Evidence for relationships between random physical events and world news

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Examination of fluctuations in variance in the outputs of isolated, continuously operating electronic random number generators revealed that the largest daily change in variance in the year 2001 occurred on an unprecedented day in United States history, September 11, 2001. Calculation of intercorrelations among random generator outputs showed that the largest daily average intercorrelation also took place on September 11. Comparison of daily RNG intercorrelations for events on 248 days that made headline news according to a commercial news service vs. similar measures for 117 non-eventful days, over a period of one year, showed a significantly larger mean intercorrelation on days with major news events ($p = 0.018$). More generally, the relationship between an objective measure of the “amount” of daily news vs. the daily RNG intercorrelations was significantly positive ($p = 0.004$). These findings suggest that the appearance of order in random systems located around the world is meaningfully linked to events that attract mass attention.

INTRODUCTION

> As I grew up I became increasingly interested in philosophy, of which [my family] profoundly disapproved. Every time the subject came up they repeated with unfailing regularity, “What is mind? No matter. What is matter? Never mind.” After some fifty or sixty repetitions, this remark ceased to amuse me.
> – **Bertrand Russell**

In a growing number of studies inspired by the questions used to taunt Bertrand Russell, anomalous order has been observed in the outputs of electronic noise-based, truly random number generators (RNG) during highly focused or coherent group events (Bierman, 1996; Blasband, 2000; Nelson, 1995, 1997; Nelson et al, 1996, 1998a, 1998b; Radin et al, 1996a, 1996b; Radin, 1997; Rowe, 1998; Schwartz et al, 1997). The events studied ranged from intense therapy sessions, to captivating theater presentations, religious rituals, popular sports competitions, and worldwide television broadcasts. In 1998, the Internet-based Global Consciousness Project (GCP) was launched to significantly expand this line of research by providing numerous parallel, continuous streams of random bits from well-calibrated, truly random, noise-based RNGs located around the world (Nelson, 2001).

The basic idea explored in these experiments is whether mind and matter are linked in a fundamental, nonlocal manner, such that when minds become ordered, or are entrained by external events to be “on the same wavelength," that matter will reflect this state of coherence. RNGs are used as the "matter" in these experiments because methods for detecting order in sequences of random events are well established, methods of generating and recording truly random bits are well understood, and several hundred independently replicated experiments support the hypothesis that under the right conditions mental intention and random events can become significantly correlated (Radin & Nelson, 1989).

In the case of the GCP, mass mental coherence is inferred to occur during major news events, and it is during these times that negentropic changes are predicted to occur in the RNGs. The hypothesis has typically been tested in the GCP data by examining whether the overall mean or variance of random bit streams shift from chance expectation during events of interest. Another method is to see whether the random bit streams become intercorrelated during events of mass interest.[1] This paper describes both types of analyses applied to a year's worth of GCP data, with special focus on the terrorist events of September 11, 2001.

Intercorrelations: A metaphor

A way of thinking about intercorrelations among RNG outputs is to imagine the GCP network as a set of buoys scattered widely across an ocean. Ordinarily, the buoys are tossed about randomly by local currents and winds, and as a result the average intercorrelations among say, the heights of all buoys, will be close to zero. However, occasionally the buoy heights will be observed to become highly positively correlated as compared to their long-term baseline readings. These readings can occur as a result of an underwater earthquake or a meteorite smashing into the ocean. Such events spawn a tsunami, a colossal singular wave that can influence an ocean in one fell swoop.

As the force of the tsunami spreads, buoys that are normally isolated would all feel the effects of the giant wave at about the same time. If we had been observing the buoys with remote monitors, we would be startled to suddenly see all them move about the same way at the same time. If we knew that a tsunami had been sighted, then the cause of the atypical intercorrelations would be clear.

With this metaphor in mind, I examined all intercorrelations among the GCP RNGs to see how they behaved on a daily basis over the 396 days from December 1, 2000 through December 31, 2001. My expectation was that September 11, 2001 might be the GCP equivalent of a tsunami given

[1] Such an interrelationship was observed in an experiment during the television broadcast of "Superbowl XXX" in January 1996 (Radin & Rebman, 1996). That test involved six RNGs: three based on electronic noise and three based on radioactive decay. A modest positive correlation was observed between the two sources of randomness ($p = 0.05$).

the unprecedented degree of world-wide attention the events of that day precipitated.

