Can Our Minds Emit Light at 7300 km Distance? A Pre-Registered Confirmatory Experiment of Mental Entanglement with a Photomultiplier

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ABSTRACT

With this pre-registered confirmatory study, we aimed at replicating the findings observed in two previous experiments where the focused mental entanglement (ME) with a photomultiplier located approximately 7300 km far from the location of a small group of selected participants, showed an increase in the number of photons with respect to the control periods. In particular, we aimed at replicating the increase of approximately 5% of photons detected in the ME periods with respect to the control periods in the bursts of photons above 10. The results observed in this study confirmed this increase replicating what observed in the two previous experiments. We discuss the characteristics of these photons which energy is estimated in approximately 65 eV at 788 THz and how ME can generate them at distance.

Key Words: mental entanglement at distance, photons, generalized quantum theory, photomultiplier

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Introduction

Generalized quantum theory (GQT) provides a formalized theoretical model for the extension of the nonlocal effects observed in entangled particles to a larger or macro environment (von Lucadou, 2007; Walach and von Stillfried, 2011; Filk and Römer, 2011). The theory is introduced in order to provide a foundation for future research that will establish whether these effects, which are clearly established in the micro world of quantum physics, can be observed in real-world interactions between people, objects, or other potentially entangled systems that are larger than individual particles that are only observed in very small environments.

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According to GQT authors, there are some necessary conditions in order to apply GQT to the macro world: The genuinely quantum theoretical phenomenon of entanglement can and in general will show up also in GQT if the following conditions are fulfilled:

1) A system is given; inside which subsystems can be identified.

2) Entanglement phenomena will be best visible if the subsystems are sufficiently separated such that local observables pertaining to different subsystems are compatible.

3) There is a global observable of the total system, which is complementary to local observables of the subsystems.

This theory has already been positively supported using systems comprising humans and random event generators (REGs) (Walach *et al.,* In press). The novelty of our study is the use of a PhotoMultiplier Tube (PMT) instead of a REG. Preliminary evidence by Schwartz (2010), Caswell, Dotta and Persinger (2014) and Joines, Baumann and Kruth (2012), suggest that human focused intention triggers biophotons emissions that could represent the carrier of a sort of quantum-like mental entanglement (ME) with electronic apparatuses or other types of targets. We hence apply the GQT assuming:

a) a small group of participants and the PMT represent two subsystems of a single larger one created by their informational relationship (see Procedure), and

b) this informational relationship constitutes an entangled state, and

c) the measurable variables represent the system's comprehensive characteristic even though measured individually.

It is important to point out that this type of entanglement is conceived as a generalized form of quantum-like nonlocal correlations corresponding to a situation whereby elements of a quantum system remain correlated non-locally and instantaneously no matter how separated they are in space or in time, without implying any causal or transmission direction of information between the subsystems.

We remark that the informational interpretation of conventional quantum mechanics plays an important role in justification of our purely informational model of ME experiments. The idea that quantum theory is not about particles nor waves, but about information and the latter is the fundamental element of quantum reality was discussed in works of leading experts in quantum foundations, e.g., Bruckner and Zeilinger (2005); Fuchs (2002). Of course, these authors wrote about information obtained from physical systems, but the usage of this interpretation for cognitive systems is quite natural (Khrennikov, 2004).

The application of quantum formalisms to domains other than quantum physics – such as biological or mental processes - is independent from the hypothesis that processing of information made by biological systems is based on quantum physical processes within these systems. This approach, known as "quantum biological information", is grounded on the quantum-like paradigm: biological systems of sufficiently high complexity may process information in accordance with laws of quantum information theory (Asano *et al.,* 2015).

Preliminary Evidence

In a pilot study, for the first time, Tressoldi *et al.* (2014), used a PMT as the detector of mind-matter entanglement at distance. This device allows investigating whether photons can be the physical correlates of ME at distance. In that study, five participants selected for their strong commitment toward this line of research and their experience in mental control practices, mainly meditation, were able to increase of about 20 photons per minute the photons detected by a PMT located approximately 7300 km far from their location, with respect to the control sessions.

In two pre-registered confirmatory experiments, Tressoldi et al. (2015) failed to support their confirmatory hypotheses, but observed an increase of approximately 5% of photons in the bursts exceeding at least six standard deviations (6σ) the average photons count, corresponding to bursts above 10 photons. These results are reported in the tables 1Sa, 1Sb and 1Sc, in the Supplementary Materials.

The failure of these two pre-registered confirmatory experiments was due to two intuitive but naïve hypotheses. The first one was that ME effects, if any, should be detected simultaneously on the PMT and lasting only for its duration. The observed results showed that it was not so. These effects appeared even after a delay of approximately 20-30 minutes even if participants were not engaged in a ME after the planned five minutes.

The second naïve hypothesis was that ME could enhance the photons count linearly or with a constant effect. This was not the case. The results showed that ME increased only the bursts of photons exceeding more than 6σ those detected on average every half a second during the different experimental and control periods. Prompted from the results of these exploratory findings, we conceived this third pre-registered confirmatory study.

Methods

Study Pre-registration

The study was preregistered at the Open Science Framework site (*https://osf.io/7h3d8*) before data collection. Ten experimental sessions had been planned to be carried out in ten different days.

