RESEARCH NOTE

Electrocortical correlations between pairs of isolated people: A reanalysis [version 1; referees: 2 approved]

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v1 **First published:** 15 May 2017, **6**:676 (doi: 10.12688/f1000research.11537.1)
Latest published: 15 May 2017, **6**:676 (doi: 10.12688/f1000research.11537.1)

Abstract

A previously reported experiment collected electrocortical data recorded simultaneously in pairs of people separated by distance. Reanalysis of those data confirmed the presence of a time-synchronous, statistically significant correlation in brain electrical activity of these distant "sender-receiver" pairs. Given the sensory shielding employed in the original experiment to avoid mundane explanations for such a correlation, this outcome is suggestive of an anomalous intersubjective connection.

Open Peer Review

Referee Status: ✓ ✓

	Invited Referees 1	2
version 1 published 15 May 2017	✓ report	✓ report

1 **Edward Justin Modestino** , Curry College, USA

2 **Aliodor Manolea** , Hyperion University from Bucharest, Romania

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Competing interests: No competing interests were disclosed.

How to cite this article: Radin D. **Electrocortical correlations between pairs of isolated people: A reanalysis [version 1; referees: 2 approved]** *F1000Research* 2017, **6**:676 (doi: 10.12688/f1000research.11537.1)

Grant information: The author(s) declared that no grants were involved in supporting this work.

First published: 15 May 2017, **6**:676 (doi: 10.12688/f1000research.11537.1)

Introduction

Giroldini *et al.* (2016) reported an experiment where pairs of people isolated by distance each had 14-channel electroencephalograms (EEGs) recorded simultaneously (Emotiv EPOC+, San Francisco, CA). The "sender" (S) of each pair was exposed to 128 stimulus epochs per test session, where each epoch consisted of a one-second exposure to a light or sound stimulus (the latter presented over earbuds). Using a whole brain EEG coherence metric, Giroldini *et al*. found that after 25 experimental sessions that the "receiver's" (R) electrocortical coherence increased during the stimulus epochs. This was interpreted as a reflection of a "nonlocal" connection between S and R. The effect was primarily observed in the EEG alpha band of 8 – 12 Hz, with a statistically stronger effect reported in the range of 9 – 10 Hz. To double-check how robust the reported effect might be, this study developed a simpler correlational approach and applied it to the original, unfiltered EEG data.

Methods

The raw EEG data from Giroldini *et al.* (2016) was obtained from: doi, 10.6084/m9.figshare.1466876.v8 (Tressoldi, 2016).

Matlab (R2013a) scripts were written to conduct the analysis. These scripts may be obtained from: 10.6084/m9.figshare.4954643.v2 (Radin, 2017).

To process the raw EEG data, first use the script readEEG.m (this uses the function importfile1.m), then put all of the newly processed files (in Matlab's .mat format) into a single folder and run the script EEG_xcorr_raw.m in that folder. This will create Giroldini's *et al*.'s brain coherence metrics for each pair of participants. Finally, run the script EEG_analysis_Radin.m, which will analyze those files and generate results in graph form.

As a brief description of the method, the processing scripts follow Giroldini *et al*.'s method for creating a whole brain coherence metric for each S and R datafile. The scripts then create an ensemble median of this metric plus and minus one second from stimulus onset. A Pearson correlation is then formed between the ensemble median curves for S and R pairs. The two-tailed p-value associated with that correlation is transformed into a one-tailed z score using an inverse normal transform. Then a nonparametric permutation analysis is used to determine the probability associated with that z score (i.e., this z is not distributed as a standard normal deviate because its variance is inflated due to the autocorrelated nature of EEG data). The p-value resulting from the permutation analysis is converted into a standard normal deviate (this is now a conventional z score). The same process is used on the remaining 24 pairs of EEG data. The final step combines the 25 z scores into a Stouffer $Z = \sum z_s/5$, where Z is distributed as a standard normal deviate.

Results

The above procedure results in a Stouffer Z = 2.705, p = 0.006 (two-tailed). Four of the 25 sessions are independently significant at $p < .05$ (two-tailed); all four of those sessions had positive S-R correlations.

To check if this S-R relationship is in time-synchrony, the Matlab script circular shifts each R's EEG coherence signal -2 seconds, and then repeats the entire analytical procedure to determine the overall Stouffer Z score. Then R's coherence signal is shifted to the right by 100 msec, reanalyzed, and this is repeated until reaching a lag of +2 seconds. If the original S-R correlation was synchronized in time, then we would expect to see the peak result at lag 0. Figure 1 shows that this was indeed the case.

