INTRODUCTION

Time is a highly relative measure for the continuum of experience in human cognition. Different from the concept of ‘absolute time’, perceived time is influenced by the individual subjective state, which is in turn governed by inputs we receive from our environment through the sensory modalities – vision, audition, olfaction, etc. It has been observed that such sensory input can influence time perception to a considerable extent; this fact has been extensively exploited practically.

- Film segments/ images depicting horror are perceived to play longer.
- Pleasant music is often played at waiting rooms and on the automated calling machines to minimize length of time perceived.
- Feelings of stress and anxiousness lead to time passage being perceived as very fast.

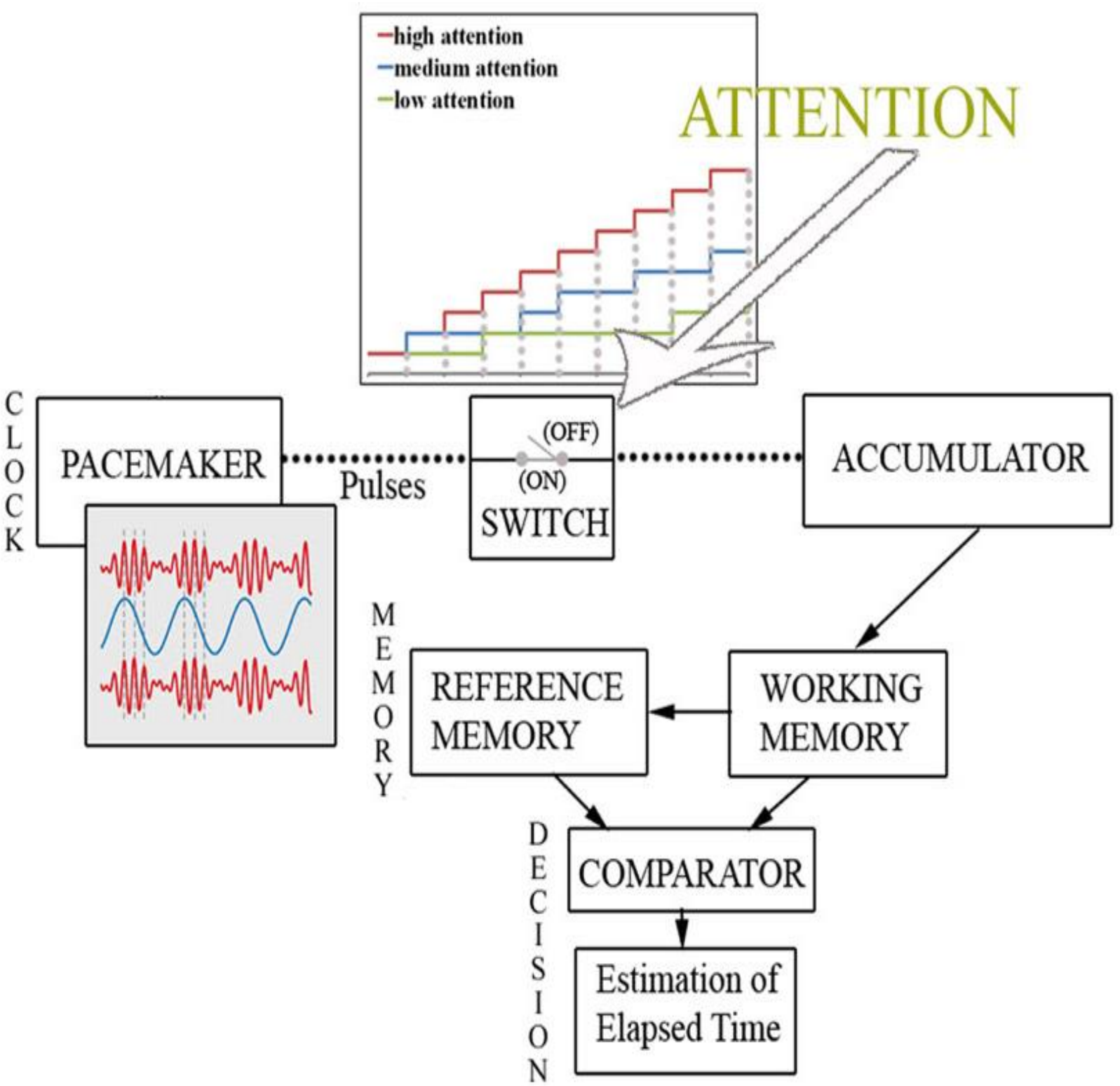
A major cognitive aspect underlying all such experiences is the **emotion** generated by the sensory input. It has been found that the affective state does influence time perception for short intervals; however, the effect is largely subjective and dependant on the stimulus parameters. Here, we focus on the modality of audition and its influence on subjective time perception.