Confirmatory Hypotheses

a) The percentage of photons in the bursts composed by at least 11 photons (corresponding to bursts exceeding 6 standard deviations the average count) detected by the PMT every half second during the 40 minutes of ME (5 min) and post-ME (35 min) will exceed those detected in the 40 min of the two control periods. We will estimate the effect sizes (ES), with their corresponding 95% confidence intervals, of the comparisons of the percentages observed in the ME and Post-ME with respect to those observed within the two control periods. The corresponding Bayes Factors (BF) will be estimated by using the Morey (2014) applet, with this predefined priors: $\mu1, \mu2 = 0; \sigma1, \sigma2 = 1$. A BF above three will be considered as an acceptable evidence.

b) Postulating a non-random effect of the ME on the PMT: We expect a (positive or negative) correlation between the means of photons of the ME + post-ME 40 minutes with those obtained in the experiment 1 and 2 by Tressoldi (2015). No correlation is expected between the analogue means in the two control periods. The correlations, with their 95% CIs, will be estimated by using a bootstrap procedure with 10000 samples. The posterior probability High Density Interval (HDI) of the linear regression will be estimated by the Jags-Ymet-Xmet-Mrobust.R function included in Kruschke (2014). The randomization of the experimental and control periods will be determined by using the www.ranfom.org online service.

Participants

Four selected participants, three males and one female, were included using the same criteria of the pilot study, that is strong motivation toward this line of research and a long experience in mental control practices, mainly meditation. Their age ranged from 39 to 69. Three of them participated in the previous experiments. All participants were also included as co-authors.

Ethics, Consent and Permissions

The study was completed following the requirements of the Ethical Committee of the Dipartimento di Psicologia Generale of Padova University, Italy. A written consent that was signed by each participant before performing the task.

Apparatus

The Photomultiplier (PMT; see Figure S1 in the *Supplementary Material*) was placed in the Bioenergy Lab of the Rhine Research Center, in Durham, NC, USA and was managed by the co-author JK. The Photomultiplier Tube (type 56 DVP) with PMT housing (Pacific Photometric Instruments Model 62/2F - thermoelectrically cooled to near -23 °C) is able to measure two photons per second in the 400 to 200 nm wavelength range. Signals from the PMT are amplified by a Pacific Photometric 3A14 amplifier, and photons are counted by a photon counter (Thorn EMI GenCom model C-10) every half second. This information is transferred to a computer in the external darkroom and the number of photons detected is recorded every half second for the duration of an experimental session.

Procedure

The research assistant, co-author PT, agreed with the co-author JK, responsible of the Bioenergy Lab, the day and the time to start and end of each session. In the settled day and hour, JK activated the PMT. The duration of each session was predefined in 180 minutes divided in four periods as presented in the Table 1.

Table 1. Splitting up of each session periods.

PMT Cooling	Pre-ME (or Control)	ME + Post-ME (or Pre-ME)	Control (or ME + Post-ME)
60 minutes	40 minutes	40 minutes	40 minutes

The ME + post-ME (ME for short) period was randomly placed in the third or in the fourth period by using the randomization facilities available on the www.random.org website. This randomization yielded the following sequence: 2, 1, 2, 1, 2, 2, 1, 1, 1, 2. The five ME minutes started at the onset of the third or the fourth period, corresponding to the 100-105 minutes and 140-145 minutes respectively. To reduce possible experimenter effects, the co-author JK, responsible of the Bioenergy Lab, was kept blind of this sequence.

As in the two experiments of Tressoldi et al. (2015), each participant acted in his/her home connecting with the other participants via the video chat ooVoo™. Approximately five minute before the period of ME, the research assistant started a simple relaxation procedure to allow an emotional bonding among all the participants. During the five minutes of ME the participants were free of choosing the preferred mental strategies to influence the PMT activity even if they were suggested to imagining to enter within the PMT and trying to emit light feeling completely at ease, protected from external disturbances in strong and positive connection with the other participants.

As in the pilot study, all participants were provided with some images of the Rhine Research Center, the Bioenergy Lab and the PMT to have a representation of the site and the apparatus to be influenced. Feedback about their performance was delivered at the end of all ten sessions.

Results

Photocount Distribution

The typical photocount distribution is presented in Figure 1. This is a typical Poisson distribution ranging from zero photons to bursts of above ten photons which could be considered as outliers.

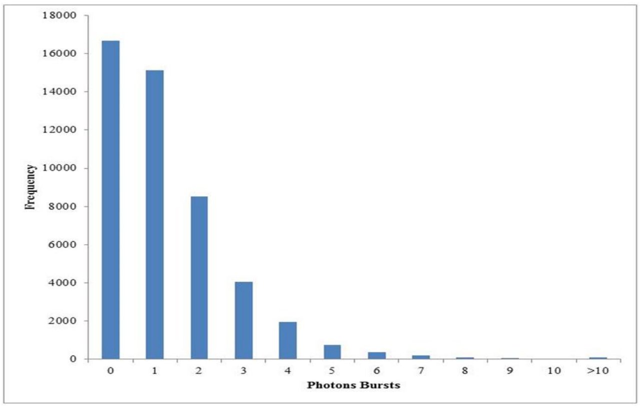

Figure 1. Typical photocount distribution.

Confirmatory Hypotheses

a) The percentage of photons in the bursts composed by at least 11 photons (corresponding to bursts exceeding 6σ the average count) detected by the PMT every half second during the 40 minutes of ME and post-ME, will exceed those detected in the 40 min of the two Control periods. These results are presented in Table 2.