VARIANCE ANALYSIS PROCEDURE

Each RNG in the GCP network is connected to the Internet via a PC. The RNG is programmed to generate a sample of 200 random bits per second. The random bits are further processed, typically by comparing each bit to a "target" bit, whereby a match produces the equivalent of a 1 and a mismatch produces the equivalent of a 0. These bits are summed so each RNG produces one random number per second, each around the chance expected mean of 100, plus or minus about 10.[2] The important thing to keep in mind for the purposes of this paper is that the RNGs are located in many locations around the world, and the random numbers they generate are based on indeterminate electronic noise. Under the null hypothesis the RNG outputs should be completely independent of any external events, and of each other.

This first analysis examined time-varying changes in variance across all RNGs for each day in the year 2001. The procedure was as follows:

1) Download the daily datafiles for each day in 2001. GCP data are publicly accessible at the web site http://noosphere.princeton.edu. The datafiles are essentially in the form of a matrix, where the columns identify specific RNGs and the rows are per-second outputs.
2) Calculate the daily empirical mean and standard deviation for each RNG running each day.
3) Exclude all raw RNG values ≤ 50 or ≥ 150; also exclude RNGs with daily empirical means > 103 or < 97 or daily standard deviations > 6 or < 8. These thresholds ensure that the data collected are from properly functioning RNGs. Well over 99% of the RNG data are valid.
4) Use the resulting per RNG mean & standard deviations to calculate one t-score (199df) per RNG, per second.
5) Because t (199df) ≈ z, calculate a t-squared value per RNG per second; assume that this is essentially a chi-squared value.
6) Sum the chi-squares across all reporting RNGs, keeping track of the number of RNGs and samples in the sum.
7) Create a 5-minute consolidation of the per-second data across RNGs, in terms of chi-squares and associated degrees of freedom. This creates 288 chi-squared values per day. This step is conducted primarily to compress what is otherwise a very large daily dataset (e.g. 86,400 seconds per day × 36 RNGs = 3,110,400

[2] It is a bit more complicated than this, no pun intended. See Nelson (2000) for more details.

data elements, vs. 288 5-minute periods per day × 36 RNGs = 10,368 data elements).

8) Use a 6-hour sliding window to smooth the data from step 7.
9) Calculate a z score for each point in Sept 8 as $z=\sqrt{\chi^2 * 2}-\sqrt{df * 2-1}$, where χ^2 is the chi-square value and *df* is the associated degrees of freedom. This can also be done for the data in Step 7 to get a z-score for each 5-minute segment.

VARIANCE ANALYSIS RESULTS

Figure 1 shows z scores for each 5-minute segment for all RNG data generated between June 16 and September 20, 2001. As expected, the graph demonstrates that overall the RNG outputs look like "well-behaved" noise.

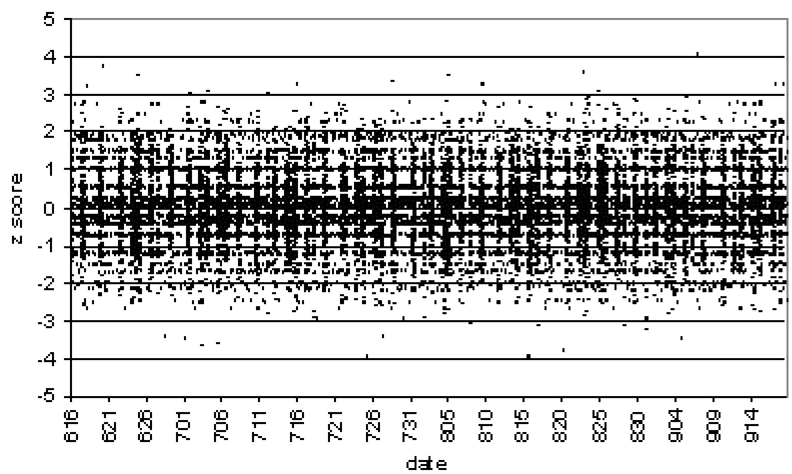

Figure 1. z scores of 5-minute summaries, across all RNGs from June 16 to September 20, 2001.

To better visualize fluctuations in the RNG outputs, and to consolidate the data into time lengths more appropriate to the way that humans respond to big news events (i.e., in terms of hours rather than minutes), the data are smoothed with a 6-hour sliding window. Because each sample in this analysis represents 5 minutes of data, a 6-hour sliding window consists of 72 samples. Each point in the 6-hour window is created by summing the chi-squared values associated with 72 contiguous 5-minute periods, and then calculating the z-score equivalent for the resulting chi-squared and associated degrees of freedom. Then the smoothing window slides one sample to the right, and the process is repeated. The *center* of this smoothing window is constructed to indicate present time. Figure 2 shows the result of smoothing the data in Figure 1.

