KPU Registry ID Number: 1008 Date Submitted: 23rd April 2014

Study Registration For the KPU Study Registry

1. The title or name of the experiment (for listing the experiment in the registry).

Brain-to-brain (mind-to-mind) interaction at distance: a proof of concept of mental telecommunication

2. The name, affiliation, and email address for the lead experimenter(s) for the study.

Patrizio Tressoldi, Dipartimento di Psicologia Generale, Università di Padova, ITALY. patrizio.tressoldi@unipd.it;

3. A short description or abstract of the purpose and design of the experiment.

This confirmatory study of the pilot experiment of Tressoldi et al. (2014), aims at demonstrating the possibility to detect a short sequence of silence-signal events by analyzing the EEG activity of one person connected only mentally by a stimulated partner separated by approximately 200 km.

4. A statement or list of the specific hypothesis or hypotheses being tested, and whether each hypothesis is confirmatory or exploratory. (confirm/explore guidance)

The confirmatory hypothesis is that the coincidences of events (silence-signal) in their correct sequence, detected by analyzing the EEG activity of the one person connected only mentally with his/her partner who is receiving this stimulation, will far exceed those expected by chance. For example with a series, silence-signal-silence-signal-silence-signal-silence, delivered to one member of the pair, we expect to count a number of coincidences in the EEG activity of the non-stimulated member of the pair exceeding the number of errors or missing recorded in the half-matrix 7x7 (28 cells).

5. The planned number of participants and the number of trials per participant.

We will include six participants selected for their degree of long friendship and capacity to stay mentally focused. Three of them will be located in a lab located in the Department of General Psychology of Padova University and the remaining three in a private lab located in Florence, approximately 200 km far from the first one. Each

participant will act as “sender” (stimulated person) and as “receiver” (non-stimulated person) with each of the three people located in the other lab. During each trial the four participants (two for each lab) not involved in it, will wait in another room without observing the trial. The overall trials will be eighteen.

6. A statement that the registration is submitted prior to testing the first participant, or indicating the number of participants tested when the registration (or revision to the registration) was submitted.

The registration is submitted prior to testing the first participant.

7. The specific statistical test method that is planned for each hypothesis, including dependent and independent variables,

The dependent variable is the overall number of coincidences between the events (stimulation or silence) of the EEG activity of the “receiver” and the protocol of stimulation (see example in Figure 1). The corresponding percentages of all coincidences and errors and missing events, with respect to the total number of events (18 trials x N events) will be compared by using their confidence intervals and the Bayes Factor using an uninformative prior using the beta(1,1) distribution. The null model is that the percent of coincidences and the percent of errors and missing events will be equal (i.e., 50% coincidences or $P = .5$).

We will consider a replication evidence whether the overall coincidences will approximate those obtained in the pilot study corresponding to 78 % and the BayesFactor will be equal or above 10 in favor of the alternative hypothesis.

We will exclude only trials with clear artefacts. No data adjustments will be allowed before their analysis. The classification process, see item 10, will be carried out using the same parameter: fifty percent of the data, sampled randomly, will be used for the training of the network separately for each trial even if the participants are the same with reversed roles and the data used for training will be also included in the final analysis for each trial.

8. The power analysis or other justification for the number of participants and trials.

The results of the pilot study, 78 % of coincidences, obtained with 15 trials, suggest that 18 trials will be sufficient for the replication.

9. The methods for randomization in the experiment.

We will use the ‘rand’ function of C++ language.

10. A detailed description of the experimental procedure.

Both member of the pair, both hosted in a sound and light attenuated lab, one located in Florence-Italy and the second in the Department of General Psychology of Padova University, Italy, 190 km away, will be prepared for their EEG activity recording using using two Emotiv® EEG Neuroheadset connected wirelessly to PCs running Windows OS. Their technical characteristics are 14 EEG channel based on the International 10-20 locations are: AF3, F7, F3, FC5, T7, P7, O1, O2, P8, T8, FC6, F4, F8, AF4, plus 2 references, one mastoid (M1) sensor acted as a ground reference point to which the voltage of all other sensors was compared. The other mastoid (M2) was a feed-forward reference that reduced external electrical interference. The signals from the other 14 scalp sites (channels) were high-pass filtered with a 0.16 Hz cut-off, pre-amplified and low-pass filtered at an 83 Hz cut-off. The analogue signals were then digitized at 2048 Hz. The digitized signal was filtered using a 5th-order sinc notch filter (50–60 Hz), low-pass filtered and down-sampled to 128 Hz. The effective bandwidth was 0.16–43 Hz.

The signal will be elicited by an audio clip of a crying baby, selected for being proved to enhance arousal and delivered to the participant by Parrot ZIK® headphones connected with the PC controlling stimulus delivery and EEG recordings.

The synchronization of the start and end of EEG recording of the two partners, will be made by an internet connection with the two computers connected with the two Emotiv® EEG Neuroheadset.

When both participants were ready, a trial will start. Each trial will be composed of a randomly chosen period from 1 to 3 minutes of silence to favor mental silence, followed by a random choice of sequence of 1,2 or 3 30-second signals interspersed in 60 seconds of silence, for a total of 3,5 or 7 segments respectively, for a maximum duration of 8 minutes overall.

To facilitate the mental connection between the two partners, they will wear two virtual goggles seeing a fixed image of the face of the partner.

The roles between the two partners will be changed following these rules: the role of “sender” cannot be maintained for more than three consecutive trials to avoid discomfort; the role of “receiver” must be changed after each trial to avoid lack of concentration.

The EEG raw data will be analyzed off-line by a special devised software to calculate the number of coincidences of events in their correct sequence, recorded in the EEG of the “sender” and the “receiver” separately for each trial.

A coincidence is detected when the signal/silence state from the receiver’s EEG classification match the signal/silence state of the stimulus to the sender at the beginning and/or ending of the stimulus segment for the sender.

The software, BrainScanner™ is a special classifier based on a neural network using a C-supported vector classification (C-SVC) machine (Steinwart and Christmann, 2008; Chang and Lin, 2011) as training technique.

The main goal of the experiment is to find evidence of coincidences between the events delivered to the sender and the EEG signals of the receiver, and the analysis of the senders' EEG is a secondary or exploratory analysis.

The coincidences between the events of each trial will be visualized as in the following figure where in the first row it is represented the sequence of events, silence in red and signal in black, and in the second row, the sequence of events as detected by the classifier. For each trial, it will be counted the number of coincidence and errors or missing signals.

Figure 1: example of the visualization of the coincidences between the sequence of events (red= silence; black = signal) delivered to the sender and the EEG activity of the receiver.

For example in the above case, in the EEG activity of the receiver we can observe a correct sequence of all seven events even if their duration is not perfectly overlapped as in the case of the third signal. We will use the criteria to consider a coincidence if the sequence of events is respected and at least one of the border of the segments (corresponding to the outset and the end of their duration) coincides with the original protocol.

We recognize that this design does not preclude alternative explanations and that other experiments need to be conducted that compare randomly assigned signal and silence periods and that use different data for validating or confirming the classification process that were used for training it.

Reference

Tressoldi, P. E., Pederzoli, L., Caini, P., Pasquale, F., Ferrini, A. and Melloni, S. (2014). Brain-to-Brain (Mind-to-Mind) Interaction at Distance: A Pilot Study (April 11, 2014). Available at SSRN: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2423852