Table 2. Number of bursts >10 photons and their corresponding photons detected in the three different periods of the ten sessions.

Period	Bursts>10	Photons	%	95% HDI*
Control pre-ME	66	887	28.5	27-30
ME	**88**	**1164**	**37.4**	**35-39**
Control	78	1060	34	32-36

HDI*= High Density Intervals estimated with the Jags-Ycount_Xnom2fac-MpoissonExp.R script
Available at
https://sites.google.com/site/doingbayesiandataanalysis/software-installation

In the ME periods we observed an increase of approximately 9% and 3% of photons with respect to the Control pre-ME and Control periods respectively. Even if not included in the confirmatory hypotheses, we also observed an increase of approximately the same percentages of the bursts >10 photons. The estimation of the corresponding ES is presented in Table 3. Estimation of Bayes Factors are presented in Table 2S in the Supplementary Materials.

Table 3. ES *d*, using *probit* method estimation of the comparisons of the percentages of photons Bursts >10 and their total count (photons) observed in the different periods.

Comparison	Bursts >10	Photons
	ES[95% CI]	*ES*[95% CI]
Control pre-ME vs ME	.26 [.17, .35]	.24 [.15, .33]
ME vs Control	.11 [.03, .19]	.09 [.01, .17]

Table 4. Correlations and their 95% CIs between the data obtained by the three Experiments (Conf = confirmatory experiment; 1= experiment 1; 2 = experiment 2).

Period	*Conf vs 1* [95% CI]*	*Conf vs 2* [95% CI]*	*1vs 2* [95% CI]*
Control Pre-ME	-.08 [-.38, .20]	.16 [-.17, .47]	-.08 [-.39, .22]
ME	**-.11 [-.38, .16]**	**-.04 [-.36, .30]**	**-.39 [-.64, -.06]**
Control	-.10 [-.36, .16]	.16 [-.17, .45]	-.11 [-.41, .27]

*obtained with 10000 bootstrap samples;

From the data reported in Table 4, it clearly emerges that this confirmatory hypothesis was not supported.

With respect to the confirmatory hypothesis, we obtained a strong support in the comparison between the Control pre-ME and the ME periods and a small support in the comparison between the ME and the control periods. b) We expect a (positive or negative) correlation between the means of photons of the ME + post-ME 40 minutes with those obtained in the experiment 1 and 2 by Tressoldi et al. (2015). No correlation is expected between the analogue means of the Control pre-ME and control periods. These correlations are presented in Table 4.

Summary of the Three Experiments

In table 5 we report the overall results obtained by the three experiments for a total of thirty sessions and in Figure 2 and 3, the corresponding percentages of the bursts >10 and of their photons count.

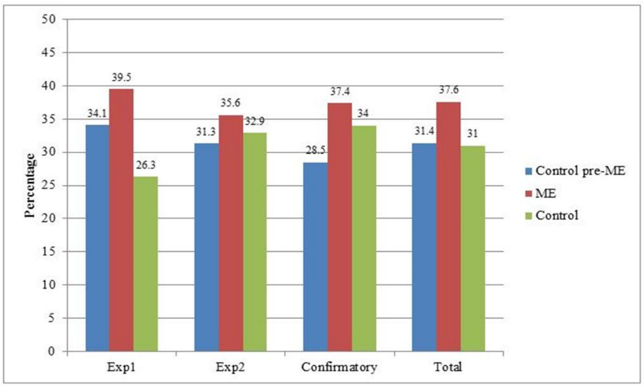

Figure 2. Percentages of photons detected in the bursts >10 in the three experiments and their total percentages.

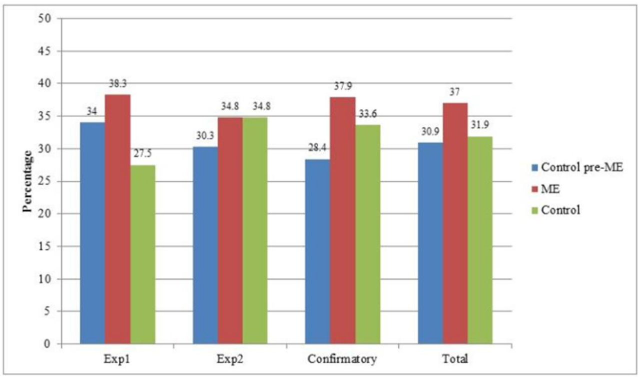

Figure 3. Percentages of the bursts >10 in the three experiments and their total percentages.

Discussion

In the ME periods there is an increase of approximately 5% of the bursts exceeding 10 photons with an increase of 6% of their photons with respect to the Control pre-ME and Control periods. The estimation of the effect sizes of the comparisons between the ME vs Control Pre-ME and ME vs Control periods of the total results, is presented in Table 6. Bayes Factors are presented in the Table 3S in the Supplementary Materials.

Table 6. ES *d*, using *probit* method estimation of the comparisons of the percentages of photons bursts >10 and their total count (photons) observed in the different periods.