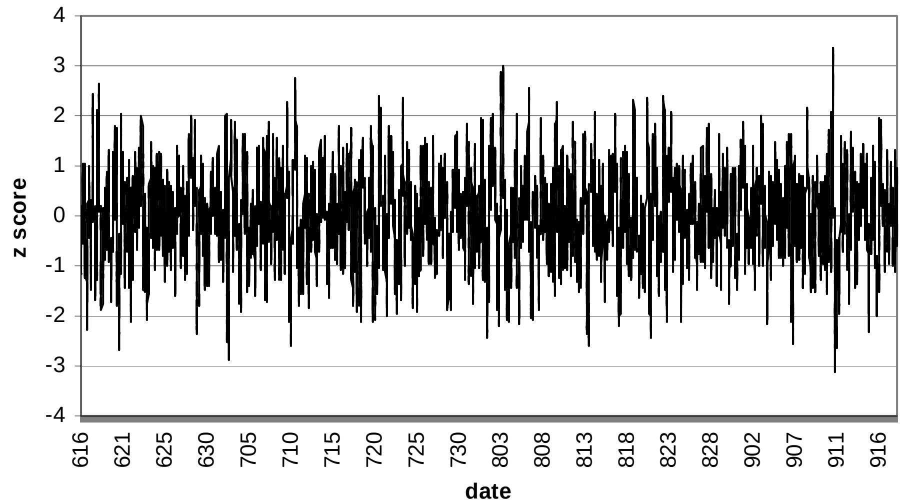

Figure 2. z scores associated with 6-hour sliding window applied to z scores in Figure 1.

From Figure 2 we see on the right end of the graph that something interesting may have occurred on September 11. On this day the z score rose above +3 then rapidly dropped below -3. Figure 3 shows this in more detail over a 24 hour period, starting at 8 PM September 10, 2001, Eastern Daylight Time. The curve peaks about an hour before the first airplane hit World Trade Tower #1 at 8:46 AM EDT, and the curve drops to its lowest point around 2:30 PM, which is when World Trade Tower #2 collapsed.

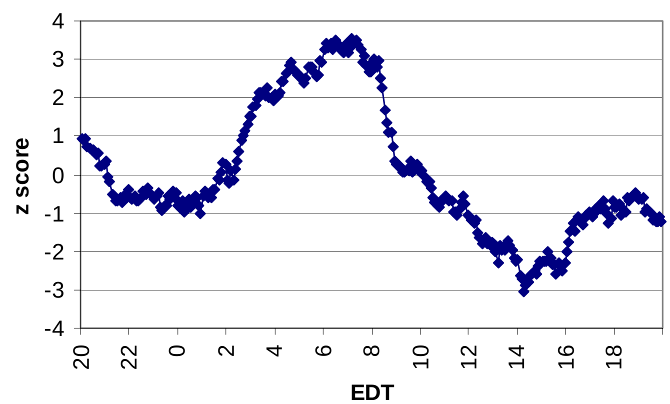

Figure 3. Composite z-score across all 36 RNGs running from 8 PM September 10, 2001 to 8 PM September 11, 2001. The x-axis is in hours, Eastern Daylight Time.

To illustrate the statistical significance of the z scores shown in Figure 3, Figure 4 shows the odds against chance for the 6-hour smoothed data for the entire month of September, 2001. The large peak occurs on September 11. It also turns out that the 6.5 drop in z scores within an 8-hour period, as observed on September 11, is unique across all days in the year 2001.

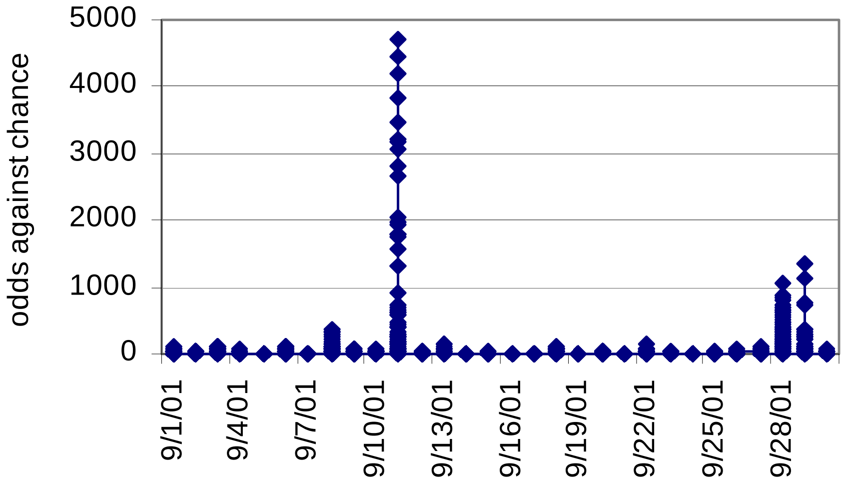

Figure 4. One-tailed odds against chance for 6-hour smoothed variance data for the month of September, 2001.

