Co-modulation of heart rate variability and language

Mayara dos Santos Nascimento[1], Advisor: André Fujita

[1]Funded by CNPq through PIBIC scholarship

Introduction

Human beings have the unique ability to communicate and extract meaning through spoken and written language. And such language processing is one of the most complex cognitive tasks that humans routinely engage in.

To explore the heart rate and behavior of social interaction, this research project aims to assess the interaction between two or more individuals. In this work, we reviewed studies on neural mechanisms and markers of social interactions, however the research bias was based on performing a behavioral experiment via analysis of heart rate variability.

Methods and Procedures

In this work, the behavioral experiment described by Dikker [1]. All participants must have normal or corrected-to-normal vision, and no history of psychiatric or neurological disorders, free from any psychotropic medication.

During the experiment, those selected will be asked to view 45 hand-drawn color images depicting fictional scenes in which an animal or object performs an action on another animal or object (for example, a penguin hugging a star). The speaker will be instructed to describe the images, using declarative sentences, simple in the present continuous tense, with a single transitive verb and without adjectives or adverbial phrases.

Each image was assigned a predictability score, derived from an online questionnaire in which 40 volunteers described each of the 45 scenes with the description they considered most appropriate. None of these 40 volunteers will participate in the experiment. For each scene, we assigned a score reflecting the percentage of participants who entered the same answer.

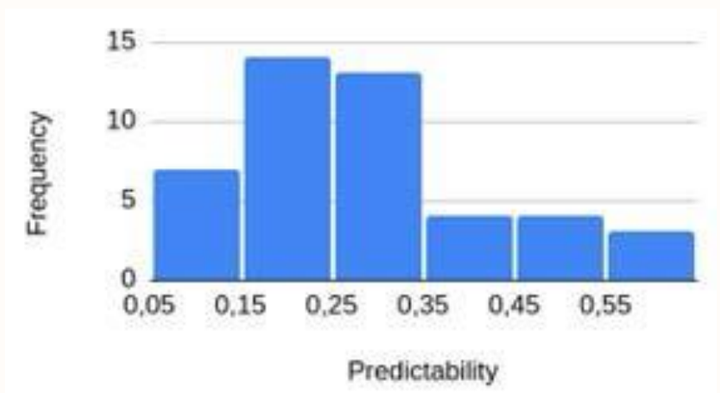

Figure 1: Frequency of predictability

Predictability is given by 1 minus the entropy value, with 0.0 being the least predictable and 1.0 the most predictable. Based on the distribution of predictability, items will be assigned one of two conditions: high predictability and low predictability.

Experimental procedure

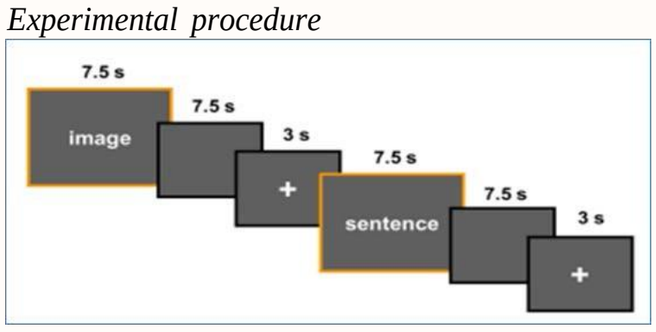

Figure 2: Dikker, Suzanne, et al. (2014)

During the sessions of the face-to- face experiment, and will be simultaneously heard by the listeners during the capture. Then, for both the speakers and listeners, we will present each image, for 7.5 seconds, followed by 7.5 seconds of blank and then intermittent fixation crosses (375 ms on /off, 3 seconds total). Then the display of the next image begins. Each participant will see a total of 45 trials in random order, distributed in five blocks. Each session will last approximately 45 minutes and in parallel, heart rate will be captured by Polar H10 electrocardiogram sensors.

Results

For the captures, a software was built, whose main characteristics are:

•It has an operator window, where the beginning of the capture is controlled.

•Allows you to establish the capture routine, image display time, pause, etc.

•Has windows for volunteers, where the images and instruction message are displayed.

•Displays the images contained in a folder randomly.

•Saves the electrocardiogram signal.

•Automatically locates available cameras, and electrocardiogram sensors on localhost and other hosts on the network.

