Photonic Measurement of Apparent Presence of Spirit Using a Computer Automated System

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Background: Research investigating the potential of detecting the purported presence of spirit (POS) has been hampered by the necessity of employing a human being to collect the data. To infer the presence of alleged spirit, it is essential to remove the simultaneous presence of an experimenter (POE), thereby eliminating his or her physical energy as well as accompanying conscious intentions and expectations.

Objective: The purpose of these two proof of concept experiments was to explore the feasibility of completely automating data collection in the absence of an experimenter to determine if evidence consistent with POS was still obtained.

Design: A computer automated system was developed making it possible to collect all data in the absence of an experimenter (thereby achieving complete experimenter blinding). In the evenings, the computer would perform as follows: (1) start the experimental run at random times, (2) conduct 30-minute baseline as well as POS trials involving two different alleged spirits, and (3) record background light in a completely dark chamber with a highly sensitive low-light Princeton Instruments charge-coupled device (CCD) camera system.

Setting: The CCD camera and light-tight recording chamber were housed in a light-tight room; the computer, large screen monitor, and speakers were housed in a separate control room.

Participants: The participants were two purported spirits involved in previous research published in this journal, in which a silicon photomultiplier system was used.

Intervention: The primary intervention was the computer selecting and presenting visual and auditory information inviting Spirit 1 or Spirit 2 to enter the chamber in the absence of experimenter presence and awareness.

Main Outcome Measurements: The CCD camera provided 512 × 512 pixel images of 30-minute exposures (reflecting a combination of possible background light plus instrument dark noise). The images were imported into image processing software, and two-dimensional fast fourier transform (FFT) analyses were performed. Visual examinations of the FFT images were performed; average brightness levels of the FFTs were calculated and subjected to repeated measures analyses of variance.

Results: Compared with prebaseline and postbaseline images, the POS trials were associated with reliable increases in the average brightness of the FFT images, suggesting increased structure of the background light as revealed in the FFTs.

Conclusion: These findings indicate that POE per se is not sufficient to explain the observed POS effects. Future experiments can address the remaining potential psi interpretations (decision augmentation theory [DAT] and retro psychokinesis [PK]) as well as the source of the observed information (ie, the chamber, cosmic rays, and/or the CCD chip itself).

Key words: Survival of consciousness, detection of spirit, low-light CCD detector, photomultiplier sensors, photons, experimenter intention, spirit intention, DAT, psychokinesis, computer automation

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INTRODUCTION

The thesis that (1) mind is in at least some respects separate from brain, and that (2) consciousness survives physical death, is receiving increased attention by science, the public, and the media. Various observations point to the possibility of "life after death"; the research includes blinded laboratory experiments with mediums,[1,2] accounts of near death experiences,[3] and cases of possible reincarnation.[4,5] A common assumption made by investigators in this area is that the organized energy and information that presumably comprises the history and essence of a person continues in some form in the "vacuum" or "zero-point field" of space after physical death (reviewed in *The Sacred Promise*[2] and by Laszlo in *Explore*[6]). In this paper, the term *spirit* is used to refer to the hypothesized existence of organized energy and information.

Although there are various speculations about the possible nature of this inferred organized energy and information, including photonic, electromagnetic, and/or quantum fields, it can be hypothesized that the purported presence of spirit (POS) could in principle be detected with suitably sensitive and reliable sensors and appropriate analytic techniques.[2,6] Laszlo, in this journal (and others cited in his paper), refers to this possibility as "instrumental transcommunication."[6]

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The quest to detect POS has been hampered by three primary categories of factors: (1) conceptual, (2) technological, and (3) experimental.

Concerning *conceptual* factors, it is necessary not only to posit the existence of alleged spirits, but it is essential to entertain the possibility that under certain conditions spirits can (and will) reliably collaborate with the experimenters just as human participants are required to do in conventional research.

Technologically, it is necessary to have sufficiently sensitive and reliable sensors, amplifiers, and signal processing systems that can record and display the types and frequencies of energies and information that presumably comprise (and/or can be influenced by) alleged spirits.

However, the most challenging factors may be *experimental.* Historically, virtually all anecdotal observations (eg, ghost hunting), as well as exploratory experimental effects (from purported electronic voice phenomena to the measurement of low-light photons by using a silicon photomultiplier system), have involved one or more observers or experimenters being present at the time the recordings were made.[7] It is conceivable that some, if not all, of the observations made could be explained in terms of possible presence of experimenter (POE) effects, including the following: (1) awareness of the occurrence of the conditions, and (2) hypotheses and associated intentions and expectations. Until possible POE effects are eliminated experimentally, potential POS interpretations can be questioned.

Presence of an experimenter contains the simplest (and most obvious) set of potential alternative parapsychological explanations that must be addressed—and successfully ruled out—before POS can be considered seriously.

In the discussion following this writer's three exploratory proof-of-concept experiments reported in this journal, investigating the possible application of silicon photomultiplier systems for detecting POS as well as POE, it was proposed that future research could eliminate POE effects—at least in terms of *conscious awareness and intentions*—by having the experiments run entirely by computer in the absence of any experimenters.[7]

This writer proposed that a completely computer-automated system could be constructed that could determine whether purported POS effects could occur in the absence of hypothesized POE effects. Presence of spirit theory (here termed POST) would predict that positive results should be obtained with complete computer automation, and therefore with *complete experimenter blinding.*

However, removing POE per se does not eliminate all possible nonspiritual paranormal interpretations. Two remaining potential explanations include decision augmentation theory (DAT)[8] and retro PK. Decision augmentation theory predicts the possibility that in the process of designing research protocols or in conducting experiments, investigators may unconsciously make decisions that favor the likelihood of obtaining effects in alignment with the hypothesis under test. Retro PK predicts the possibility that the expectations of the experimenters when they analyze the data in the future will retroactively influence random events in the past that were used to make decisions. These psi possibilities notwithstanding, the process of experimentally removing POE effectively addresses the most plausible (and obvious) alternative hypotheses to POST (other than DAT and retro PK).