Comparison	Bursts >10 ES[95% CI]	Photons ES[95% CI]
Control Pre-ME vs ME	.16 [.07, .25]	.16 [.07,.25]
ME vs Control	.13 [.04, .22]	.17 [.08, .26]

Have we demonstrated the possibility to increase the number of photons detected with a PMT at approximately 7300 km of distance by using the ME of a small group of selected participants? Probably yes, in particular if we refer to the number of photons detected in the bursts exceeding 10 photons. After a pilot, two unsuccessfully pre-registered studies and this positive preregistered confirmatory one, now we have a clearer idea on how to measure the effects of ME on a PMT. Our results, see HDIs estimates of percentages, show that ME shows its effects increasing the bursts with more than ten photons. In other words, it seems that ME effects correspond to very fast burst of light of approximately 20 photons/sec equivalents to an energy estimated in 65 eV[2], at approximately 788 THz, a really non-trivial energy. Furthermore, these effects seem to appear even after a delay of approximately 35 minutes. At present, we have no idea about its causes. We can only exclude that the participants continued their ME after the planned five minutes.

Can these small effects be due to external causes, for example experimenter or geomagnetic influences? This possibility was present in the first experiment of Tressoldi et al. (2015) because the experimenter acting on the PMT knew which periods were assigned to ME and to the control periods. Furthermore, control periods were recorded in different days with respect to the ME ones. These two potential causes were eliminated in the second experiment of Tressoldi et al. (2015) and in the present one, keeping blind the experimenter acting on the PMT about when the ME was applied and recording the ME and control periods on the same days.

[2] Estimating an average wavelength of 380 nm, 1 photon = 3.26 eV.

Table 5. Bursts >10 photons and their photons count in the Control pre-ME, ME and control periods observed in the three experiments.

	Confirm. Exp		Exp1		Exp2		Total			
Period	Bursts>10	Photons	Bursts>10	Photons	Bursts>10	Photons	Bursts>10	HDI	Photons	HDI
Control Pre-ME	66	887	79	1113	68	952	213	28-34	2952	30-32
ME	**88**	**1164**	**89**	**1290**	**78**	**1081**	**255**	**33-40**	**3535**	**36-38**
Control	78	1060	64	858	78	999	220	28-35	2917	30-32

As to the characteristics of the photons detected by the PMT, it is obvious that these bio- or mental- photons cannot have the characteristics of classical photons given the many obstacles between the participants and the detector. One provisional explanation is that they may be generated in the process of entanglement between the participants and the PMT that does not entail a transmission of information and energy, as postulated by our theoretical model presented in the introduction. However, according to some authors (Cifra *et al.,* 2015), the Poisson distribution of the photocount is a sign of a coherent but also of a classical, non-quantum nature of light.

The GQT model that we adopted as grounded foundation for this study clearly needs more specifications about its components, subsystems and how these states can be established and measured when applied to a mind-PMT entanglement. However, we think the results observed in this study may foster further investigations that could give some responses to the multiple questions let open by our study.

Is it possible to replicate these experiments? The only limitations are the availability of a good PMT and some very selected participants. If replicated independently, it can support the hypothesis that human mind can be entangled at distance with predefined targets and it is possible to measure the energy of this entanglement. The possibility to measure the energy of these bio- or mental-photons may give some suggestions about how human mind can be entangled at distance with biological and physical targets as demonstrated for example by the studies on biological systems, e.g., plants, cell cultures, etc. (Roe *et al.,* 2015) and on random number generators (Bösch *et al.,* 2006).

Authors' contributions

PE, LP and JK were responsible for design and conception of the study. PT and LP analyzed the data, drafted and revised manuscripts. PT, LP, MM and EP contributed to the data collection. All authors read and approved the manuscript.

All raw data are available on

http://figshare.com/articles/Mind_Interaction_on_a_Photomultiplier/1466749

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Competing interests

The authors declare that they have no competing interests.

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Supplementary Materials

Table 1Sa: Main results of Experiment 1 reported by Tressoldi et al. 2015.

Period	Bursts>10	%	Photons	%
Control pre-ME	79	34	1113	34.1
ME	**89**	**38.3**	**1290**	**39.5**
Control	64	27.5	858	26.3

Table 1Sb: Main results of Experiment 2 reported by Tressoldi et al. 2015.

Period	Bursts>10	%	Photons	%
Control pre-ME	68	30.3	952	31.3
ME	**78**	**34.8**	**1081**	**35.6**
Control	78	34.8	999	32.9

Table 1Sc: Correlations, and their 95% CIs and HDIs, between the data of Experiment 1 and Experiment 2

Period	Pearson's correlation [95% CI]*	95%HDI§
Control pre-ME	-.084 [-.40, .23]	-.12, .06
ME	**-.39 [-.64, -.06]**	**-.33, -.04**
Control	-.11 [-.41, .27]	-.12, .07

*= obtained with 10000 bootstrap samples; §= standardized beta linear regression coefficient.

Table 2S: Bayes Factors estimation of the comparisons of the percentages of photons Bursts>10 and their total count (photons) observed in the different periods and with respect to the chance probability of .33, observed in the Confirmatory experiment.

Comparison with expected chance = .33	
	$BF_{H1/H0*}$
Bursts >10	.07
Photons	2.2×10^5

*= estimated with the function bayes.test.equiprobability available on
http://figshare.com/articles/Mind_Interaction_on_a_Photomultiplier/1466749

Comparison	Bursts >10	Photons
	$BF_{H1/H0*}$	$BF_{H1/H0*}$
Control pre-ME vs ME	1.5	9.6×10^{10}
ME vs Control	.31	2.85

* Estimated with the Morey (2014) function with priors: μ1,μ2 = 0; σ1,σ2 = 1

Table 3S: BFs estimation of the comparisons of the percentages of photons Bursts>10 and their total count (photons) observed in the different periods in the three experiments.