At this point it is important to acknowledge that the above results, while interesting, were determined post-hoc. That is, I had an expectation about how the GCP data might behave on September 11, but I did not specify in advance the exact procedures used to find these effects. Thus, while the analyses are straightforward, they cannot be used in formal hypothesis testing. However, after settling upon the basic parameters used in the above analyses (the use of chi-squared values per RNG to measure variance and the application of a 6-hour sliding window to smooth the data), I decided to use the same parameters in the next analysis.[3]

INTERCORRELATION ANALYSIS METHOD

The following procedures were employed:

1. For each RNG, determine one *z*-score per second as $z = (x - 100)/\sqrt{50}$, where *x* is the raw RNG count.

[3] I am indebted to Roger Nelson, Douglas Mast (2000), Richard Shoup, and James Spottiswoode for inspiring this analysis through their critical comments and observations about the GCP data and hypotheses.

2. Create a z-squared value per RNG per second.
3. For each RNG, sum 300 contiguous z-squares to create a chi-square value and associated degrees of freedom for non-overlapping 5 minute periods per day.
4. Smooth these 5-minute segments, per RNG, using a 6-hour sliding window. Smoothing reduces the 288 datapoints per day to 288 – 72 = 216 datapoints. Because some RNGs are connected to PCs that are used for other tasks, some data may occasionally be skipped. At least 100 smoothed datapoints are required per RNG to be included in the succeeding steps.
5. Calculate a Pearson correlation between all possible pairs of smoothed curves, among all RNGs, per day. E.g., among 36 RNGs there are 630 possible pairs.
6. Transform each correlation with a Fisher z transform; use these values to form μ, the daily mean Fisher z, and σ, the standard deviation of the Fisher z's.
7. Test μ against the null hypothesis of 0 as $t = \mu / \left(\sigma / \sqrt{N}\right)$, where N is the number of correlations calculated per day.

INTERCORRELATION ANALYSIS RESULTS

Figure 5 shows the daily mean Fisher z scores for all days between December 1, 2000 and December 31, 2001. Figure 6 shows the odds against chance associated with t-tests of the daily values, as described in Step 7. The peak daily value occurred on September 11, 2001.

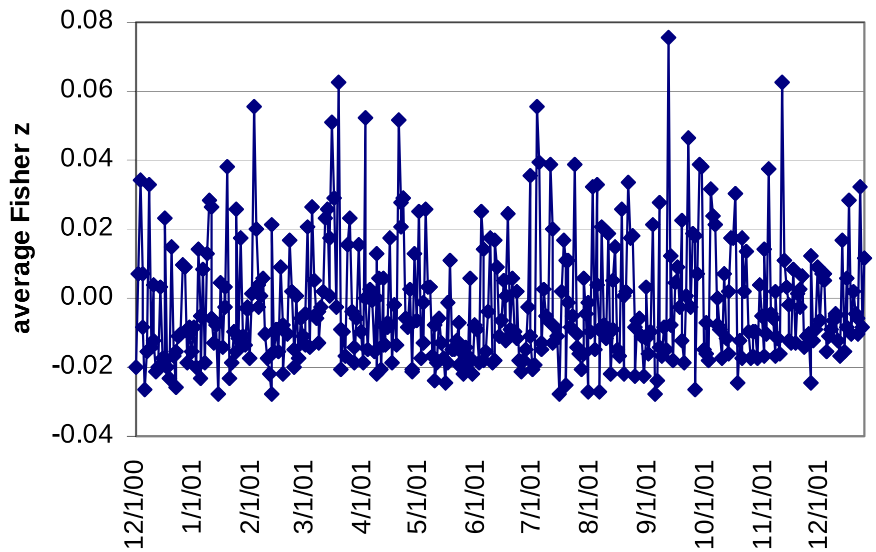

Figure 5. Daily average Fisher z of all RNG intercorrelations. The peak value is September 11, 2001.