The present research is unavoidably controversial and seemingly inconsistent with mainstream materialistic philosophy. Both of the anonymous reviewers of the original submission of this manuscript verbalized the challenging nature of inferring the possible existence of spirit in their opening remarks. Their statements are inserted verbatim (ie, unedited for grammar); the italics were added by this writer. Reviewer one wrote "I applaud the courage and chutzpah of the experimenters in taking up this challenge to a basic paradigm of modern science: *the presumed spirits simply do not exist.*" Reviewer two wrote, "I must introduce this review by acknowledgement that I am *suspicious of extrapolations like those made in this paper"* Appreciating these challenges and concerns, the reader is encouraged to insert the terms *alleged, supposed,* or *apparent* whenever the word *spirit* happens to be mentioned in the text in the absence of such qualifiers.

Keeping these questions in mind, the present paper nonetheless provides what may be the first experimental evidence indicating that *alleged* POS effects can be reliably observed in the absence of possible POE factors (ie, conscious, real-time human presence effects).

METHODS

CCD Camera and Operating System

Patterns of low-level light were recorded in a light-tight metal imaging chamber housed in a light-tight imaging room. A Princeton Instruments VersArray XP NTE3 CCD-77-B air cooled detector (camera) with a Princeton Instruments ST133A controller was used to obtain 30-minute exposures (Princeton Instruments, Trenton, NJ). The camera is cooled to −77°C. Figure 1 provides a diagram of the components of the camera and operating system.

Previous research using this camera and controller has documented the exquisite sensitivity and reliability of this technology for imaging low-level "biophoton" light emitted by biological systems (eg, plants and humans) as well as photons emitted by nonliving substances such as certain minerals (including diamonds).[9] The technology is sensitive enough to detect patterns of light surrounding and interconnecting biological systems (sometimes termed *auras*). The lens of the camera is focused a few millimeters above a stage consisting of nonfluorescing white graph paper with light blue lines. The purpose of the white background is to reflect either photons, biophotons, or associated auric/field light back to the lens, depending upon the conditions of a given experiment.

In the present research, no biological samples were placed on the stage (ie, the camera was peering into a pitch-black environment). Hence, the camera was not registering biophoton activity here; it was detecting whatever photons were either spontaneously present in the chamber or entered the chamber, including occasional cosmic rays (and possibly, hypothesized photons associated with purported POS). The purpose of the white background paper was to reflect any potential photons back to the lens; otherwise the photons would be absorbed by the black walls of the chamber.

The camera control room was adjacent to the imaging room. As depicted in Figure 1, the PC that runs the system used two displays: the smaller 19-inch monitor displayed the camera imaging software (WinView32, version 2.5.21.0, Princeton Instruments), the larger 32-inch monitor displayed the PowerPoint (Microsoft Corporation, Redmond, WA) presentation that provided visual instructions

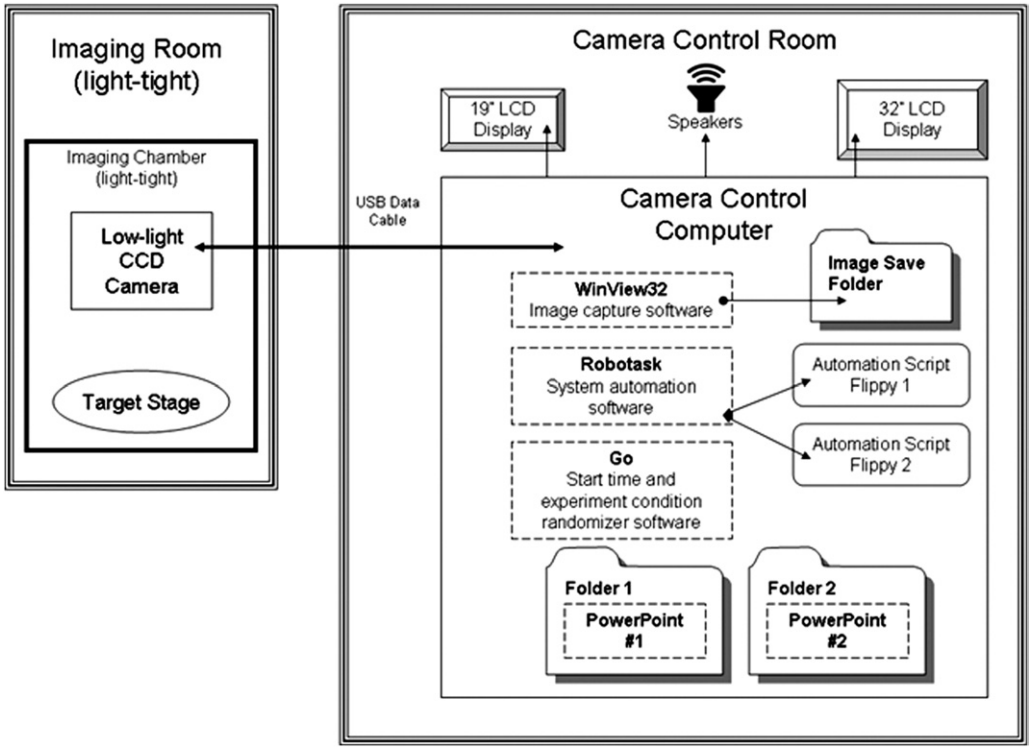

Figure 1. Block diagram of components of the camera imaging room and control room.

for the alleged spirits (as well as audio information described below). System automation was programmed using RoboTask version 4.0 software (Neowise Software).

Experimental Methods

The experimental methods were first tested using a *living* experimenter (herein called the *live experiment*) prior to computer *automating* the system (termed the *automation experiment* and *automation replication experiment*). There were also two sets of control (no intervention) trials. Altogether, a total of five separate experimental conditions were run:

- live experiment
- automation experiment
- automation control trials
- replication automation experiment
- replication automation control trials

The live experimental design involved the experimenter collecting 30-minute baseline trials as well as two POS trials involving two alleged spirits (Susy and Sophia) who had seemingly participated previously in the silicon photomultiplier research.[7] In this report, they will be referred to as Spirit 1 and Spirit 2, respectively. As in the previous research, multiple research mediums and psychic intuitives independently claimed that Spirits 1 and 2 were fully committed to collaborating in the research.