Control Pre-ME vs ME	2.37	12×10^{15}
ME vs Control	.96	19×10^{15}

* Estimated with the Morey (2014) function with priors: μ1,μ2 = 0; σ1,σ2 = 1

Comparison with expected chance = .33	
	$BF_{H1/H0*}$
Bursts >10	.04
Photons	7.9×10^{12}

*= estimated with the function bayes.test.equiprobability available on
http://figshare.com/articles/Mind_Entanglement_with_a_photomultimeter_at_distance/1528158

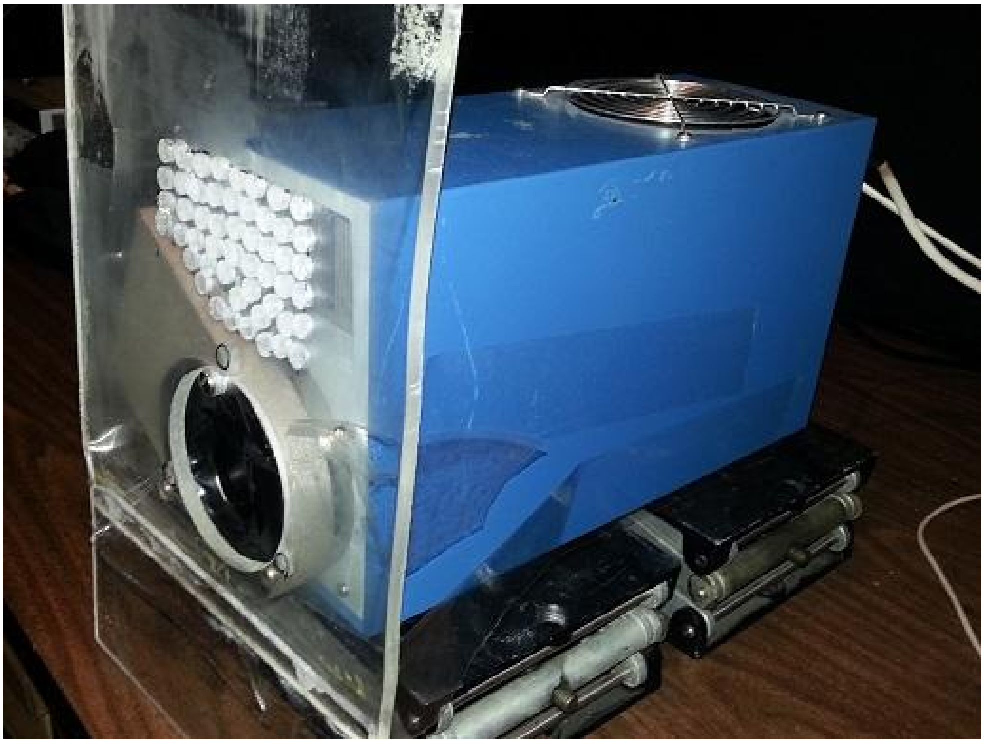

Figure S1. Image of the PMT.

A Comment on *Can Our Mind Emit Light at 7300 km Distance?*

Hartmut Grote

ABSTRACT

The paper titled 'Can Our Minds Emit Light at 7300 km Distance? A Pre-Registered Confirmatory Experiment of Mental Entanglement with a Photomultiplier', published in *NeuroQuantology* in September 2016, claims a significant effect for mental action at a distance (or something similar) onto a physical system. This author re-analyzed the experimental data with a Monte-Carlo method estimating the background distribution from random permutations of the experimental data. While the authors of find a Bayes factor of $9.6x10^{10}$ for one of their main results, this author finds the result of the Monte-Carlo simulation to be not significant: The probability to find the data (or more extreme data) as observed (under a null hypothesis of no mental influence) is p=0.074 and p=0.30 for two pre-specified conditions, respectively. The error in the claiming of the high significance in probably stems from the assumption that the statistics of the data is binomial distributed, which, as will be argued, seems to be an incorrect assumption.

Key Words: mind-matter; entanglement; data-analysis

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Introduction

In the work reported in (Tressoldi *et al.,* 2016) the authors conduct an experiment where the output of a photomultiplier tube is recorded for three distinct conditions. The conditions are called *Pre-ME*, *ME*, and *Control*. During the ME condition, 'mental intention' is applied by humans to the photomultiplier from a remote location. In both other conditions no such 'mental intention' is applied, and these conditions serve as controls.

Every half second the number of detected photons (over the last half second) is sampled, and according to the pre-specified protocol in (Tressoldi *et al.,* 2016), only the number of photons in samples with more than 10 photons are counted for the analysis. The number of *occurances of samples* with more than 10 photons (called *bursts > 10* in Tressoldi *et al.,* 2016) is used for a post-hoc analysis in (Tressoldi *et al.,* 2016), but is not analyzed in this comment.

For each of the three conditions, 10 sessions have been performed, each lasting 40 minutes, as described in (Tressoldi *et al.,* 2016), and thus each resulting in 4800 samples. The observed photon numbers (again, only counting photons in samples with more than 10 photons) summed over 40 minutes for each session are shown in Table 1 below.

