs.

Abstract

This project focuses on trying to investigate the nature of human clap. We performed experiments asking our participants to clap together, while we controlled how they were able to listen to other claps. During this journey, however, we realised a lot of underlying phenomena that revealed the mind process of an individual. While the distance posed several obvious hurdles for the project, we were able to make the best of it and come up with some results that would've been otherwise unseen.

Due to the online nature of the semester, various problems were faced in the procedure. The results that were established were more qualitative than quantitative in nature.

Contents

1 Introduction

Humans are the smartest beings on the planet, and yet we reflect some traits that instinctively relate us with other species. A shoal of small fish swim in beautiful patterns to confuse their predator. Birds fly in complete unison as they migrate every winters towards the south. Similarly, humans too can synchronise with large masses with which they might have never met before.

We often see how at a concert the audience starts to applause in a rhythmic and synchronised manner. How does this happen and what affects the individual participant of such events? In this project we shall study the behaviour and psyche of such synchronised clapping.

2 Experiment 1

2.1 Aim

The aim of this experiment is to understand the manner in which two individuals clap on being able to listen to each other.

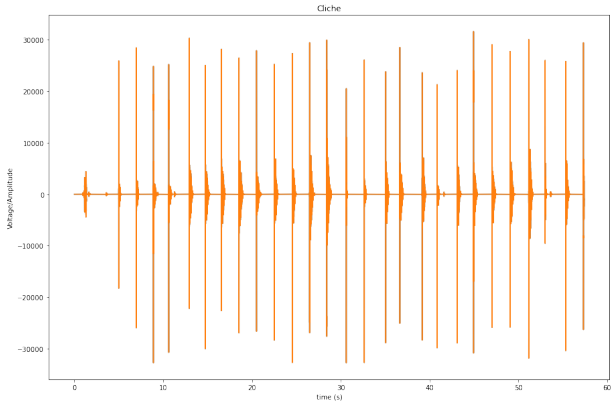
2.2 Procedure

- A discord call was set up with the two subjects.
- They are asked to clap together and to explicitly try to synchronise with each other while doing so.
- The individual recordings are started simultaneously using a bot.
- After the recording, the average ping for each of the participant during the call is noted.
- The recordings are processed in *.wav format and are analysed.
- Three such sets were made.

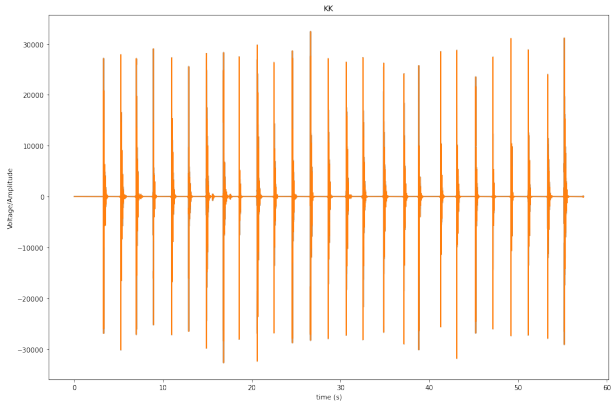
2.3 Observations

2.3.1 Set 1: Aditya and Kartikey

- Ping(Aditya) = 75 ms
- Ping(Kartikey) = 51 ms
- The two volunteers were more or less synchronized, apart from a few instances towards the end.