In the live experiment, following a 60-minute camera warm-up period, an initial 30-minute baseline was obtained. This initial baseline (dark noise) image was subsequently automatically subtracted via the WinView 32 software from each of the subsequent baseline and POS trials. This was necessitated because the CCD chip had a few areas of increased brightness caused by small imperfections in the chip; baseline subtraction is routinely used in low-light imaging protocols (eg, in astrophotography) to assist in removing the majority of the effects of such minor imperfections. Although the subtraction procedure helps remove the effects of these minor imperfections, the procedure unfortunately *adds* noise generated by the recording process itself. Especially when attempting to quantify very low levels of background light, it is preferable, if possible, to use a chip that is virtually free of such pixel imperfections.

Encouraged by the positive findings of the live experiment (summarized below), we had a new, near perfect replacement chip installed by Princeton Instruments. As a result, the automation experiments no longer necessitated the use of an initial subtraction background baseline procedure; however, the standard camera warm-up period was employed.

Both the live and automation experimental designs followed a Baseline Active Baseline (BAB) BAB structure for a set of trials comprising a given POS run. A 30-minute baseline (B) trial both preceded and followed a given POS (active A) trial. Depending upon the run, either Spirit 1 or Spirit 2 was invited for the first BAB period; the other alleged spirit was invited for the second BAB period. Approximately 15 minutes separated the first and second BAB sets of trials. In the live experiment, the order of Spirits 1 and 2 were alternated over runs. In the automation experiments, the order of Spirits 1 and 2 was randomly determined by the computer (and

hence unknown to the experimenter prior to, and during, the actual data collection).

In the live experiment, the experimenter followed a specific script and read the words out loud. The intent was to treat the alleged spirits as living and conscious subjects deserving of respect and appreciation. As mentioned above, *the feasibility of this kind of research assumes the potential reliable collaboration of the alleged spirits.*

In the automation experiments, a recording of the experimenter's voice reading the scripts out loud was played on speakers as part of the PowerPoint presentation. The PowerPoint presentation included written summary instructions on the screen as well as images of a given spirit (eg, the photograph used in the PowerPoint had been taken of Susy when she was 89 years old) for their respective POS trials.

Prior to the start of a given BAB period, the experimenter said,

> Dear Susy (or Sophia), thank you for being part of our experiment today. My name is Mark and I would like to welcome you to our lab. The goal of these experiments is to try to document your existence. I hope that you will work with us and that the results are for the greatest and highest good. When I start imaging, could you please enter the chamber in the next room and fill it with your light.

Prior to the A trial, the experimenter said, "Dear Susy (or Sophia), I have started the imaging process. I would like to invite you to enter the chamber in the next room now and fill it with your light." The implication was that Susy (or Sophia) was to remain in the chamber and "fill it with your light" until further instructed.

At the end of the A trial, the experimenter said,

> Dear Susy (or Sophia), the exposure is completed. You no longer need to interact with the chamber. I'm going to be taking more images today so I would like to ask that you do *not* interact with the camera again until I invite you. This will allow us to properly document your interaction with us. Thank you for your help.

At the end of a given BAB period, the experimenter said, "Dear Susy (or Sophia), thank you for your help. We are done for the day."

In the live experiment, the experimenter directly operated the computer and was present in the control room during all seven 30-minute trials (pre-B, BAB BAB). Hence, the experimenter knew when the experiment began as well as the timing and order of the trials (ie, the experimenter was not blind). Live experiment runs were conducted during the daylight hours of 11 AM and four PM.

Automation experimental runs were conducted during the evening hours of 11 PM and four AM. In the automation experiments, once the automation software was started around four PM, the experimenter left the control room and was blind to any and all information regarding precisely when the experiment would begin (the actual onset was determined by a random number program which started the runs between 11 PM and midnight). Hence, he was blind to *when the actual A trials would be conducted.* In addition, the experimenter was blind to *which spirit would be invited first* (the POS order was also determined by a random number program). The experimenter was typically home asleep at that time the data were collected; hence, he was not conscious of the actual running of the experiment. However, as was mentioned previously, it was still theoretically possible that the experimenter might have unconsciously (and unintentionally) influenced the randomization process via retro PK.

In the automation experiments, before the experimenter left the control room in the afternoon, he read the following script aloud to potentially increase the possibility that Spirits 1 and 2 would be present for the late evening experiment:

> Hello Susy and Sophia. Sometime between 11:00 pm and midnight tonight this computer will turn on and invite you to participate in our experiment. The goal of these experiments is to try to document your existence. Once the experiment starts, the computer will display a photo of you and my voice will give you directions. For these experiments to be successful, we need you to follow the directions carefully. During the parts of the experiment that we are calling baselines, we ask that you do not interact with the camera or the chamber in the next room. At other times, you will be invited to enter the chamber. When this happens, please fill the chamber with your light. After 30 minutes, the computer will play my voice again giving you the instructions to stop. At that time, it is important that you stop filling the chamber with your light and please do not interact with the camera or chamber in any way. When the experiment is over for the night, my voice will play again thanking you for your participation and indicating that you are free to leave. Thank you for being part of our experiments.

The live experiment consisted of four runs containing a total of eight sets of BAB trials (four for Spirit 1 and four for Spirit 2). The automation experiment also consisted of four runs containing a total of eight sets of BAB trials for Spirits 1 and 2.

In addition, a separate set of four computer-automated control runs of BBB BBB trials containing a total of eight sets of BBB trials were conducted to rule out possible effects of changes in camera function over time. The automation control trials provided essential information regarding spontaneous variability and noise as detected by the camera over time.

Furthermore, three follow-up automation experimental replication BAB BAB runs (termed the replication automation experiment) were conducted; the third used a checkerboard pattern on the stage inside the camera chamber.

Finally, at the recommendation of an anonymous reviewer, 12 additional computer automated control runs of BBB BBB trials containing a total of eight sets of BBB trials were run. The replication automation control trials provided additional essential information regarding spontaneous variability and noise as detected by the camera over time.

Statistical Analysis

The WinView software saved the raw data as 512 × 512 pixel image files; the RoboTask software saved a text file that listed the precise timing of each step as it actually occurred in a given run during the night. In the live experiment, the WinView software was run by the experimenter; in the automation experiments and control trials, the WinView software was run by RoboTask.