	Session Nr.										
Condition	1	2	3	4	5	6	7	8	9	10	**Sum**
Pre-ME	112	66	61	127	171	78	90	54	49	79	**887**
ME	130	104	53	178	127	103	108	133	100	128	**1164**
Control	107	71	72	116	87	87	36	124	123	237	**1060**

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Table 1. Experimentally obtained data of the study (Tressoldi *et al.,* 2016) for three different conditions. The numbers represent the total number of photons in bursts with more than 10 photons for the 10 sessions for each condition. For illustration: The photon counts of 112 for the first session of the Pre-ME condition is the result of 9 (out of 4800) samples that have more than 10 photons:

$4\times 11 \textit{photons} + 2\times 12 \textit{photons} + 1\times 13 \textit{photons} + 1\times 14 \textit{photons} + 1\times 17 \textit{photons} = 112 \textit{photons}.$

The data for the individual sessions is not given in (Tressoldi *et al.,* 2016), and was downloaded from the raw data repository cited in (Tressoldi *et al.,* 2016) for each condition, which correspond to the column labeled 'photons' in Table 2 of (Tressoldi *et al.,* 2016).

The sum of these photons of the 10 sessions is shown in the last column for each condition. These sum values correspond to the column labeled 'photons' in Table 2 of (Tressoldi *et al.,* 2016). The sum of photons for the ME condition (1164) is found to be larger than the sum for the Pre-ME (887) and the Control (1060) conditions, which was the main prediction under test in (Tressoldi *et al.,* 2016).

However, the main analysis question is to what degree these differences (of ME vs. PRE-ME and ME vs. Control) are statistically significant.

To test this, in this comment we make no a-priori assumption about the underlying distribution of the counted photons, but rather evaluate this distribution empirically from segmentation of the data. we start from a null hypothesis (of no mental interaction) and thus treat all 30 individual data points in Table 1 as equal, combining them in a set we call DATA. We then draw randomly 10 elements of DATA (draw without replacement) and compute their sum as A. We then draw another 10 elements of DATA (again without replacement) and compute their sum as B. We then calculate A-B and store the result in the array N. We repeat this procedure 100,000 times (starting always with the 30 data elements in DATA) and end up with an array N with 100,000 results, describing the target data distribution. Finally, we can compare our data of interest to the distribution of elements in N: The sum of the ME data minus the sum of the Pre-ME data (277) and the sum of the ME data minus the sum of the Control data (104). The results are shown in Figure 2.

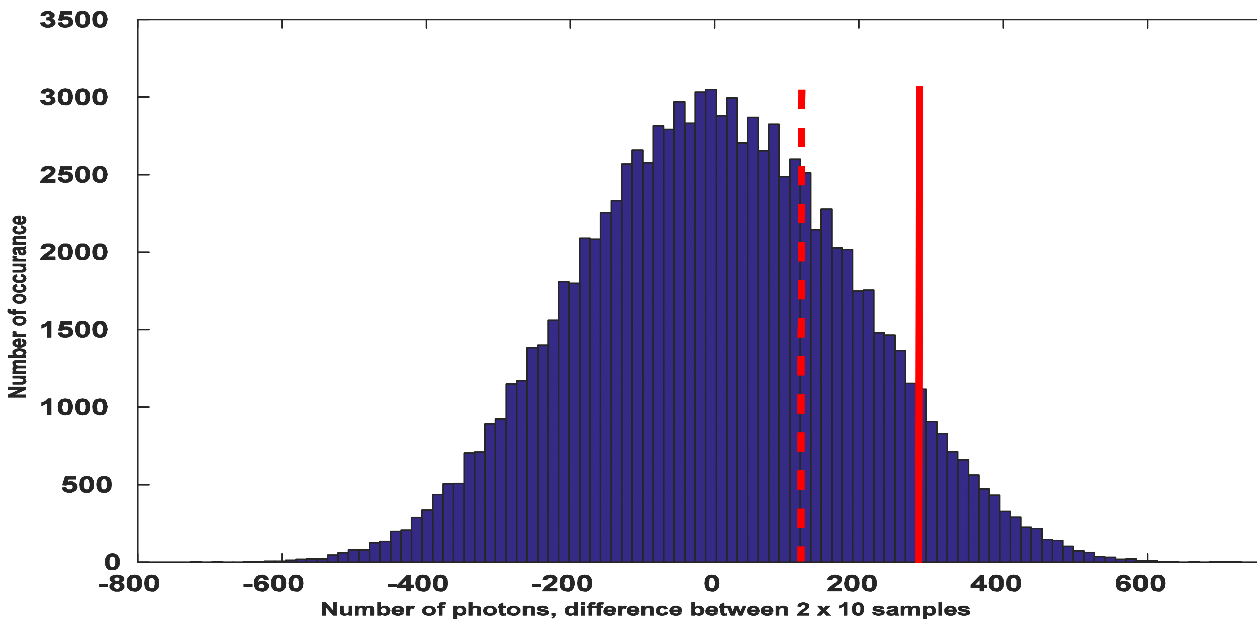

Table 2. Histogram of 100.000 permutations of the data presented in Table 1, evaluating the difference of the sum of two sets of 10 data points each. The vertical lines denote the position of the sum of ME data minus the sum of Pre-ME data (277, solid line) and the sum of ME minus the sum of Control (104, dashed line). The corresponding one-sided probabilities to find these results (or more extreme ones) by chance under a null hypothesis are p=0.074 (ME minus Pre-ME) and p=0.30 (ME minus Control).