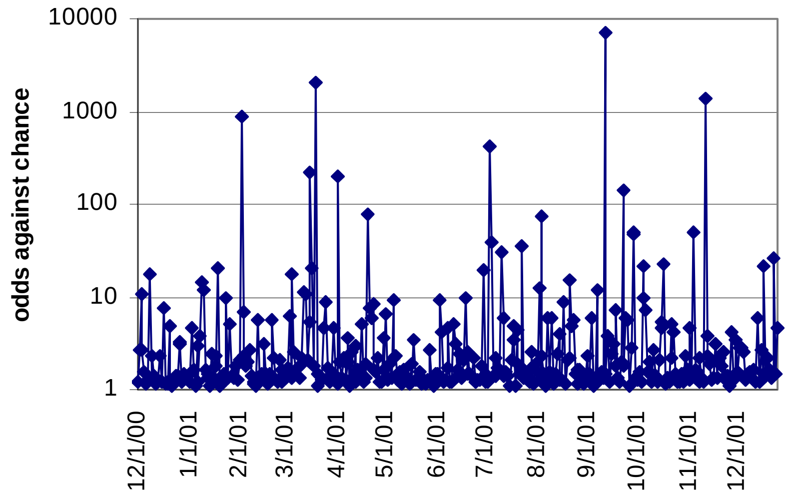

Figure 6. One-tailed odds against chance for values observed in Figure 5.

One question that may arise when examining these results is whether the especially large intercorrelation on September 11 may have been due to unusual environmental artifacts, such as increased cell-phone usage around New York City and Washington, D.C., which somehow affected RNG outputs. If this were the case, then we might expect to see some very high intercorrelations on that day, associated with a few RNGs located around these cities. As a result, the standard deviation of the RNG intercorrelations on September 11 should be inflated. Figure 7 shows that the standard deviation was unremarkable compared to all other days, thus from this perspective there is no evidence that the results were due to environmental artifacts.

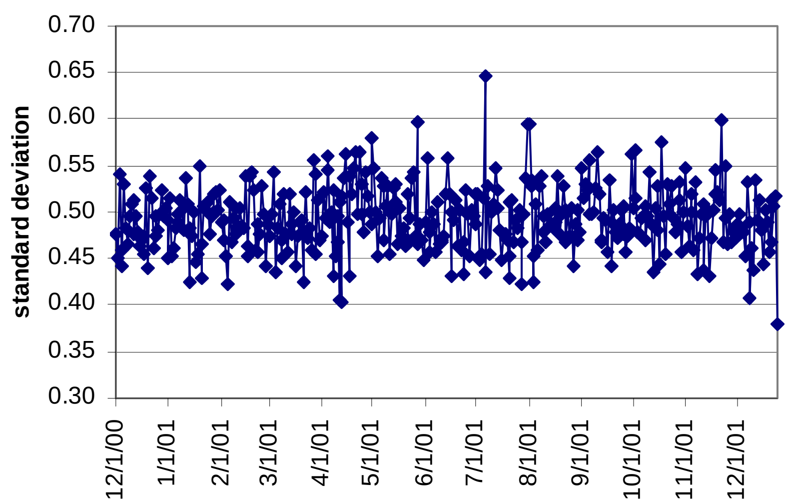

Figure 7. Standard deviations for daily average Fisher z intercorrelations.

Figure 8 shows additional evidence for a common rise in intercorrelations on September 11. The Figure shows the probability distribution function for all RNG intercorrelations on all days as compared to the intercorrelations observed on September 11, 2001. A t-test of the mean difference between these two distributions results in t = 3.67, p = 0.00012 (grand mean = -0.001, standard error = 0.001; September 11 mean = 0.075, standard error = 0.021).

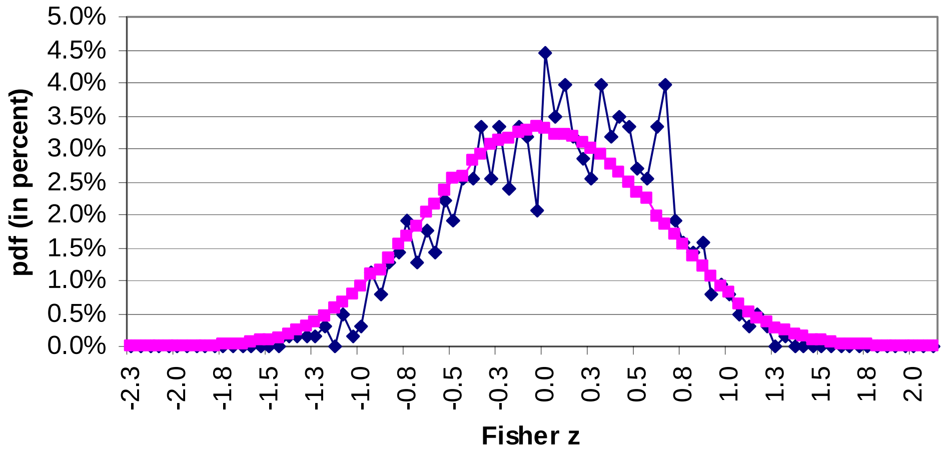

Figure 8. Probability distribution function for all Fisher z intercorrelations from December 2000 through December 2001, and similar intercorrelations observed on September 11, 2001.