EXISTING THEORIES

A few models attempt to explain time perception in presence of auditory stimulus. These concentrate on two major aspects of auditory stimulus – *arousal* and *valence*.

Considering the 'pleasantness' of music, conventional wisdom supports the claim that perceived duration may be shortened by music generating positive feelings. However, the cognitive model (Block, 1990) suggests that listeners may selectively devote more attention to such music, thus augmenting perceived time.

The 'internal clock model' proposed by Treisman and Gibbon seeks to explain the cognitive basis of time perception.



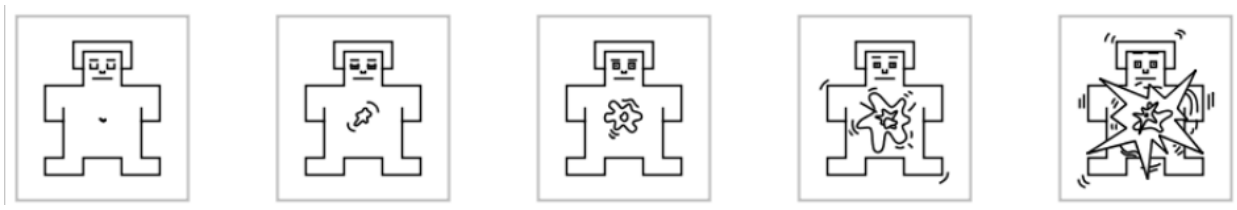
OBJECTIVES

- Empirically analysing the effect of affective states generated by musical stimulus on duration perception of the stimulus itself, and parameters (of the music) responsible.
- Observing effects of auditory stimulus on coupled time-and-performance based tasks.
- Testing conformity of observations with current cognitive models of time perception.

METHODS

Experiment 1:

20 truncated musical pieces chosen on basis of tempo and type. 40 subjects rated 5 music samples each for arousal (low-high) and valence (positive-negative).



Experiment 2:

Samples from Experiment 1. Temporal bisection regime used to train subjects (white sound used for training).
40 subjects estimated the playing duration of 5 music samples each.

Experiment 3:

- **Fruit Ninja** :

Fixed time mode chosen. 6 subjects. Each subject asked to play three trials for training. Asked to play thrice again with musical stimulus. Performance measured.

- **Asphalt** :

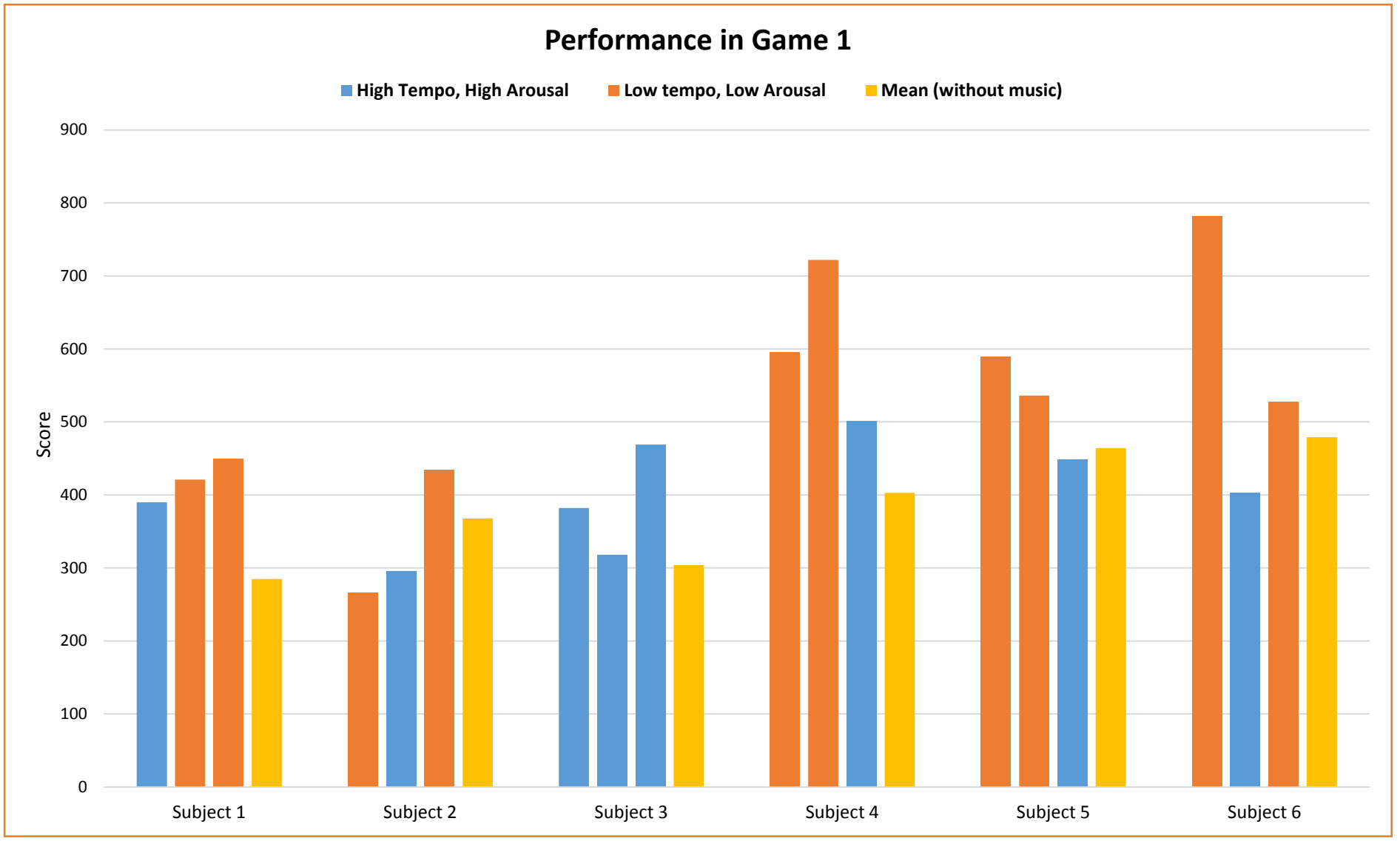
Variable time mode, fixed race length. 6 subjects. Each subject asked to play three trials for training. Gameplay time told to subject. Asked to play thrice again with musical stimulus. Subject asked to estimate gameplay time, and performance measured.