(a) Aditya



(b) Kartikey

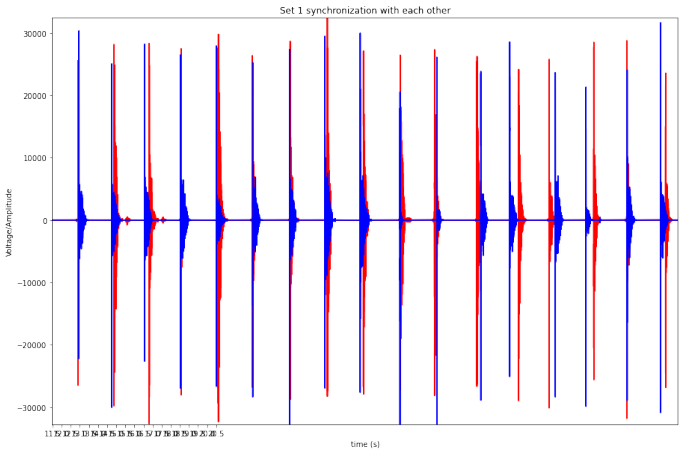
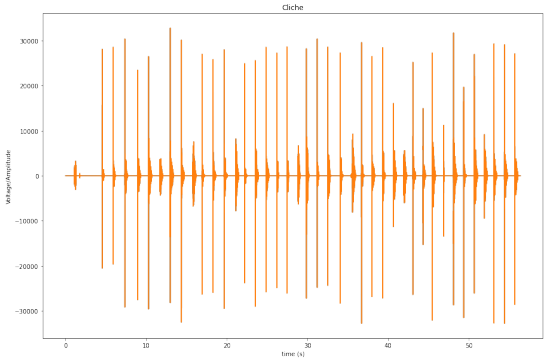


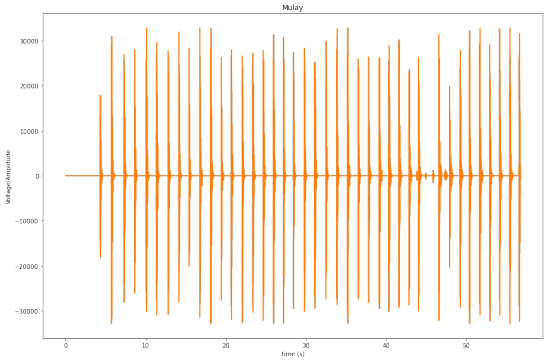
Figure 2: Aditya and Kartikey

2.3.2 Set 2: Aditya and Advait

- Ping(Aditya) = 55 ms
- Ping(Advait) = 15 ms
- The two volunteers were more or less synchronized, with Aditya lagging a few milliseconds behind Advait.



(a) Aditya



(b) Advait

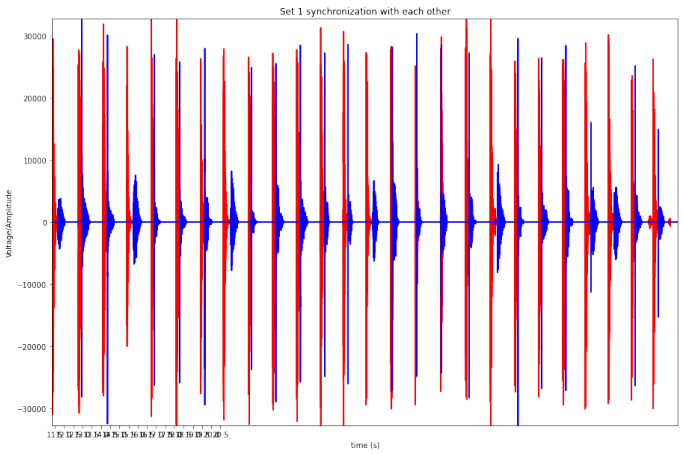
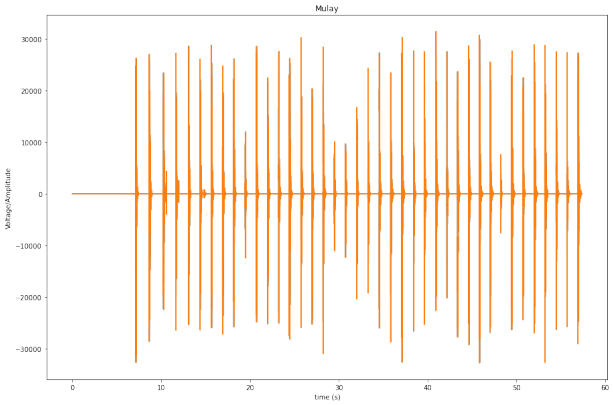