Based upon close examination of the raw image files, it was quickly observed that the POS (A) trials appeared to have increased

complexity or structure in the patterns of grey scale dots displayed in the images. These observations replicated patterns witnessed in earlier pilot studies involving approximately a hundred active and control trials testing the feasibility of conducting systematic POS experiments. To potentially quantify these apparent increases in structural patterns, and to rule out possible subjective visual discrimination biases from the analyses, the images were imported into ImageJ image processing software (available for biomedical researchers from the National Institutes of Health) and subjected to two-dimensional FFT analyses. The FFT analyses were performed exclusively on the raw images, not the averaged data.

It was observed in both the earlier pilot studies and the formal live experiment that increased structure in the raw image files was typically associated with relative increases in the overall brightness of the 512 × 512 pixel FFT images files. Using the ImageJ histogram function, it was possible to calculate average pixel brightness values over the total 262,144 pixels that comprised a given FFT image. *Employing the average pixel brightness histogram procedure removed the possibility of any subjective visual judgments from entering into the statistical analyses.* The average brightness values were analyzed using repeated measures analyses of variance.

Since the present report focuses on the novel use of the computer automation paradigm for removing the presence of the experimenter, statistical analyses were conducted exclusively on the two automation experiments (which employed the new CCD chip) and their associate automation control trials. The descriptive results of the live experiment, briefly summarized below, were included in this report to illustrate the *clear replication of the FFT brightness effects above and beyond (1) the POE, and (2) a mildly compromised LCD chip.*

RESULTS

Live Experiment (Combined POE Plus POS)

Figure 2 displays the averaged FFT images of the four trials for Spirit 1 (left column) and for Spirit 2 (right column) for the live experiment (upper three rows of images), with their respective prebaselines subtracted (total n = 8 spirit trials). For comparative purposes, Figure 2 also displays the FFT images of the averages of the four trials for Spirit 1 and for Spirit 2 for the automation experiment (lower three rows of images; again total n = 8 spirit trials).

Each set of three rows of images includes the following: (1) the averaged 512 × 512 pixel FFT image (top row), (2) a magnification of the center section of the averaged FFT image (middle row), and (3) a magnification of the lower middle section of the averaged FFT image (lower row). Images two and three are displayed as smaller because they represent small sections of their respective image one.

Three replicated patterns of brightness observations are readily visible in the averaged images displayed.

First, the live experiment images have a clear cross-shaped pattern in their FFT images, which is replicated for both Spirit 1 and Spirit 2, whereas the automation experiment reveals a more diffusely rounded pattern for both Spirit 1 and Spirit 2.

The cross-shaped patterns revealed in the live experiment FFTs were likely caused by the subtle (yet measurable) imperfections in certain areas of the chip.

Second, the increased FFT brightness effect appears to be stronger (more intense) for Spirit 2 than Spirit 1, and this observation is visible in both the live experiment and the automation experiment. ImageJ histogram analysis of the averaged pixel brightness values verifies this obvious visual brightness effect.

Third, close examination of Spirit 2's images suggests the presence of somewhat brighter patterns of shapes (complexity of structure) than Spirit 1, and this observation is replicated in both the live experiment and the automation experiment. The brightness patterns suggest that Spirit 2 produced a stronger effect than Spirit 1.

These initial observations provided the rationale for the statistical analyses performed on the two automation experiments.

Automation Experiment (POS Alone)

Histogram analyses were performed on each of the FFT images comprising the BAB BAB design. The average brightness values were entered into a spreadsheet and analyzed using Statistica version 6.0 (StatSoft, Inc., Tulsa, OK). A repeated measures analysis of variance was performed with conditions (BAB) and spirits (Spirit 1 vs Spirit 2) as repeated factors. The results are displayed in Table 1.

The main effect for BAB was significant ($F(2,6) = 5.780$, $P < .04$). The means and standard errors are displayed in Figure 3. It can be seen that compared with their surrounding prebaseline and postbaselines, the average brightness of the FFT pixels was greater for the active POS (middle) conditions (the average of Spirits 1 and 2; n = 8 BAB trials).

The means (and standard errors) for BAB for Spirits 1 and 2 are displayed in Table 2. It can be seen that the increased FFT brightness effect was apparent for both Spirit 1 and Spirit 2 conditions.

Although the increased brightness effect in the FFTs appeared to be stronger for Spirit 2 when compared with Spirit 1, the interaction between conditions (BAB) and Spirits (1 vs 2) was not significant ($F(2,6) = 1.319$, $P < .335$). It is possible that with a sufficient increase in the numbers of trials (see replicated patterns below), this apparent difference between Spirits 1 and 2 might reach statistical significance.

Automation Control Trials

To rule out the possibility that these apparent POS effects might somehow be related to unexpected camera changes over time, a separate set of four BBB BBB computer automated runs were conducted. Similar PowerPoint presentations were used except no spirits were invited. Images of FFTs were created, histograms analyses were performed, and the average brightness values were added to the spreadsheet for statistical analysis.

A mixed analysis of variance was performed with conditions (BAB) and spirit/time (BAB for Spirit 1 vs Spirit 2) as repeated factors, and group (POS trials vs control trials) as between-group factors. The conditions (BAB) by group (POS trials vs control trials) was significant ($F(2,12) = 4.29$, $P < .04$).

The means (and standard errors) for the averaged BAB (actually BBB for the control conditions) are displayed in Table 3. The pattern of means indicated a general decline in FFT brightness over BBB.

Figure 4 provides an important summary of the automation experiment and automation control trials in terms of averaged FFT images.

