MSc in Computational Cognitive Neuroscience

Goldsmiths
UNIVERSITY OF LONDON

Observing Interpersonal Dynamics During Conversation through the use of Wearable Sensors

Jeevan S. Matharu (jmath003@gold.ac.uk)
Supervisor: Jamie A. Ward (j.ward@gold.ac.uk)

Introduction

There are many factors that aid efficient and engaging conversation. One of the biggest non-verbal factors is synchronicity of head movements which has been described as acting as 'social glue' [1]. Research investigating individuals body language during conversation has shown it is possible to detect who is acting as a passive listener and who is acting as an active speaker through the use of body mounted wearable sensors (in the form of a necklace) [2] providing a key insight into interpersonal dynamics during conversation.

This research will be investigating interpersonal dynamics during conversation in a dyad setting using eSense earbuds [3][4] that feature an accelerometer and gyroscope allowing accurate, real-time, head movement tracking. OpenPose [5] will also be used to track head movements through the video recordings of each experimental trial. These two modalities were chosen to collect data during the Covid-19 period without the need of in-person experiments and should provide a set of robust, reliable datasets.

Hypotheses

This research aims to test the following hypotheses:

- There will be synchronous head movement when two people are in conversation.
- The roles within the conversation (speaker and listener) can be classified based on head movement.

Data Collection

Head movement data will be collected using the following two methods:

The eSense earbud records head movements made by the participant in real-time using the built in 6-axis sensors. The datasets will be recorded using an android companion app.

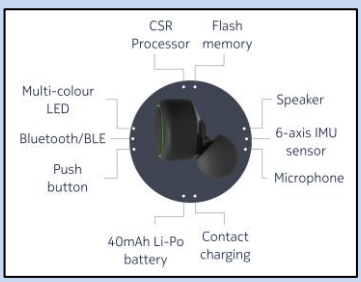


Figure 1: eSense earbud features.

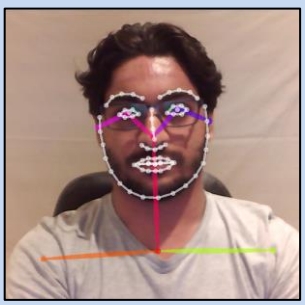
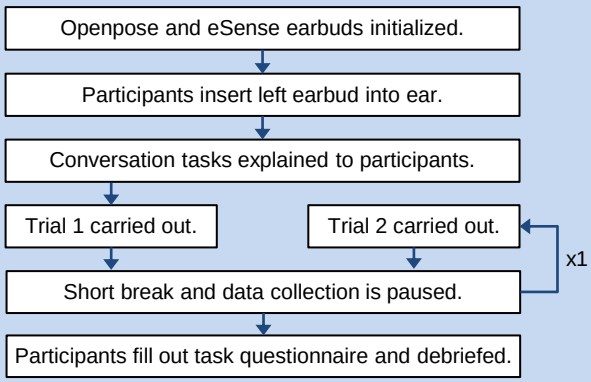


Figure 2: Openpose face map.

The video recordings collected during each trial will be analyzed using OpenPose to track head movements based on selected facial anchor points (white dots seen in *figure 2*). The most common anchor points used are the eyes, nose, and temples as their positions differ the least across participants.

Methods

The experiment will consist of two trials, each using a semi-structured conversation task that will evoke natural and engaging conversation between the participants. The first trial will use a meal-planning task where the participants have to create a meal using ingredients they dislike and the second trial will use a holiday-planning task where the participants will plan a holiday based on holiday activities they dislike. The procedure is as follows:



Data Analysis

- Each participants dataset will be synchronized with their corresponding partners' dataset to ensure the time-series align.
- The eSense and video datasets will need to be cleaned before any further analysis can be carried out. This will include removing any extra noise from the earbud data and excessive movements from the video data.
- A cross-wavelet analysis [6] will be performed on the datasets calculating the wavelet coherence of head motion within each trial.
- Further exploratory analysis will be performed on the data based on the wavelet coherence results.

Summary

This study builds on the previous research conducted on interpersonal dynamics during conversation and provide further insight into how head movements help facilitate conversation. With limited previous research using wearable sensors, this study has an exploratory aspect that may reveal new interactions within individuals. The inclusion of a further exploratory analysis on conversations within a triad setting is being reviewed to possibly uncover new head movement patterns that have not previously been investigated. Future research may see this study repeated in a more natural setting to test whether the environment may play a role in how we converse.

[1] Lakin, J. L., Jefferis, V. E., Cheng, C. M., & Chartrand, T. L. (2003). The chameleon effect as social glue: Evidence for the evolutionary significance of nonconscious mimicry. *Journal of nonverbal behavior,* 27(3), 145-162.
[2] Gedik, E., & Hung, H. (2018). Detecting conversing groups using social dynamics from wearable acceleration: Group size awareness. *Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies*, 2(4), 1-24.
[3] Kawsar, F., Min, C., Mathur, A., & Montanari, A. (2018). Earables for Personal-scale Behaviour Analytics. *IEEE Pervasive Computing,* 17(3).
[4] Min, C., Mathur, A., & Kawsar, F. (2018). Exploring Audio and Kinetic Sensing on Earable Devices. *WearSys 2018, The 16th ACM Conference on Mobile Systems, Applications, and Services (MobiSys 2018)*, Munich, Germany.
[5] Cao, Z., Hidalgo Martinez, G., Simon, T., Wei, S., & Sheikh, Y. A. (2019) OpenPose: Realtime Multi-Person 2D Pose Estimation using Part Affinity Fields, *IEEE Transactions on Pattern Analysis and Machine Intelligence.*
[6] Hale, J., Ward, J. A., Buccheri, F., Oliver, D., & Hamilton, A. F. D. C. (2019). Are you on my wavelength? Interpersonal coordination in dyadic conversations. *Journal of Nonverbal Behavior*, 1-21.