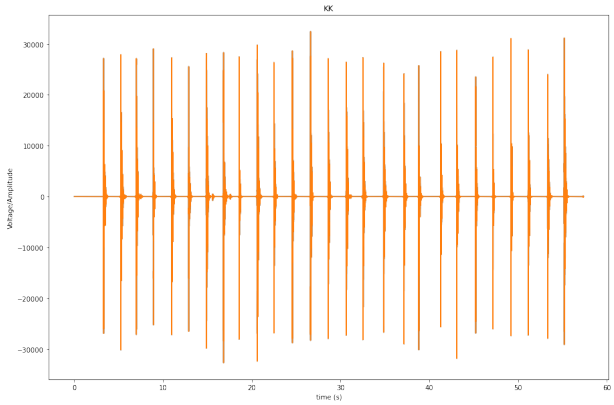
Figure 4: Aditya and Advait

2.3.3 Set 3: Advait and Kartikey

- Ping(Advait) = 18 ms
- Ping(Kartikey) = 52 ms
- The two volunteers were more or less inconsistent, with Advait leading the recording while Kartikey missed a few claps.



(a) Advait



(b) Kartikey

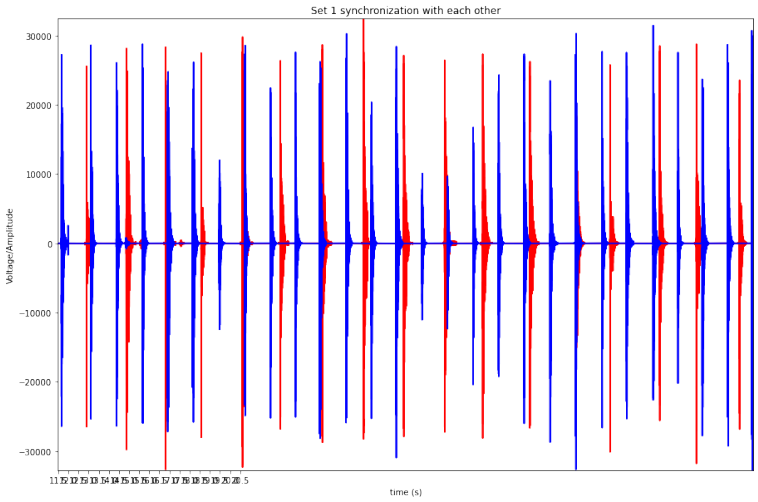


Figure 6: Advait and Kartikey

2.4 Results

From the observations, the following results were inferred:

- In a pair of two, one of the volunteer determines the rhythm while the other follows. Here, the participant with a better microphone/internet quality overshadows the other and the other subconsciously decides to follow.
- In set 1, it is seen that while Kartikey and Aditya start off well, Kartikey fails to register a clap or two due to which he goes off the beat in the latter part. Since his internet was not as strong as Aditya's, he naturally decided to follow rather than to lead without being told to do so.
- In set 2, it is seen that both Aditya and Advait have a strong connection and are able to clap together. Aditya's claps are registered a moment after Advait's since Advait's lower ping helped him be the leader in this case as well. However, no claps were lost to noise and Aditya was able to follow perfectly.
- In set 3 it is seen that the peaks, although nearby, do not overlap very well. This can be accounted to the fact that Advait has a very fast connection with a ping less than 20 ms, while Kartikey's connection is not as consistent and sees a higher ping of greater than 50 ms throughout. This leads to a difference in not only the delay in time at which the two volunteers listen to each other, but also varied with the reaction speed that they have on listening to the claps at varied intervals without a regular rhythm.

3 Experiment 2

3.1 Aim

The aim of this experiment is to have three volunteers clap together and identify the pattern that they follow. We also try to understand how an individual participant decides to act in this case.