The upper row of FFT images displays the POS findings for the automation experiment the lower row of FFT images displays the control findings for the automation control trials. The four

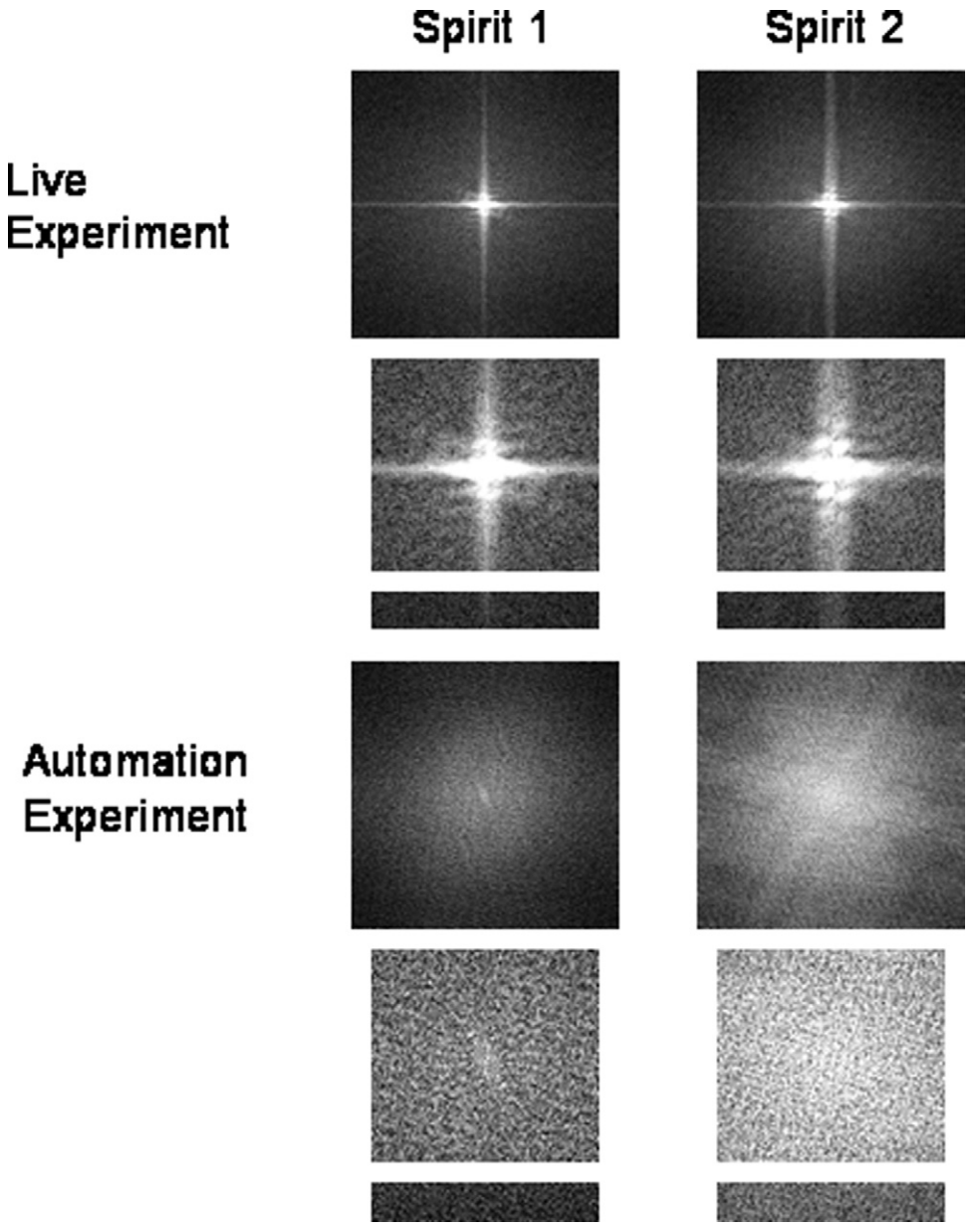

Figure 2. Averaged FFT images of Spirit 1 and Spirit 2 for the live experiment and the automation experiment.

images for the upper POS (automation experiment) row present the averaged FFT images for the prebaselines, Spirit 1, Spirit 2, and postbaselines, respectively; the four images for the lower control (automation control trials) row present the comparable averaged FFT images for prebaselines, control trials (see below), and postbaselines, respectively.

For POS (BAB BAB) trials one to six, or auto control (BBB BBB) trials one to six, the prebaseline FFT images reflect the averages of trials one and four. The postbaseline FFT images reflect the averages of trials three and six.

For the POS (BAB BAB) trials, Spirit 1 FFT images represent the average of trials two and/or five (depending upon which order was determined by the computer); Spirit 2 FFT images represent the averages of trials five and/or two (again depending upon the order determined by the computer).

For the control (BBB BBB) trials, control one FFT image represents the average of trial two; control two FFT image represents the average of trial five. This procedure was employed to make it possible to look for potential time trends in the BBB BBB trials, at the same time preserving the prebaseline and postbaseline comparisons.

Each row's average brightness was individually adjusted so that the prebaseline values would appear similar. This makes it easier to compare the patterns of brightness both within and across rows.

Concerning the POS FFT images (upper row), it can be seen that both the Spirit 1 and Spirit 2 trials were relatively brighter (ie, higher

Table 1. Mixed Analysis of Variance Table with Conditions (Baseline Active Baseline/BAB) and Spirit/Time (BAB for Spirit 1 vs Spirit 2) as Repeated Factors, and Group (Presence of Spirit/POS Trials vs Control Trials) as Between-Group Factors

	SS	*df*	MS	F	*P* Value
Intercept	240636.4	1	240636.4	9828.776	.000
Error	73.4	3	24.5		
Main effect spirits (1 and 2)	2.7	1	2.7	0.027	.879
Error	293.5	3	97.8		
Main effect conditions (BAB)	187.3	2	93.6	5.780	.039
Error	97.2	6	16.2		
Interaction spirits by conditions	105.8	2	52.9	1.319	.334
Error	240.6	6	40.1		

SS, sum of squares; MS, degrees of freedom; MS, mean square; F, F ratio.

percentage of brighter to darker pixels) than their surrounding prebaseline and postbaseline trials. These images provide a visual summary of the averaged pixel brightness values reported above. In addition, it can be seen that the averaged Spirit 2 trials were somewhat relatively brighter than the averaged Spirit 1 trials.

Finally, it can also be seen that the four averaged FFT images for the control trials (lower row) were all relatively dark compared with the averaged FFT images reflecting Spirit 1 and Spirit 2 trials (ie, the averaged control trials clearly did not show evidence of increased brightness compared with their respective prebaseline and postbaseline averaged values.