We take from this simulation that the one-sided probabilities to find these experimental results (or more extreme ones) by chance under a null hypothesis are p=0.074 (ME minus Pre-ME) and p=0.30 (ME minus Control). (The MATLAB code used for this computation is given in the appendix.)

This result does not change much when the background distribution is estimated only from the Pre-ME and Control conditions, allowing for a less conservative analysis. In this case one obtains p=0.10 (ME minus Pre-ME) and p=0.33 (ME minus Control) that the data (or more extreme data) have been obtained by chance under a null hypothesis.

While the authors of (Tressoldi *et al.,* 2016) claim a Bayes factor of $9.6x10^{10}$ (Lower Table 2S in the appendix of (Tressoldi *et al.,* 2016) for the condition of 'Control Pre-ME vs. ME') and thus an extremely significant result, we can only guess here where this error in (Tressoldi *et al.,* 2016) originates from: The authors claim that the data in their experiment would follow a Poisson distribution and show a figure do demonstrate this (Figure 1 in Tressoldi *et al.,* 2016). While the exact condition under which the data in this figure was obtained is not specified, it is denoted as `typical'. However, regardless of the question under which condition this data was taken, it is obvious that the distribution is not Poissonian, but has a significant tail towards higher photon counts. The authors refer to these outliers as '6 sigma' events, but fail to explain while such nominally rare events would occur so often if the data was really Poissonian distributed. Table 2 in (Tressoldi *et al.,* 2016) shows that even for the control conditions, where no mental influence is assumed, the number of times where more than 10 photons are registered in one sample is 66 and 78, respectively. A real Poissonian distribution with a mean expectation value of 1 photon count per sample does roughly reproduce the left part of Figure 1 in (Tressoldi *et al.,* 2016) for small photon numbers. However, the probability to get more than 10 photon counts in a real Poissonian distribution is of order $p=10^{-8}$ for a single sample. Even with the 48000 samples presumably underlying the data in Figure 1 in (Tressoldi *et al.,* 2016), the probability to obtain a sample with a photon count larger than 10 in this data is still smaller than p=0.001. So how tiny would the probability to get 66 or 78 such events be? Rather than answering this question, our conclusion here is that the data simply is *not* Poissonian distributed. Apparently, the photons must be correlated to a degree, in order to explain the high number of samples (bursts) with more than 10 photons. Considering the physical processes inside a photo-multiplier tube this may not come as a surprise since the number of generated electrons within the tube as well as the corresponding counting process can depend on several parameters. It is thus very hard or may be impossible to find an analytical a-priori description of the photon count statistics.

Now, for the Bayes factor calculation in the lower table 2S of (Tressoldi *et al.,* 2016), the authors use a web-based applet cited as Morey (2014) with an URL as repeated here (Morey, 2016). For this, only the sum data in Table 1 have been used by the authors of (Tressoldi *et al.,* 2016), which implies that an assumption of the underlying distribution has to be made, in order to be able to make a statistical assessment of the significance. The Morey applet (Morey, 2016) does in fact require a binomial distribution of the underlying data (Morey, 2016b). However, for the data here, to be binomial distributed, it would be required that each detected photon (in bursts of >10 photons) is statistically independent from each other photon. The conclusion from above strongly suggests otherwise. Since the Poissonian distribution is the limit of a binomial distribution, and accepting the conclusion from above, that the data is not Poissonian, it seems exceedingly unlikely that the data is binomial distributed.

If the `outliers' in the photon counts are just taken as they are, making no assumptions about the underlying distribution, and the statistical background is estimated as described in this comment, from segmentation of the actual data, then the results vanish to non-significance. Similarly, the extremely large Bayes factors presented in Table 3S in (Tressoldi *et al.,* 2016) probably stem from the same error as described above.

The main hypothesis as put forward in (Tressoldi *et al.,* 2016) was: *The percentage of photons in the bursts composed by at least 11 photons (corresponding to bursts exceeding 6Ïƒ the average count) detected by the PMT every half second during the 40 minutes of ME (...), will exceed those detected in the 40 min of the two Control periods.* While this hypothesis was confirmed, we conclude with the analysis presented here that it was confirmed only in a statistically non-significant way. The result may reasonably have been obtained due to chance alone.

Acknowledgments

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References

Tressoldi P, Pederzoli L, Matteoli M, Prati E, and Kruth J G, Can Our Minds Emit Light at 7300 km Distance? A Pre-Registered Confirmatory Experiment of Mental Entanglement with a Photomultiplier, NeuroQuantology 2016; 3:447-455.

Morey RD. https://richarddmorey.shinyapps.io/probitProportions, accessed Nov 17, 2016

Morey RD. Personal communication, Nov 18, 2016b.