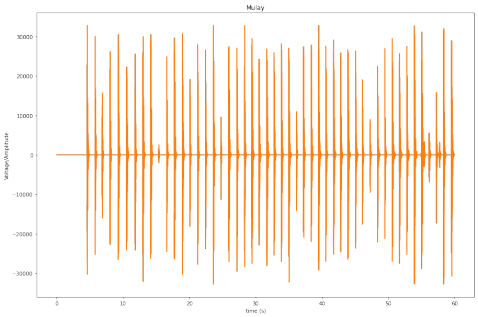
3.2 Procedure

- A discord call was set up with the three subjects.
- They are asked to clap together and to explicitly try to synchronise with each other while doing so.
- The individual recordings are started simultaneously using a bot.
- After the recording, the average ping for each of the participant during the call is noted.
- The recordings are processed in *.wav format and are analysed.
- Two such sets were made.

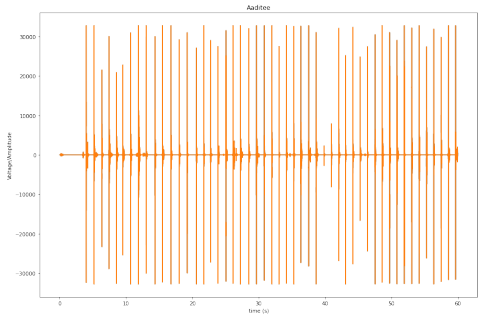
3.3 Observations

3.3.1 Set 1: Advait, Aaditee and Aditya

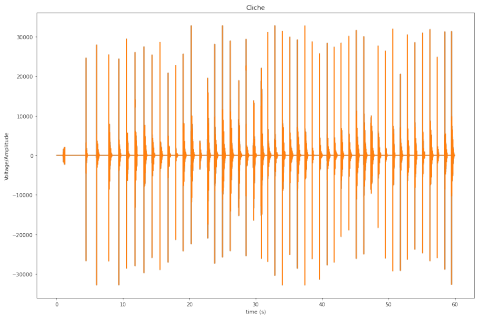
- Ping(Advait) = 16 ms
- Ping(Aaditee) = 47 ms
- Ping(Aditya) = 18 ms
- Claps from all three volunteers stay close together with a large extent of synchronisation, which is not only visible in the charts, but also noticeably audible during the experiment.