One might now ask whether these results are due to a fortuitous selection of a 6-hour smoothing window.[4] Figure 9 shows the September 11 results as a factor of varying the window smoothing from 5 minutes to 12 hours in length, in terms of t-scores of the difference between the Fisher z means for September 11 vs. the grand mean for all other days. The value z = 3.7, associated with the difference between the two distributions shown in Figure 8, appears on this graph at the window size of 6 hours. The optimal window length turns out to be about 8 hours, but all window lengths greater than 10 minutes result in significant differences. This suggests that the large intercorrelation observed on September 11, 2001 is not due to a fortuitous selection of window length.

[4] But recall that this window size was selected in advance, based on the initial variance analysis.

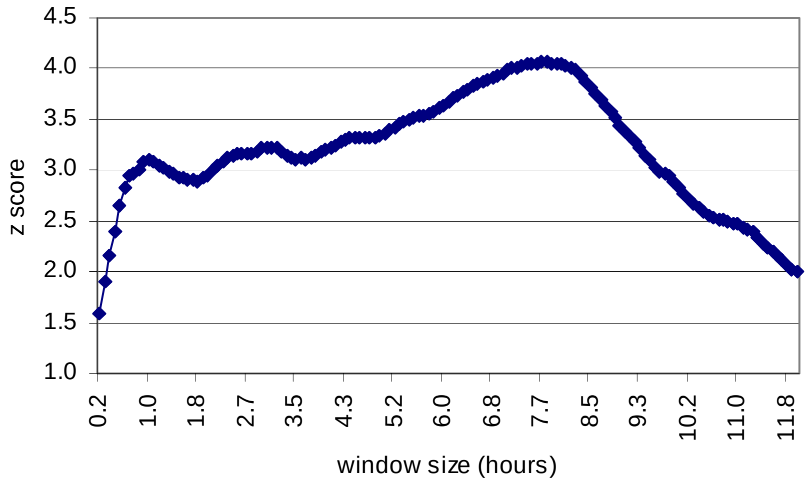

Figure 9. Effect of window size length on differences between the distribution of all daily intercorrelation values vs. the distribution for September 11, in terms of a one-tailed z-score.

NEWS ANALYSIS METHOD

Given the significant variance and intercorrelation results associated with September 11, 2001, the next logical question is whether the GCP hypothesis generalizes to less dramatic days. To answer this question, I examined how the RNGs behaved on 25 single-day events listed in the GCP event registry[5] (multi-day events were excluded from this analysis), from December 1, 2000 through December 31, 2001. The hypothesis predicts that the daily intercorrelations for these days, as compared to all other days, would be significantly larger. A t-test supports this prediction, $p = 0.016$ (one-tail), and this difference remains significant after excluding September 11, 2001, $p = 0.024$.

While this points in the right direction, many of the events entered into the GCP registry are there because someone guessed that a given event might be associated with a change in randomness in the RNGs. While such guesses were valid because they were made in advance of examining the GCP data, one could argue that this opportunistic method of registering events overlooked many other events that also attracted mass attention, and more importantly it provokes the criticism that the method of selecting newsworthy events was too subjective.

To create an objective measure of "newsworthy," I took all news events listed in the "Year in Review" from the *InfoPlease* web site, www.infoplease.com, for the one-year period from December 2000

[5] See http://noosphere.princeton.edu

through November 2001.[6] This site lists top headline news in three categories: world news, US national news, and a combined business, science and society category. *InfoPlease* is affiliated with ESPN, Time, and the Reuters news service, thus the information on the site is assumed to be reasonably accurate. Of greater importance, the news items listed in the "Year in Review" pages were selected by the *InfoPlease* editors completely independently of the GCP. This web site was selected over other potential online news sources, such as CNN, because it provides a comprehensive day-by-day list of news *events*, whereas most other sites list important news *stories*, such as "the economy," without providing day-to-day details.

For the one-year test period, a total of 393 news events were listed; these took place on 248 days. The GCP hypothesis predicts that these 248 days would have a larger mean intercorrelation than the remaining 117 non-newsworthy days. A t-test confirmed the prediction, $p = 0.018$.