Figure 1 also shows a significantly negative deviation at a lag of 900 msec post-stimulus. Because this analysis is based on the absolute magnitude and not the direction of the correlation, this decline indicates that the S-R correlation strength declined *below* chance-expected levels about 1second post-stimulus. This may reflect a drop in electrocortical coherence in S generated by the explicit presentation of a stimulus; thus, during that time, the magnitude of the S-R correlation would be expected to momentarily

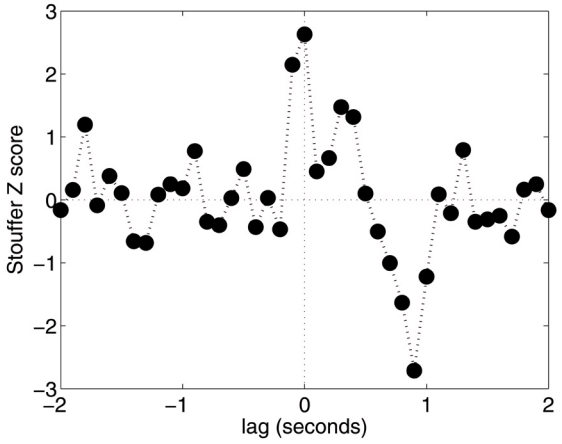

Figure 1. Time-synchrony analysis. Positive lags in this graph represent post-stimulus S-R correlations; negative lags are pre-stimulus.

drop. If similar negative correlations are observed in future experiments of this type, it may prove to be a useful secondary indicator of a genuine S-R relationship.

Conclusion

Analysis of previously collected EEG data showed a significant time-synchronized correlation between the electrocortical activity of "sender" and "receiver" pairs. Because the data were collected under conditions where participants were isolated by shielding and distance, this outcome is suggestive of a "nonlocal" mind-to-mind interaction.

Data availability

The raw EEG data from Giroldini *et al.* (2016) was obtained from: doi, 10.6084/m9.figshare.1466876.v8 (Tressoldi, 2016).

Competing interests

No competing interests were disclosed.

Grant information

The author(s) declared that no grants were involved in supporting this work.

References

Giroldini W, Pederzoli L, Bilucaglia M, *et al.*: **EEG correlates of social interaction at distance [version 5; referees: 2 approved].** *F1000Res.* 2016; **4**: 457.
Publisher Full Text

Radin D: **readEEG analysis files.** *figshare.* 2017.
Data Source

Tressoldi P: **EEG correlates of social interaction at distance.** *figshare.* 2016.
Data Source

Open Peer Review

Current Referee Status: ✔ ✔

Version 1

Referee Report 23 June 2017

doi:10.5256/f1000research.12461.r22756

✔ **Aliodor Manolea**
Faculty of Psychology and Social Sciences, Hyperion University from Bucharest, Bucharest, Romania

The statistical method seems to be the correct one if we consider each experimental session corresponding to an S-R pair as a separate experiment.
The study is very concise and on the subject, and the results comes from a logical thinking that is materialized in a mathematical method, perfectly adapted to the purpose pursued. Well done work.

Is the work clearly and accurately presented and does it cite the current literature?
Yes

Is the study design appropriate and is the work technically sound?
Yes

Are sufficient details of methods and analysis provided to allow replication by others?
Yes

If applicable, is the statistical analysis and its interpretation appropriate?
Yes

Are all the source data underlying the results available to ensure full reproducibility?
Yes

Are the conclusions drawn adequately supported by the results?
Yes

Competing Interests: No competing interests were disclosed.

Referee Expertise: amplified states of consciousness, statistics in psychology

I have read this submission. I believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Referee Report 18 May 2017

doi:10.5256/f1000research.12461.r22753

Edward Justin Modestino
Department of Psychology, Curry College, Milton, MA, USA

This is a brief research note that is under review. It refers to an independent reanalysis of data from another research group was done for a controversial study on non-local consciousness. The reanalysis used a non-parametric permutation. The only thing that I do not understand clearly is the results. It appears that the results of 25 session (different subject pairs) divulged a significant p-value of p = 0.006 in a group analysis. Next, it is explained that four out of the 25 sessions were independently significant at p<0.05 two tailed. I am a bit confused. I guess this means the greatest significance was seen at the group level, and at the subject level only four subject pairs showed significance. I am not sure I am understanding this correctly. Please make sure it is very explicitly stated to avoid the confusion I have had.

Is the work clearly and accurately presented and does it cite the current literature?
Yes

Is the study design appropriate and is the work technically sound?
Yes

Are sufficient details of methods and analysis provided to allow replication by others?
Partly

If applicable, is the statistical analysis and its interpretation appropriate?
Yes

Are all the source data underlying the results available to ensure full reproducibility?
Yes

Are the conclusions drawn adequately supported by the results?
Yes

Competing Interests: No competing interests were disclosed.

I have read this submission. I believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Author Response 27 May 2017

Dean Radin, California Institute of Integral Studies, USA

> It appears that the results of 25 session (different subject pairs) divulged a significant p-value of p = 0.006 in a group analysis. Next, it is explained that four out of the 25 sessions were independently significant at p<0.05 two tailed.... I guess this means the greatest significance was seen at the group level, and at the subject level only four subject pairs showed significance.

Yes, that is correct. The p value of p = 0.006 is a group analysis over all 25 sessions. When examining individual sessions 4 were independently significant at p < 0.05. It is noteworthy that this latter outcome is unexpected by chance because the binomial probability of 4 or more significant (at p < 0.05) sessions out of 24 is associated with p = 0.03. What this suggests is that

while some of the other sessions did not quite reach the (conventional) threshold for significance, on average they contributed results in the same direction, thus leading to the overall stronger statistical outcome for all data combined.

Competing Interests: No competing interests.