(a) Advait



(b) Aaditee



(c) Aditya

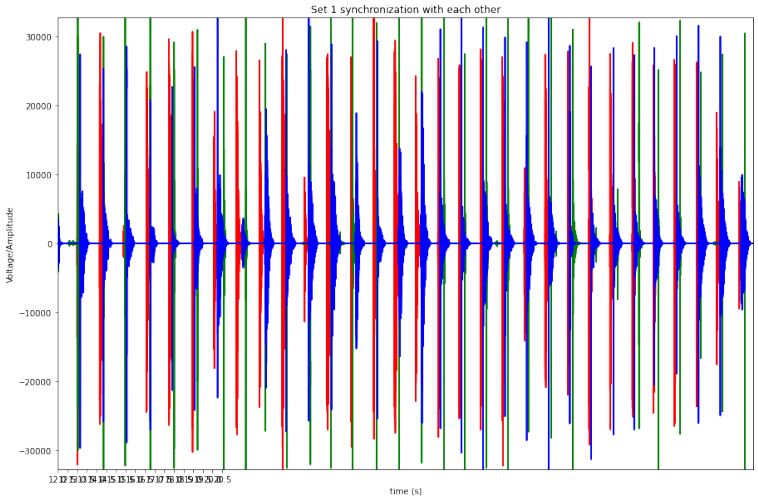


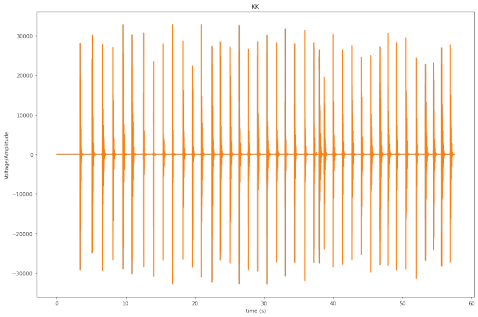
Figure 8: Advait, Aaditee and Aditya

3.3.2 Set 2: Kartikey, Aman and Pragalbh

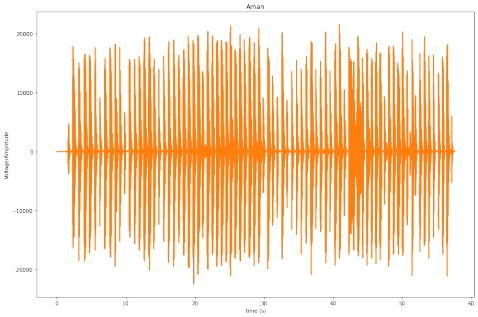
Apart from a high ping and poor connectivity, many other challenges unfolded in this set.

- Ping(Kartikey) = 215 ms
- Ping(Aman) = 44 ms
- Pragalbh = 77 ms
- The peaks in Aman's graphs are not sharp and extend over a longer period.

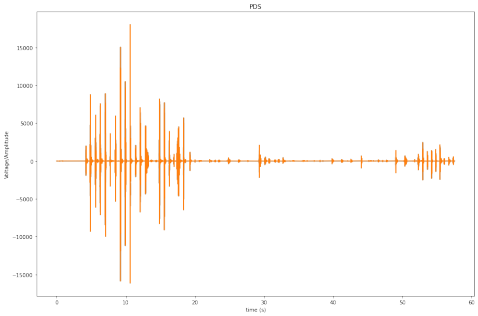
- While Kartikey and Aman record claps that are sychronized, Pragalbh's audio fades after a few seconds. Many changes were made to overcome this problem, but in the end we had to account this to hardware issues.
- In the first twenty seconds where Pragalbh is audible, his claps tend to synchronise with the others.
- There is a large amount of noise in this set.



(a) Kartikey



(b) Aman



(c) Pragalbh

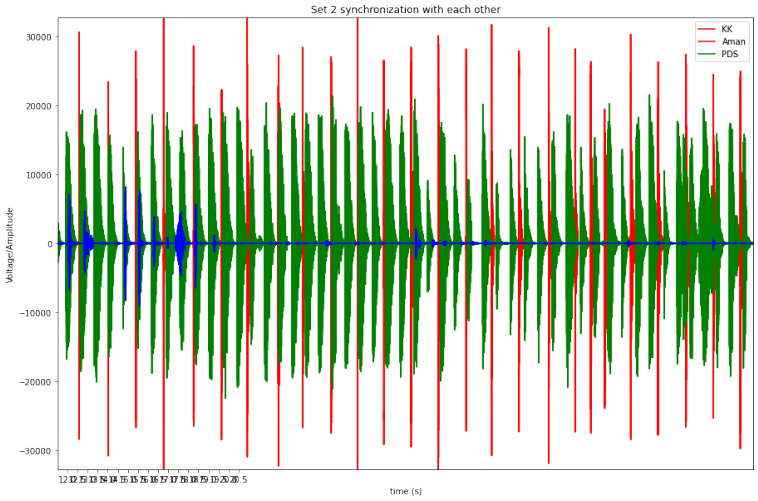


Figure 10: Kartikey, aman and Pragalbh

3.4 Results

From the observations, the following results were inferred:

- Even in a group greater than two, individuals tend to synchronise with each other.
- In this case there is no leader/follower like in Experiment 1. However, every individual acts as a follower. On asking the individuals on how they decided their rhythm, we were told that each participant determined the loudest clap that they could hear, and tried to synchronise with that one pattern alone.
- The observations and the participants' insights helped us determine that perhaps instead of synchronising with a group, an individual synchronises with the most influential person near them.
- Aman's audio was not sharp owing to the echo that we received, since his room was mostly empty.
- The noise in Aman's audio conditioned Kartikey to synchronise with the alternate claps, as he told us that he clapped only when he was able to listen to one on the other end clearly.
- While most of Pragalbh's claps were not registered, the ones that were recorded were well in-sync with Aman, which further fortifies the fact that Aman played a decisive role in this set.