However, a more interesting test is whether the "amount" of daily news would be positively correlated with the daily intercorrelation values. To test this idea it was necessary to form a "news metric." To do this, I observed that in the *InfoPlease* list of events the maximum number of news events occurring on a single day was 5. Each of those events was accompanied by a text description, and the number of characters in those descriptions, summed over all events per day, ranged from 72 to 1,193. I used these text count values as indicators of the "amount" of news per day in the sense that many news events on the same day would lead to larger values. I also used the number of events per day as a simpler news metric, but because the correlation between the total number of characters per day and the total number of events per day was $r = 0.90$, I used the text count value as the primary metric, as that provided a more continuous variable to work with.

NEWS ANALYSIS RESULT

Figure 10 shows the correlation between the daily news metric and the daily mean intercorrelations; this correlation is small, but as predicted significantly positive, $r = 0.15$, t (363 df) = 2.94, $p = 0.002$, one-tailed. If September 11 is removed from consideration, $r = 0.14$, t (362 df) = 2.71, $p = .004$, one-tailed. And if all of the non-news days are removed (these are seen in Figure 10 as a column of points at 0 on the x-axis), the correlation remains significant, $r = 0.12$, $t(246\text{ df}) = 1.87$, $p = .03$, one-tailed. The simpler correlation, between just the number of news events per day vs.

[6] A list of December 2001 events were not available on this web site as of the date of the preparation of this analysis.

the daily intercorrelation, is similarly significant, r = 0.13, t(363 df) = 2.50, p = 0.020, one-tailed.

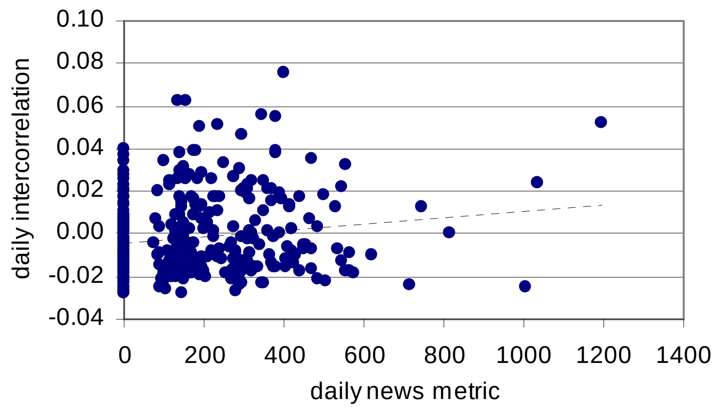

Figure 10. Correlation between daily news metric and daily RNG intercorrelation values, p = 0.002, one-tailed. September 11, 2001 is associated with a news metric value of 398 in this graph.

DISCUSSION

As mentioned above, one mundane explanation for the present results is that moments of mass human attention may be associated with unusual surges of electrical power and use of telecommunications equipment, and this in turn might create unusual environmental conditions that influence the RNGs. While an "environmental artifact" explanation is conceivable, it seems unlikely because (a) in the case of September 11, the cross-RNG variance peaked an hour before the terrorist events began to unfold, (b) the observed intercorrelations appear to reflect common changes among RNGs from many locations around the world, (c) the RNGs are powered by voltage-regulated computer power supplies and many PCs are further isolated from line power through surge suppressors and battery-powered, uninterruptible power supplies, and (d) the RNGs are designed to exclude first-order biases through the use of XOR logic.

While these items argue against an artifact explanation, we can explicitly test the effects of electromagnetic interference on the RNGs by examining RNG outputs according to local clock time. That is, if the electromagnetic environment influenced the RNG circuits, then we would expect to see differences in RNG behavior between local day and night. During the day, human use of electronic devices peaks, as does wide-spectrum electromagnetic noise, electric field strength, non-ionizing radiation, etc., due to solar radiation. During nighttime, all of these effects decline.

Figure 11 shows the z-score equivalent for variance across all RNGs, consolidated in 0.1 hour bins according to the local time of each RNG, over the entire month of September 2001. This graph summarizes 89.6 million 200-bit samples from all RNGs reporting in September 2001, for a total of 17.9 billion random bits. No day-night difference trend is observed. Between 8 PM – 8 AM (night) and 8 AM – 8 PM (day), z(difference) = 0.53, p = 0.30, one-tailed. This provides no support for an electromagnetic artifact hypothesis.