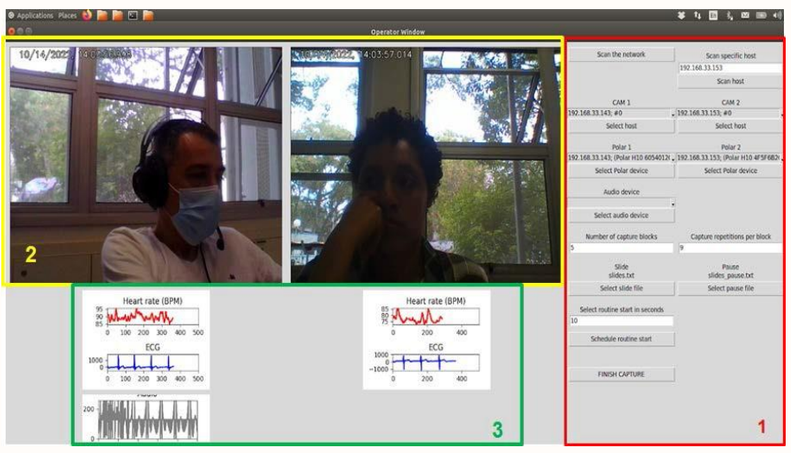

Figure 3: Operator window

Figure 3 shows the capture of the operator window that will control the data acquisition in the face-to-face experiment.

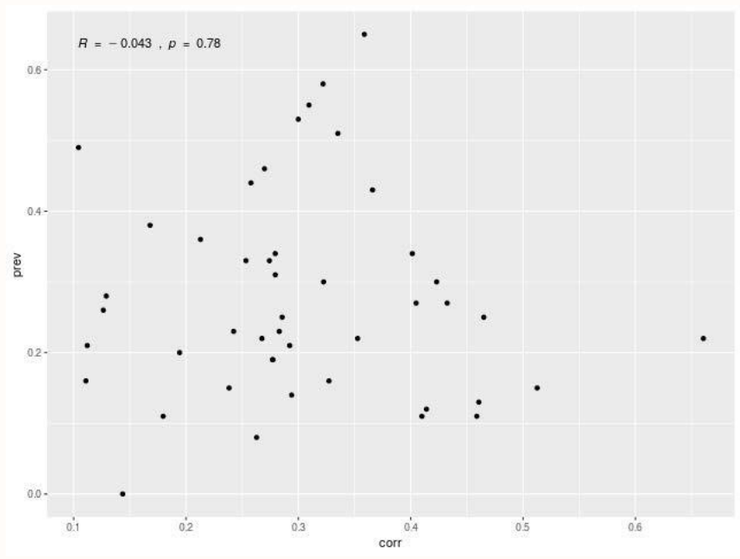

Figure 4: scatter plot

In figure 4 the X axis indicates the average correlation of the beats, while on the Y axis we have the slide predictability. The correlation is essentially zero.