4 Experiment 3

4.1 Aim

This experiment aims to determine if an individual is influenced by the whole group or by one person alone. We wish to see that if the individual listens to only one person in the group, whether or not they will synchronize with the entire group.

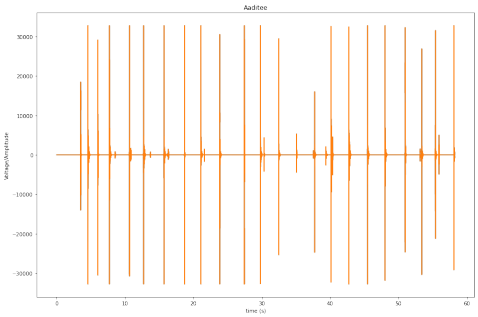
4.2 Procedure

- A discord call is set up between the 4 participants.
- The call is set such that 'A' can listen to 'B', 'B' can listen to 'C', 'C' can listen to 'D', 'D' can listen to 'A'. However, the reverse of this is not true ('B' cannot listen to 'A' and so on).
- The participants are asked to clap and try to synchronize with the person that they can listen to.
- The individual recordings are started simultaneously using a bot.
- After the recording, the average ping for each of the participant during the call is noted.
- The recordings are processed in *.wav format and are analysed.
- Two such sets were made.

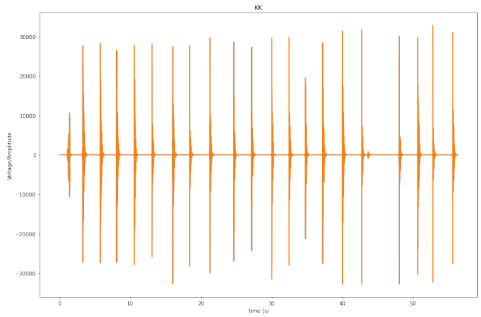
4.3 Observations

4.3.1 Set 1: Aaditee, Kartikey, Pragalbh and Aman

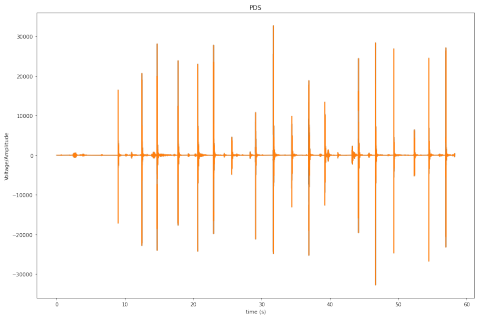
- Ping(Aaditee) = 50 ms
- Ping(Kartikey) = 211 ms
- Ping(Pragalbh) = 306 ms
- Ping(Aman) = 42 ms
- While there are instances of grouping of the claps together, they seem mostly out of sync.
- To an observer who could listen to all the 4 volunteers together, the claps sounded more rhythmic and synchronised than the graph shows.
- There is an increasing time delay between the claps and the graph grows progressively sparser near the end.