Although possible structural differences might exist between the images, because at this point they are subjective, they are not explored here. The analyses are based solely on objective measures of averaged brightness. It is conceivable that classification procedures can be developed in the future for scoring these apparent structural differences; they might serve to distinguish, for example, between different spirits and conditions.

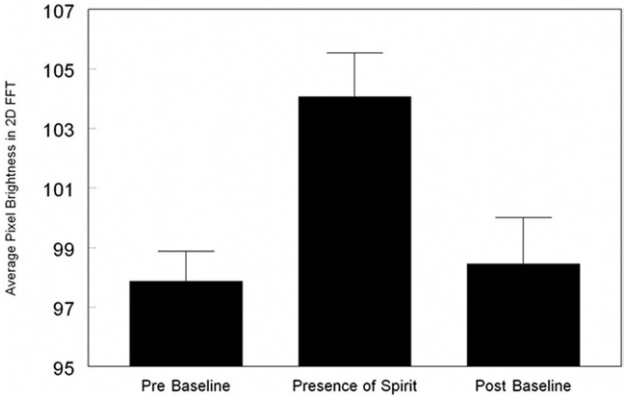

Figure 3. Means and standard errors of the average pixel brightness in the FFTs of the prebaseline, presence of spirit, and postbaseline trials of the automation experiment.

Table 2. Means and Standard Errors for Prebaseline, Presence of Spirit, and Post Baseline (BAB) Trials Separately for Spirit 1 and Spirit 2

	Prebaseline		Presence of Spirit		Postbaseline	
	Mean	SE	Mean	SE	Mean	SE
Spirit 1	96.89	2.92	101.55	4.48	100.95	4.01
Spirit 2	98.86	1.91	106.59	3.00	95.59	1.16

Replication Automation Experiment (POS Alone)

To potentially replicate and extend the apparent POS effects, after the automation experiment was run and analyzed statistically, an additional three automation runs of data were collected.

The first two BAB BAB runs continued to employ the white with blue-line paper. For the third BAB BAB run, the white paper with blue lines was replaced with white and black checkered paper. Since two-dimensional FFTs make it possible to uncover potential structural patterns in the raw images (and FFT analyses of checkered images often produce somewhat brighter FFT images), we hypothesized that the more structured background paper might increase the sensitivity of the FFT procedure to reveal underlying structure and brightness (eg, of Spirit 1).

The means and standard errors of the three runs combined (the average of Spirits 1 and 2; n = 6 BAB trials), are displayed in Figure 5. It can be seen that the pattern of means replicated Figure 3.

Figure 6 presents the replication and extension findings in finer detail by displaying the average FFT images.

For comparative purposes, the averaged prebaseline, Spirit 1 and Spirit 2 FFT images previously displayed in Figure 4 were redisplayed in Figure 6. They appear in row 1 (n = 4 runs). The averaged prebaseline, Spirit 1 and Spirit 2 FFT images of the additional two runs with the white paper with blue lines were displayed in row 2 (n = 2 runs), and the FFT images of the additional run with the checkerboard paper were displayed in row 3 (n = 1 run).

The baseline FFT images (left columns) reflect the averages of trials one and four. For clarity of presentation and visual examination, the postbaseline images (which essentially mirrored the prebaseline images as displayed in Figure 4) were not displayed in Figure 6.

As in Figure 4, each row's average brightness was individually adjusted so that the prebaseline values appear similar. This makes it easier to compare the patterns of information both within and across rows. The apparent *between*-group baseline

Table 3. Means and Standard Errors for Prebaseline, No Spirit Control (Baseline), and Postbaseline (BBB) Trials

	Prebaseline		No Spirit Control		Postbaseline	
	Mean	SE	Mean	SE	Mean	SE
Controls	104.70	2.56	101.29	1.99	99.49	2.15

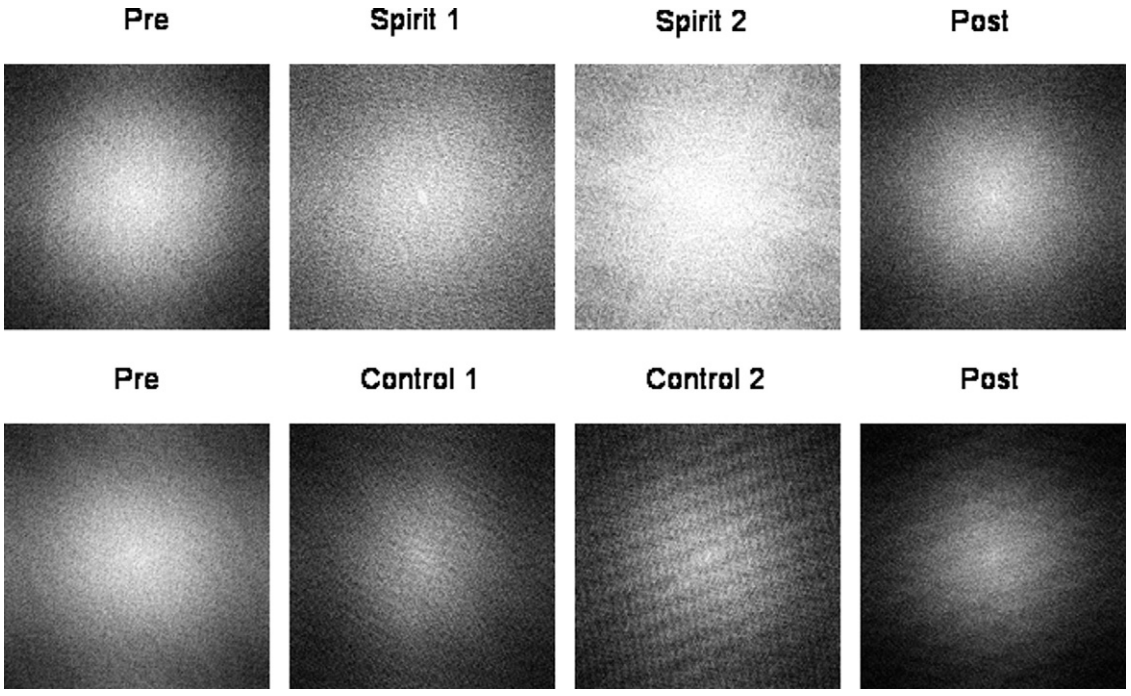

Figure 4. Averaged FFT images of the prebaseline, Spirit 1, Spirit 2, and postbaseline trials (upper row) compared with the averaged FFT images of the prebaseline, control 1, control 2, and postbaseline trials (lower row).

differences probably reflect the small sample sizes involved; it is the replicated *within* group effects that are meaningful here. For completeness of presentation, the prebaseline and postbaseline means (of the 262,144 pixels per FFT image) for the three rows were as follows: (1) 97.876 and 98.453 for row 1 (n = 4 runs, n = 8 images per average), (2) 102.231 and 104.307 for row 2 (n = 2 runs; n = 4 images per average), and (3) 97.255 and 97.582 for row 3 (n = 1 run; n = 2 images per average).