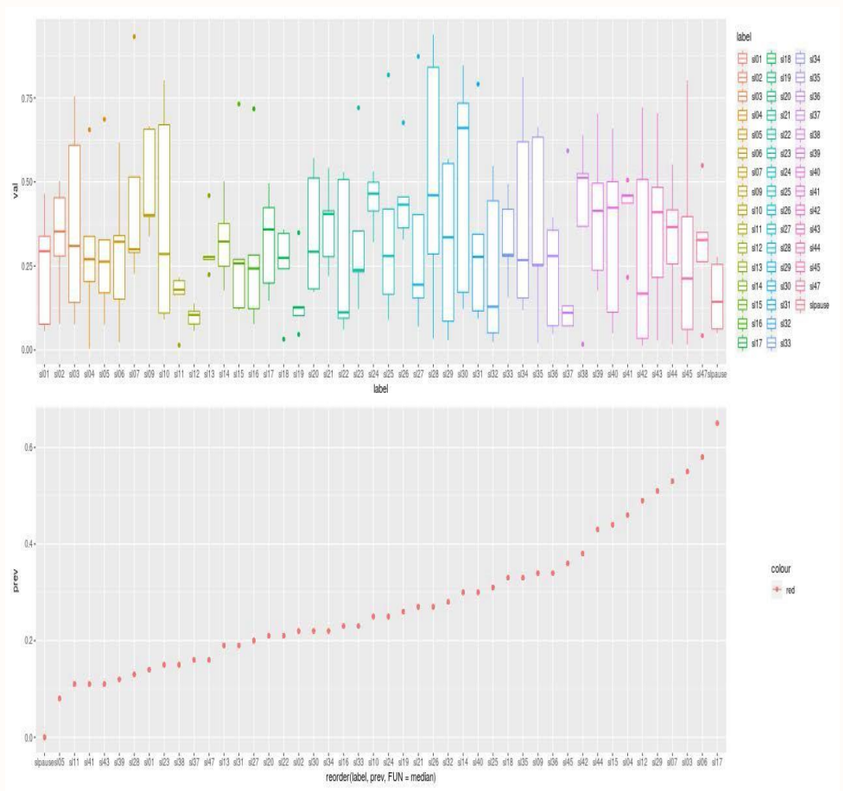

Figure 5: Box-plot with the distribution of correlations between the beats of subj1 speaker and subj2 listener. The plot in the inferior part of the figure shows the predictability of the slides. Both plots are sorted by the median correlation.

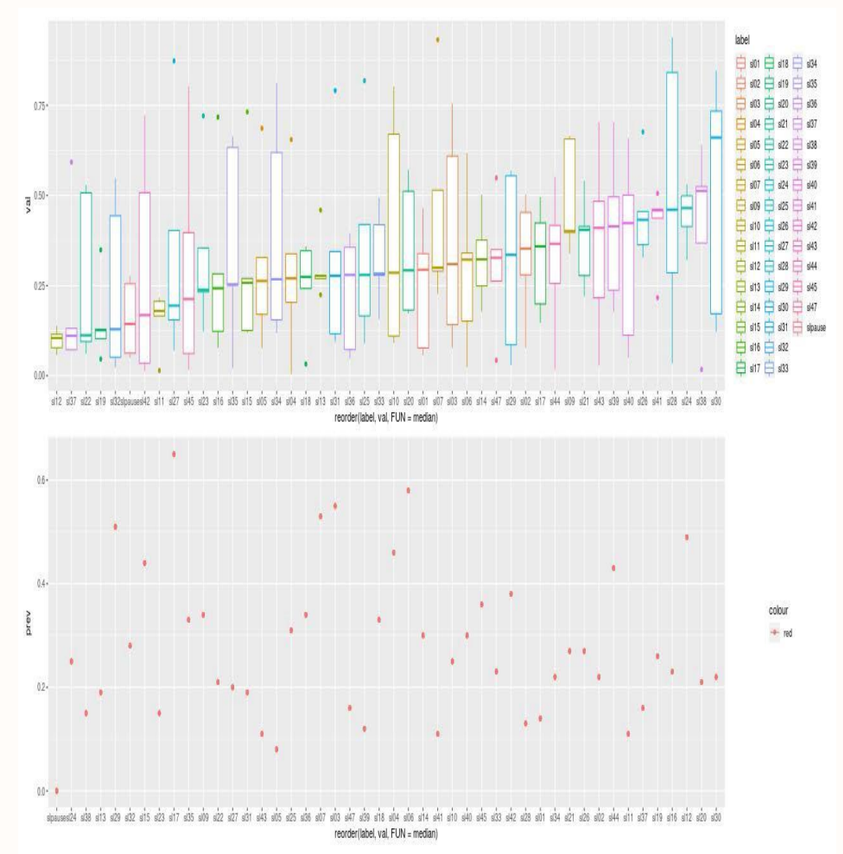

Figure 6: Box-plot with distribution of correlations between beats of subj1 speaker and subj2 listener. The plot in the inferior part of the figure shows the predictability of the slides. Both plots are sorted by median of the predictability.

Figure 5 e 6 shows whether there is any trend of increase or decrease in predictability as a function of the increase in the correlation.

Conclusions

Based on the experiment, it was impossible to verify the existence of any apparent tendency between the correlation of heart rate with the proposed and performed social interaction. Supporting the claim that given the controlled environment proposed in the experiment, it was not possible to correlate the parameters in question.

References

[1] Dikker, Suzanne, et al. "On the same wavelength: predictable language enhances speaker–listener brain-to- brain synchrony in posterior superior temporal gyrus." Journal of Neuroscience 34.18 (2014):6267-6272.