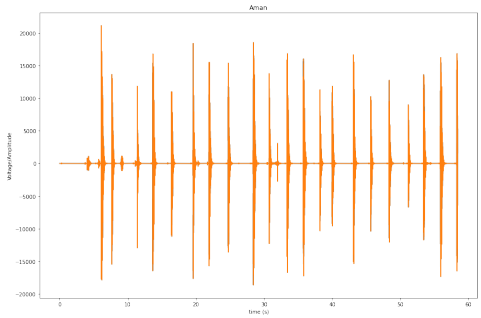
(a) Aaditee



(b) Kartikey



(c) Pragalbh



(d) Aman

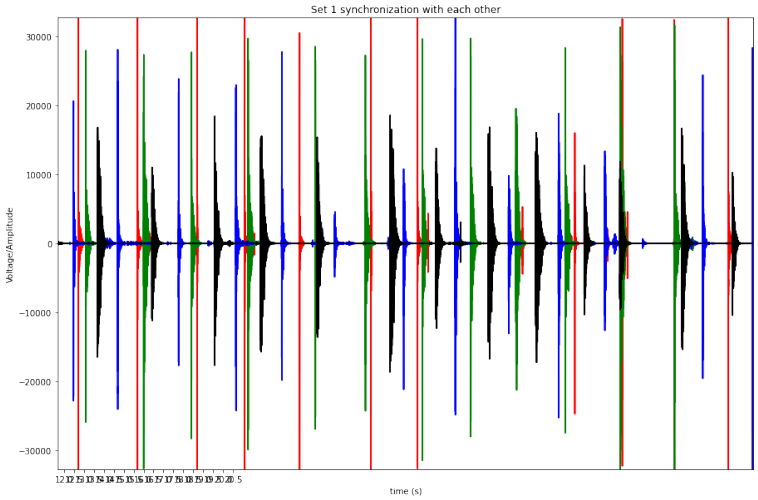
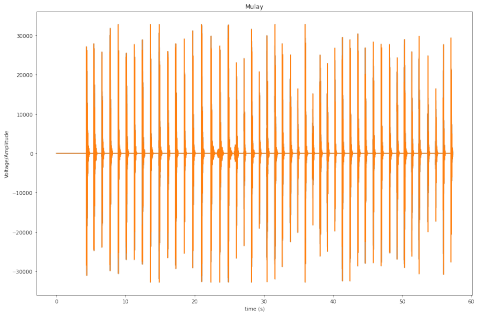


Figure 12: Aaditee, Kartikey, Pragalbh and Aman

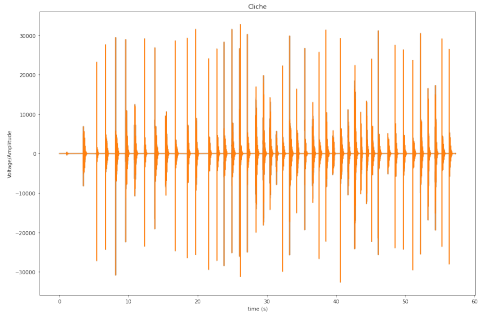
4.3.2 Set 2: Advait, Aditya, Aaditee and Aman

- Ping(Advait) = 16 ms
- Ping(Aditya) = 15 ms
- Ping(Aaditee) = 55 ms
- Ping(Aman) = 43 ms
- In the beginning of the graph, synchronization is observable for any three of the four volunteers at a given point.

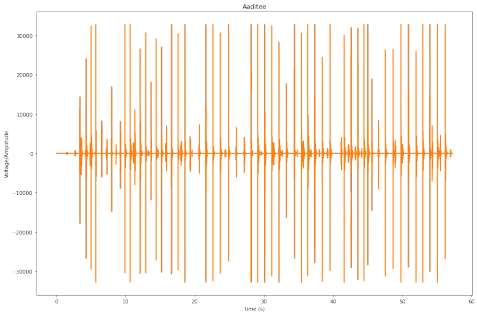
- The black (Aman) peaks are more inconsistent than the other three.
- To an observer who could listen to all the 4 volunteers together, the claps sounded more rhythmic and synchronised than the graph shows.
- There is an increasing degree of inconsistency and lack of synchronization in the graph in the latter parts.