It can be seen that *all three of the Spirit 2 trials were clearly brighter than their respective baseline trials*. Furthermore, *all three of the Spirit 2 trials were visibly brighter than their respective Spirit 1 trials*.

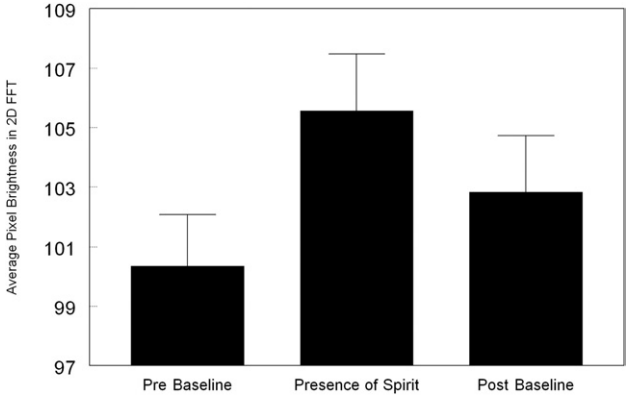

Figure 5. Means and standard errors of the average pixel brightness in the FFTs of the prebaseline, presence of spirit, and postbaseline trials of the automation replication experiment.

However, it can be seen that whereas the averaged Spirit 1 trials were somewhat brighter compared with their baseline trials in the automation experiment (row 1, n = 4), and only slightly brighter (ie, observed in the center of the image) for the average of first two trials of the replication automation experiment (row 2, n = 2), for the third trial of replication automation experiment, the Spirit 1 trial in row 3 (n = 1) was substantially brighter than its baseline trials, possibly due to the use of the checkerboard paper.

These additional observations were included in this report partly because they offer evidence of replication of Spirit 2's apparent increased effects as compared with Spirit 1, as well as illustrate the possibility of increasing the sensitivity of detecting POS in future research (row 3 of Figure 5).

Replication Automation Control Trials

Partly encouraged by the recommendation of reviewer one, a set of 12 additional automation control BBB BBB trials were run and analyzed. If the 12 sets of trials had been collected back to back, it would have taken a total of two days (48 hours, the number suggested by the reviewer).

The means (and standard errors) for the averaged BAB (actually BBB for the control conditions) are displayed in Table 4. It can be seen that there was no evidence of any consistent or systematic pattern or drift in the averaged control trials.

DISCUSSION

The present findings using the Princeton Instruments low-light CCD camera system replicate and extend the findings previously reported by this writer[7] using the sensL silicon photomul-

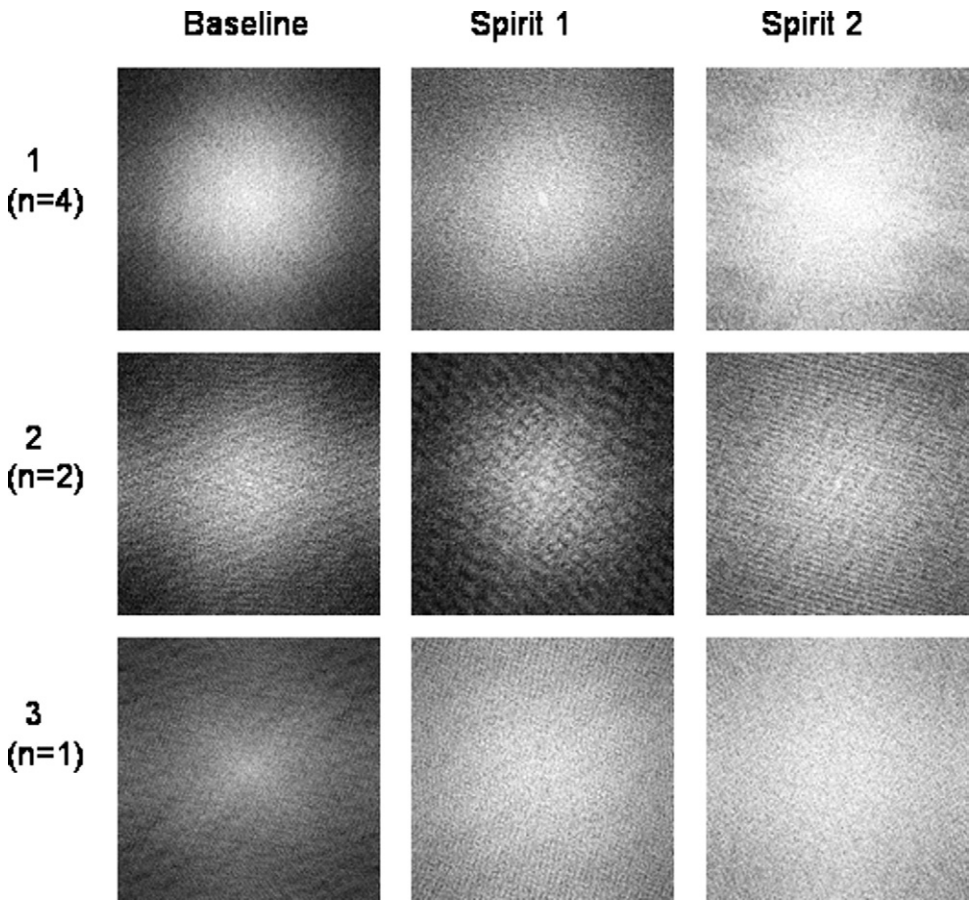

Figure 6. Averaged FFT images of the prebaseline, Spirit 1, and Spirit 2 trials for the automation experiment (row 1), two runs for the replication automation experiment using white graph paper, (row 2), and one replication automation run with checkerboard paper (row 3).

tiplier system. It appears that instructions for specific spirits to enter a light sensing system can be associated with reliable increases in the apparent measurement of photons.