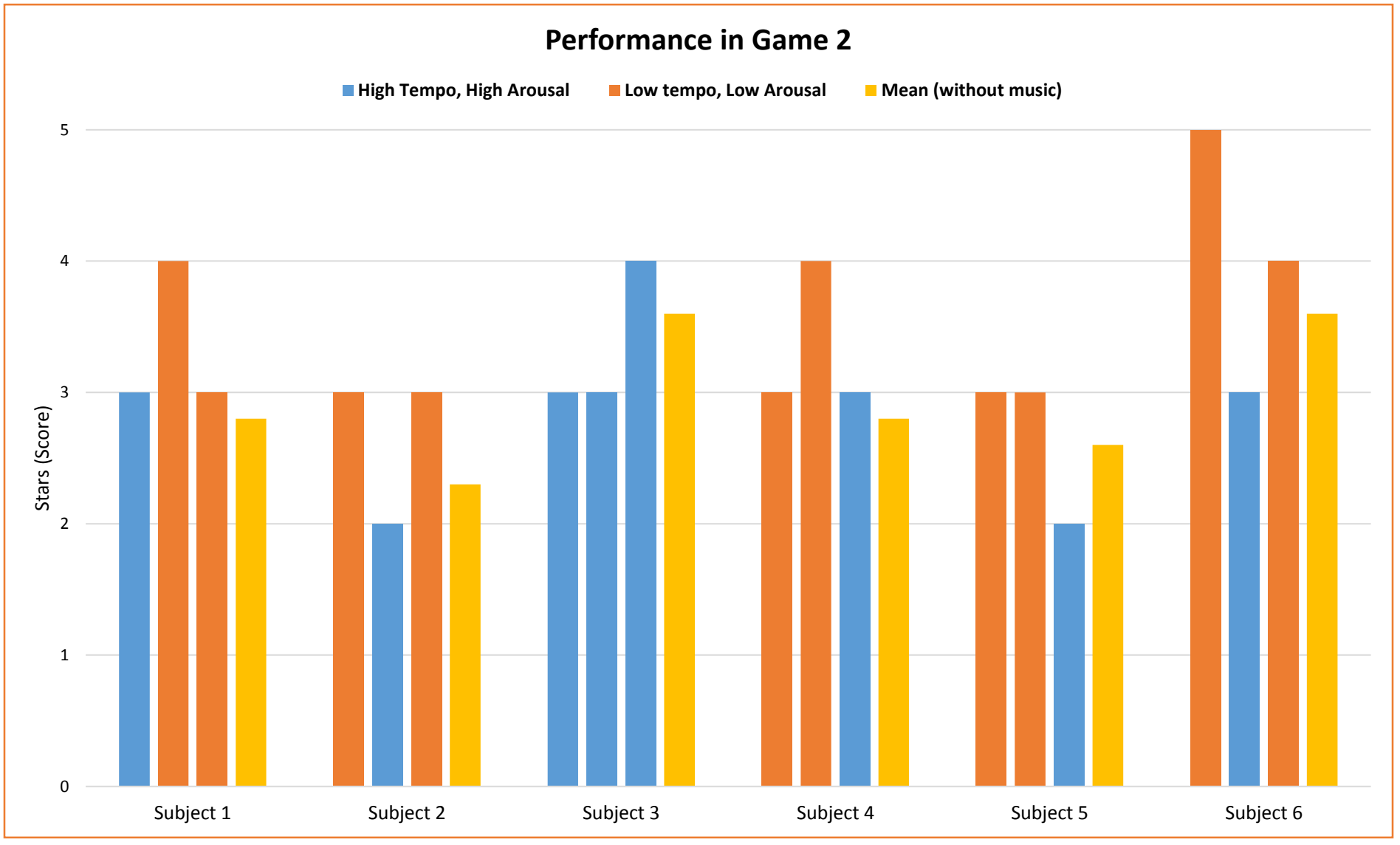
Note: Experiments 1 and 2 follow protocol used by Sylvie Droit-Volet and Marion Noulhaine in their respective studies.