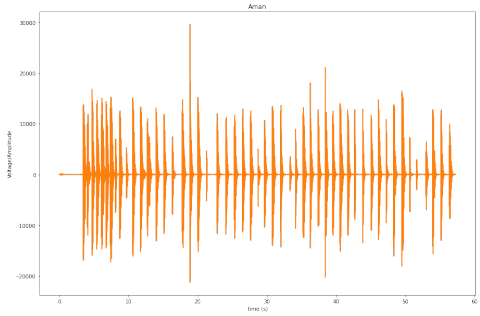
(a) Advait



(b) Aditya



(c) Aaditee



(d) Aman

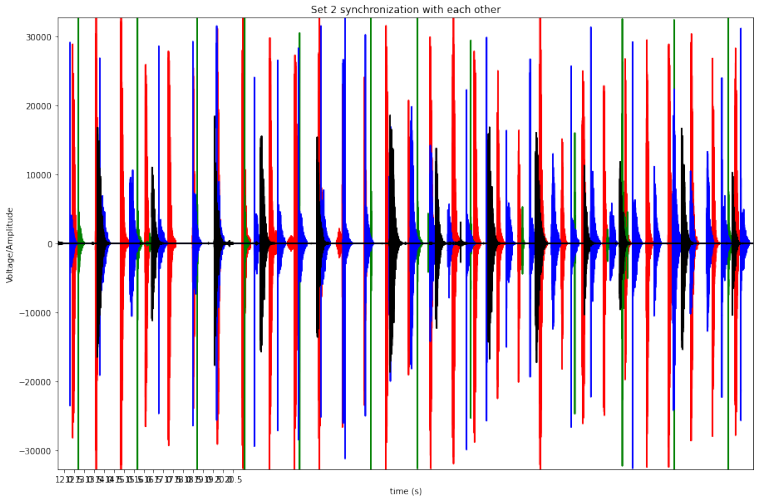


Figure 14: Advait, Aditya, Aaditee and Aman

4.4 Results

From the observations, the following results were inferred:

- On listening to the individuals, it was instantly obvious that synchronization exists because of influence of closest individual on the volunteer.
- The technical problems, however were amplified in this experiment. For every clap cycle, if 'B' faces issues, then these are carried on to 'C' who then forwards them to 'D' and so on. Therefore, a problem in any of the volunteers' connectivity or hardware was very intensely reflected on every other volunteers.
- The delay in the claps increases towards the end in each set. This is because the ping delay of 'A' not only affect 'B' but also 'C' and so on.

$$\text{Time Delay for A after 1 cycle} = ping(A) + ping(B) + ping(C) + ping(D)$$

$$\text{Similarly, Time Delay for A after 2 cycles} =$$

$$\text{Time Delay for A after 1 cycle} + ping(A) + ping(B) + ping(C) + ping(D)$$

This leads to a accumulation in ping/reaction time delays that give us a more out of sync observation as time goes by. These were some problems that were impossible to overcome in an online approach. However, we were able to establish the steps needed to conduct the same in case of an offline semester.

5 Further Proposition: How did the online semester help us?

While the experiments conducted in the online semester were crude and more qualitative than quantitative in nature, we found some solutions to the problems faced in an offline environment, like selective muting/deafening, visually restricting the volunteer and so on.

The gaming communication platform Discord is the best way to conduct these experiments. You can mute participants, you can make specific participants listen to something that the others cannot and so on. This helps with an array of such combinations of experiments. Further, bots like the "Craig" bot make it easier to record the channels and manage them. However, Discord provides its services only over the internet, where the issues of latency, ping, and network throttling by the ISP are major factors that handicaps the purpose, since the readings are not only not credible but also misleading in some cases.

To exploit the functionality of a gaming communications platform and remove any kind of network interruptions, TeamSpeak Servers can be set up on a Local Area Network on campus. TeamSpeak allows you to set up a server on a separate machine and the other participants can communicate through this server. This removes the problems faced over the internet. Since routers provide a large bandwidth, and fiber connection over a very small distance, the latency is so low (almost 0 ms) that it can be easily ignored. Volunteers can take part in these experiments from their rooms, which have less noise and echo. While working with TeamSpeak is more DIY than Discord, the participants will have to record the claps on their individual systems and some processing may be necessary after recording. These are however easy tasks and the benefits of using such a setting outweighs any challenges that one might face.