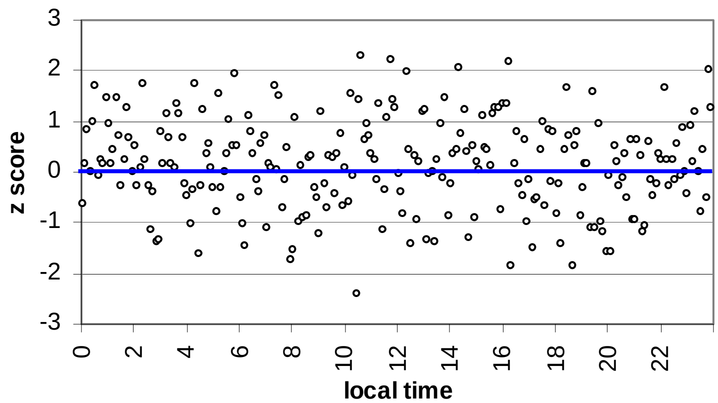

Figure 11. RNG variance consolidated according to local time per RNG for the month of September 11, 2001.

CONCLUSION

For the first half of the 20th century, quantum theorists began to seriously speculate about possible relationships between mind and matter. In the latter half of the 20th century, investigators developed increasingly rigorous methods of experimentally testing whether mind and matter interact. At the beginning of the 21st century, it appears that the answer to the question that teased Bertrand Russell is yes, mind does matter. The present studies now seem to suggest that fluctuations in the "attention" of mass mind also affects matter on a grand scale. As often occurs in science, the more we study the subtleties of Nature, the more beautifully complicated it all becomes.

REFERENCES

Bierman, D. J. (1996). Exploring correlations between local emotional and global emotional events and the behavior of a random number generator. *Journal of Scientific Exploration*, **10**, 363-374.

Blasband, R. A. (2000). The ordering of random events by emotional expression. *Journal of Scientific Exploration*, 14, 195-216.

Mast, D. (2001). Inter-egg correlation of chi-squares for one-minute blocks. Retrieved April 25, 2001 from the World Wide Web: http://noosphere.princeton.edu/corr.html.

Nelson, R. D. (1997). Multiple field REG/RNG recordings during a global event. Electronic Journal for Anomalous Phenomena, eJAP. Retrieved June 19, 2001 from the World Wide Web: http://www.psy.uva.nl/eJAP.

Nelson, R. D. (1995, March). Fieldreg: Measuring effects of group consciousness. Princeton Engineering Anomalies Research, *Technical Note PEAR 95003*; School of Engineering/Applied Science, Princeton University, Princeton, NJ 08544.

Nelson, R. D. (2001). Correlation of global events with REG data: An Internet-based, nonlocal anomalies experiment. *Journal of Parapsychology*, 65, 247-271

Nelson, R. D., Bradish, G. J., Dobyns, Y. H., Dunne, B. J. & Jahn, R. G. (1996). FieldREG anomalies in group situations. *Journal of Scientific Exploration*, **10**, 111-142.

Nelson, R. D., Jahn, R. G., Dunne, B. J., Dobyns, Y. H., & Bradish, G. J. (1998a). FieldREG II: Consciousness field effects: Replications and explorations. *Journal of Scientific Exploration*, **12**, 425–454.

Nelson, R., Boesch, H., Boller, E., Dobyns, Y., Houtkooper, J., Lettieri, A., Radin, D., Russek, L., Schwartz, G., & Wesch, J. (1998b). Global resonance of consciousness: Princess Diana and Mother Teresa. Electronic Journal for Anomalous Phenomena, eJAP. Retrieved June 19, 2001 from the World Wide Web: http://www.psy.uva.nl/eJAP.

Radin, D. I. & Rebman, J. M. (1996a). Deep interconnectedness and group consciousness: Exploring the limits of mind-matter interaction. Proceedings of the 39th Annual Conference of the Parapsychological Association, San Diego, August 1996.

Radin, D. I., Rebman, J. M. & Cross, M. P. (1996b). Anomalous organization of random events by group consciousness: Two exploratory experiments. *Journal of Scientific Exploration*, **10**, 143-168.

Radin, D. I. & Nelson, R. D. (1989). Evidence for consciousness-related anomalies in random physical systems. *Foundations of Physics*, **19**, 1499-1514.

Rowe, W. D. (1998). Physical measurements of episodes of focused group energy. *Journal of Scientific Exploration*, **12**, 569-583.

Schwartz, G. E. R., Russek, L. G. S., Zhen-Su S., Song, L. Z. Y. X., & Xin, Y. (1997). Anomalous organization of random events during an international quigong meeting: Evidence for group consciousness or accumulated qi fields? *Subtle Energies & Energy Medicine*, **8**, 55-65.