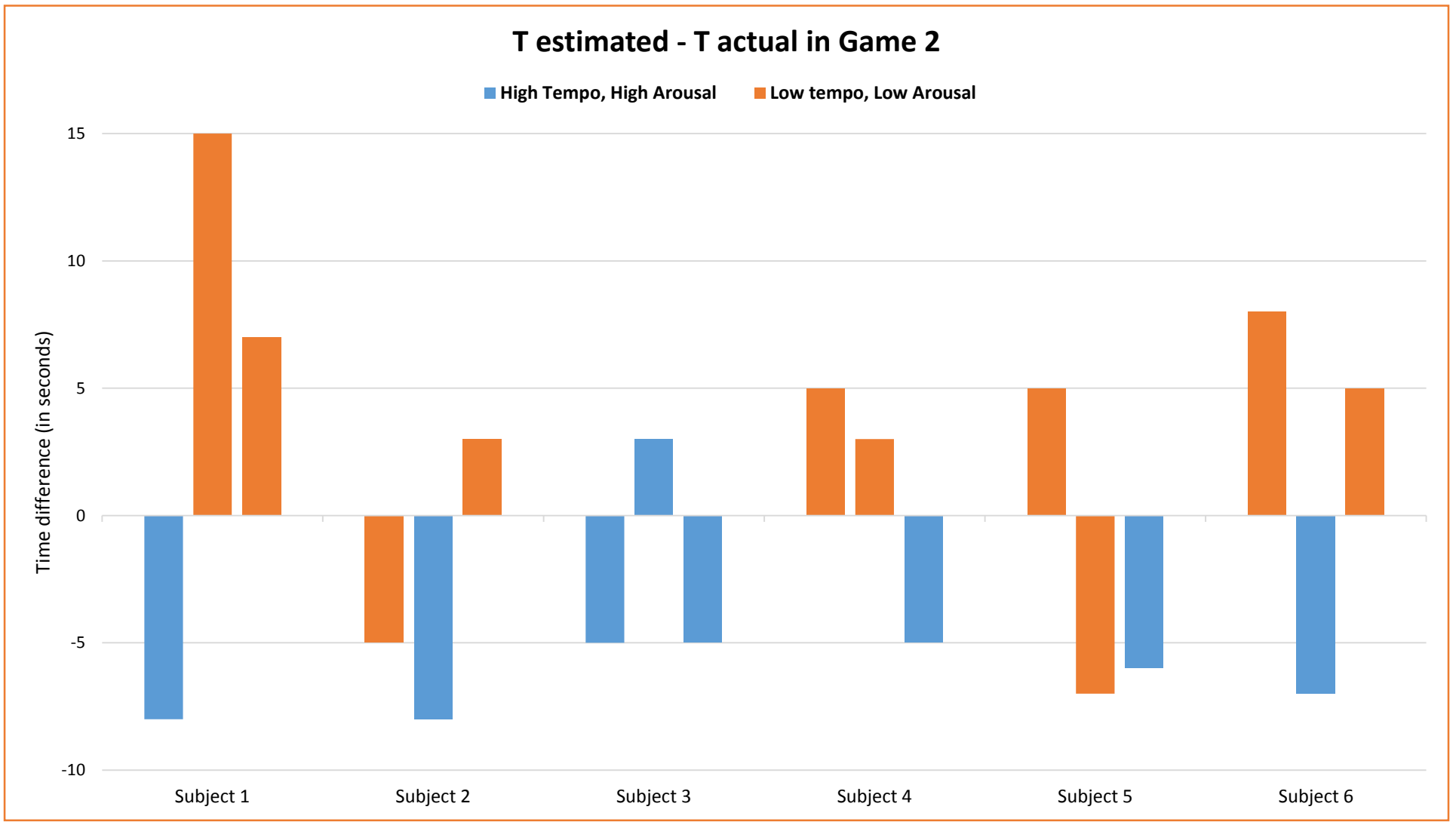
RESULTS

Tempo	Arousal	Valence	Type	T actual [in seconds]	T estimate average [in seconds]
High	High	Positive	Orchestral	15	13
High	High	Variable	Orchestral	15	14.1
High	Low	Positive	Non-orchestral	15	16.3
High	High	Positive	Non-orchestral	15	12.4 12.8 11.5 12.5
High	High	Negative	Non-orchestral	15	12.5 16.1

Tempo	Arousal	Valence	Type	T actual [in seconds]	T estimate average [in seconds]
High	Low	Negative	Non-orchestral	15	16.3
Low	High	Positive	Non-orchestral	15	12.5
Low	Low	Positive	Orchestral	15	12.3
Low	Low	Negative	Orchestral	15	16 15.7 15.8
Low	Low	Negative	Non-orchestral	15	15.9 16.5 16.1
Low	Low	Negative	Atonal	15	13.8


Performance in Game 1
High Tempo, High Arousal
Low tempo, Low Arousal
Mean (without music)
Score
900
800
700
600
500
400
300
200
100
0
Subject 1
Subject 2
Subject 3
Subject 4
Subject 5
Subject 6


Performance in Game 2
High Tempo, High Arousal
Low tempo, Low Arousal
Mean (without music)
Stars (Score)
5
4
3
2
1
0
Subject 1
Subject 2
Subject 3
Subject 4
Subject 5
Subject 6



INFERENCES

Experiments 1 & 2

- All parameters considered – tempo, arousal, valence, and type of music play a regulating role on time perception to varying extents.
- The primary factors governing this perception are tempo and valence. In general, music with positive valence ratings was judged to be shorter than music with negative valence ratings, with both estimations lying on either side of the actual (15s) duration.

- Fast-paced music was judged to be longer than slow-paced music. Arousal levels similar to the tempo level augmented the perception deviation. Generally, high-arousing music was perceived to be shorter than low-arousing music.
- Over the small dataset, orchestral music was judged to be longer in duration compared to non –orchestral music, when all other parameters were kept the same.

Experiment 3:

- We observed that performance generally improved when the player listened to accompanying music as against silence.