Appendix

MATLAB code to calculate probabilities as described above:
clear all; N=100000; bp=zeros(1,N); p=[112 66 61 127 171 78 90 54 49 79 ... 130 104 53 178 127 103 108 133 100 128 ... 107 71 72 116 87 87 36 124 123 237]; for i=1:N cp = p(randperm(30)); bp(i) = sum(cp(1:10))-sum(cp(11:20)); end p1 = sum(bp>=277) / N p2 = sum(bp>=104) / N

[1] Tressoldi P, Pederzoli L, Matteoli M, Prati E, and Kruth J G, *Can Our Minds Emit Light at 7300 km Distance? A Pre-Registered Confirmatory Experiment of Mental Entanglement with a Photomultiplier*, NeuroQuantology 2016; 3:447-455, http://www.neuroquantology.com/index.php/journal/article/view/906

[2] Morey R D, https://richarddmorey.shinyapps.io/probitProportions, accessed Nov 17, 2016

[3] Morey R D, personal communication, Nov 18, 2016

Appendix

MATLAB code to calculate probabilities as described above:

```
clear all;
N=100000;        % number of MC iterations
bp=zeros(1,N);  % make empty result array

% number of photons in bursts with n>10
% in the order Pre-ME,ME, Control:
p=[112 66 61 127 171 78 90 54 49 79 ...
130 104 53 178 127 103 108 133 100 128 ...
107 71 72 116 87 87 36 124 123 237];

for i=1:N
    % random shuffling of the 30 elements in p,
    % assigned to cp:
    cp = p(randperm(30));

    % difference between sum of two random
    % sets of 10 elements:
    bp(i) = sum(cp(1:10))-sum(cp(11:20));
end

p1 = sum(bp>=277) / N  % p-value for ME vs. pre-ME
p2 = sum(bp>=104) / N  % p-value for ME vs. control
```

Review of “A comment on ‘Can Our Mind Emit Light At 7300 km Distance ? ...’

This is a useful post-publication comment about the results and interpretations of the paper “Can Our Mind Emit Light At 7300 km Distance ? A Pre-Registered Confirmatory Experiment of Mental Entanglement with a Photomultiplier”.

The practice of post-publication reviews and comments is welcomed and should be incentivized given the international hot debate about the limitations of the usual single or double blind peer-review process (e.g. http://www.nature.com/nature/peerreview/debate) .

As to the author’s concerns about some statistical results reported in the original paper, it is clear that they seem not robust if different statistics are applied to different data.

In the original paper all statistical analyses were applied to the percentages of photons and burst >10 photons recorded in the three experimental conditions, namely pre-ME (pre mental entanglement), ME (mental entanglment), control (post mental-entanglement), see Tables 2,3, 4,5,6, 2S and 3S. It is also important to point out that all statistical analyses, but those reported in the Tables 2S and 3S, are related to frequentist or bayesian parameters estimation and not to hypothesis testing.

The statistics applied to the raw differences of photons between the Pre-ME and ME and between the ME and Control conditions by using a permutation procedure, show a less convincing support of the differences among the three experimental conditions, in particular for the difference between the ME and the Control data, p=.30, whereas the difference between the Pre-ME and ME data show a p =.074. We alert the reader to don’t infer that a p =.074 means that the null hypothesis cannot be refuted for the fact that it is greater than the conventional p <=0.05, because “God loves the .06 level nearly as much as the .05" (Rosnow & Rosenthal, 1989; p, 1277). See also the recent American Statistical Association’s statement on p-value (Wasserstein & Lazar, 2016).

However if we repeat the same analysis using the raw differences of all three experiments, for a total of 30 data for each of the three conditions, we obtain p=.032 and p=0.025 for the difference between the Pre-ME and ME data and the ME and the Control data, respectively. See data in the Appendix.

The second main concern is related to the bayesian hypothesis testing results presented in the supplementary tables 2S and 3S, because “*the Poissonian distribution is the limit of a binomial distribution, and accepting the conclusion from above [that data must be binomial distributed, and hence that each detected photon (in bursts of >10 photons) be statistically independent from each other photon], that the data is not Poissonian, it seems exceedingly unlikely that the data is binomial distributed*”. Again it is stated that “*Apparently the photons must be correlated to a degree, in order to explain the high number of samples (bursts) with more than 10 photons. Considering the physical processes inside a photomultiplier tube this may not come as a surprise since the number of generated electrons within the tube as well as the corresponding counting process can depend on several parameters*.”

We agree that the distributions of photons within the burst >10 photons show a heavy right tail making them more similar to log-normal Poisson distributions. Furthermore we are not expert of the electronic processes inside the photomultimer we used, and hence we cannot exclude that some, but not all events, can be correlated in some way. However the assumption that these conditions violate completely the indipendence of the photons bursts, must be proved analytically even if we think that a better test is to replicate independently our experiments by using different photons detectors.

References

Rosnow, R. L., & Rosenthal, R. (1989). Statistical procedures and the justification of knowledge in psychological science. American Psychologist, 44, 1276-1284).

Wasserstein, R. L., & Lazar, N. A. (2016). The ASA's statement on p-values: context, process, and purpose. The American Statistician, 70,2,129-133)

Appendix

Raw data in the Pre-ME conditons in the three experiments:

112 66 61 127 171 78 90 54 49 79 59 67 77 85 87 51 145 126 95 160 103 35 160 93 85 166 145 74 184 68

Raw data in the ME conditons in the three experiments:

130 104 53 178 127 103 108 133 100 128 102 57 92 183 70 103 118 126 107 123 100 228 140 68 134 73 175 111 147 114

Raw data in the Control conditons in the three experiments:

107 71 72 116 87 87 36 124 123 237 117 97 64 134 109 85 175 90 45 83 35 97 47 93 94 93 103 94 114 88