The present experiment is innovative and extends the previous research in two important ways. First, using a sensitive low-light imaging system, it employs a new procedure for assessing and quantifying possible structural changes in the *organization* (patterns) of photons. This approach to data analysis is a prerequisite for potentially imaging in the future (and eventually distinguishing between) different alleged spirits. Second, it introduces a novel and potentially powerful experimental procedure for *removing the physical presence*–as well as associated conscious awareness–of a sentient experimenter.

Table 4. Means and Standard Errors for Prebaseline, No Spirit Control (Baseline), and Postbaseline (BBB) Replication Trials

	Prebaseline		No Spirit Control		Postbaseline	
	Mean	SE	Mean	SE	Mean	SE
Controls	102.02	1.39	100.75	1.59	101.21	1.44

Whereas this writer's previous experiments left open the possibility that the findings might be due *entirely* to the *conscious beliefs and intentions* of the experimenter operating the equipment, the present experiments rule this possibility out. The present research underscores that the presence of a conscious experimenter is *not* necessary to obtain reliable evidence consistent with POST.

However, the absence of a physical experimenter, when combined with computer randomization of the timing and ordering of key conditions in the design, does not rule out other less obvious–yet theoretically plausible–paranormal explanations. For example, it is possible, at least in principle, that the present findings could reflect some sort of *unconscious expectancy effect* on the part of the author and/or the experimenter, and even *precognition of future experimental effects* (including possible retro/backward in time effects). Although beyond the scope of the present report, future experiments can examine potential predictions offered by DAT, which addresses such possibilities,[8] as well as other psi possibilities such as retro PK.

Until experiments are conducted that explicitly test predictions of these alternative parapsychological theories, the present findings can be viewed as being highly consistent with–but not in establishing–POST.

However, it is important to acknowledge that the findings concerning *apparent individual differences* in alleged spirit's effects on photonic measuring devices are strongly consistent with POST.

In this writer's previous research using the silicon photomultiplier system, one alleged spirit (Harry) was observed to have a consistently stronger effect in producing apparent photon bursts than another alleged spirit (Susy).[7]

In the present research using the low-light CCD camera imaging system, one alleged spirit (Sophia) was found to have a consistently stronger effect than another alleged (Susy) as observed in FFTs across the following: (1) the live experiment (Figure 2), (2) the automation experiment (Figure 4), and (3) the replication automation experiment (Figure 6).

Radin[10] has observed reliable individual differences in effects of intention on altering the behavior of light in an interferometer. Presence of spirit theory would predict that effects on super sensitive photon detecting systems could conceivably be stronger in certain alleged spirits, since presumably they are less restricted by conventional physical barriers.

Future research can apply the computer automation paradigm to any type of energy detection system. We are currently implementing computer automation protocols with interferometers, silicon photomultipliers, random event generators, and magnetic field detectors.

Although clearly promising as an experimental paradigm, the computer automation procedures tell us nothing about the possible electromagnetic or quantum mechanisms underlying the observed effects. Numerous questions are raised by these observations: For example, does the apparent detection of POS involve the actual presence of visible light or other frequencies (eg, cosmic rays) generated by spirit? Does the apparent detection of POS involve alleged spirits' ability to modulate/alter the organization of light (rather than emitting light per se)? Does the apparent detection of POS involve spirits directly effecting electron flow properties in the sensors themselves? What factors, including electronic, environmental, and potentially spiritual, enhance or inhibit detecting POS? Can positive POS findings be obtained using skeptics as experimenters (either POE or absent)? POST would predict yes.

Future questions aside, the present findings point strongly to the possibility not only in principle, but also empirically, that it is technically now feasible to detect the hypothesized POS.

One reviewer raised an important question about the apparent reliability of the present findings given the limited sample sizes, as compared with findings in conventional parapsychological research using undergraduate students. The author pointed out that in current mediumship research, where skilled (and typically professional) mediums are employed, it is observed that highly reliable results are often obtained using limited sample sizes.[1,2] The same robustness of findings may apply to alleged "skilled" spirits.[7]

However, as discussed in this paper, *consistent replication of positive POS effects requires controlling for multiple factors, presumably including the active cooperation of alleged spirits who potentially vary in their (1) motivation and (2) ability to influence the sensors employed.* It is not known at present whether specific hypothesized spirit collaborators have this (1) dependability, and (2) capability.

For example, it is not known whether the precise patterns observed here for alleged spirits Sophia and Susy would be replicated in future research for other alleged spirits such as Stephan and Peter (pseudonyms for two other spirits purportedly involved in previous, and successful, mediumship research).

Responsible caution (and prudence) will be required not only in interpreting future potential positive results, but in interpreting future possible negative (failure to replicate) findings as well.

The history of science and technology reminds us, for example, that prior to the Wright brothers initial 12-second flight of 120 feet at Kitty Hawk, it was not known whether powered aircraft carrying a human was physically possible. Many skeptical persons believed such flight was impossible. The four flights at Kitty Hawk on December 13, 1903, although they were (1) clearly limited in efficacy and reliability (eg, flight attempted on the second day "failed to replicate" because of the lack of sufficient winds), success was subsequently obtained on a third day, and (2) the sample (of flights) was small (n = 4); the Kitty Hawk observations clearly demonstrated that human flight was, in principle, then empirically feasible.

It is conceivable that (1) the total POS trials (n = 8) in the automation experiment for Spirits 1 and 2 as summarized in Figure 3, combined with (2) the total POS trials (n = 6) in the replication automation experiment for Spirits 1 and 2 as summarized in Figure 5, (both of which replicated the initial positive apparent POS trials (n = 8) from the live experiment as summarized in Figure 2), together (automation experiments, n = 14; live experiment, n = 8) point to the possibility that human detection of spirit is, in principle, now empirically feasible.

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