- Performance generally improved in both games with low arousal, low tempo music.
- Statistically, gameplay time was often underestimated when high tempo, high arousal music was used. Overestimation occurred with low tempo, low arousal music.

CONCLUSION

In this project, we have studied the elementary effects of affective auditory stimulus on short-duration time perception. Our inferences conform with the ‘internal clock model’, and we have identified some key characteristics of the stimulus which play an important role in time perception cognition. Our final experiment suggests significant influence of auditory stimuli on coupled non-affective tasks and their performance. However, more data needs to be obtained and analysed to confirm the findings from this project.

ACKNOWLEDGEMENTS

We would like to express profound gratitude to our instructor, Prof. Amitabha Mukerjee, who gave us this opportunity to conduct and present our work. We are deeply obliged to Prof. Gianna Cassidy and her lab for helping us design our experiments and providing pointers for analysis.

We would also like to thank all the tutors of SE367A who guided us throughout the project workflow. Finally, we would like to acknowledge all our friends who participated in the experiments without asking for incentives.

REFERENCES

- *Sylvie Droit-Volet, Danilo Ramos, et. Al,* ***Music, emotion, and time perception: the influence of subjective emotional valence and arousal?*** *Frontiers in Psychology, 2013*
- *Marion Noulhiane, Nathalie Mella, et al.,* ***How Emotional Auditory Stimuli Modulate Time Perception****, Emotion, 2007*
- *Cassidy GG, Macdonald RA (2010),* ***The effects of music on time perception and performance of a driving game****., Scand J Psychol., 455-64*
- *Treisman,M.(1963).****Temporal discrimination and the indifference interval :implications for a model of the "internal clock****." Psychol. Monogr. 77, 1–13.*