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RESEARCH

Field RNG Data Analysis, Based on Viewing the Japanese Movie *Departures (Okuribito)*

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Abstract—This study examined the possibility that a random number generator (RNG) could detect field consciousness while people watched a film in a movie theater. We conducted 10 measurements at movie theaters showing *Departures (Okuribito)*. One hardware and two software random number generators simultaneously generated random numbers at 512 bits per second. The results showed significant *Z*-scores derived from *chi*-squares during the film viewing. But MANOVA using two variables of *Z*-scores (Stouffer's *Z* and the *Z* from *chi*-squares) showed no significant differences between these conditions because the differences of averages were small in the Stouffer's *Z*-scores. MANOVA using RNG and pseudo random sequences revealed time-related period effects during film viewing. The biases demonstrated by the three random variables were similar to each other. The similarities between hardware- and software-generated random number sequences were significant when Stouffer's *Z*-scores were calculated on the basis of 600-second time intervals by averaging all 10 measurements. Audience size has positive effects on the outputs of all the RNGs. Finally, several hypotheses related to RNG biases and future tasks are discussed.

Keywords: parapsychology—RPG102—pseudo random numbers—emotion—consciousness—mind–matter interaction—PK

Introduction

Random number generator (RNG) devices produce bits (1s or 0s) during real-time processing using avalanche noise or thermal noise as the source of randomness. The products of RNGs have been used primarily for computer security, calculations in a simulation, and so on. In a different context, however, the results of RNGs have departed from expectations of randomness, as reflected in several statistics (Nelson, Radin, Shoup, & Bancel, 2002), during certain meetings (Nelson, Bradish, Dobyns, Dunne, & Jahn, 1996), broadcast events

(Radin, Rebman, & Cross, 1996), and sports events (Bierman, 1996).

In parapsychology, RNGs have been widely used to investigate the interaction between field consciousness and physical systems (Bierman, 1996, Ibison, 1998, Nelson, 2001, Nelson, 2002, Nelson, Radin, Shoup, & Bancel, 2002, Radin, 2002). These studies are referred to as "field REG/RNG" (Nelson, Bradish, Dobyns, Dunne, & Jahn, 1996, Nelson, Jahn, Dunne, Dobyns & Bradish, 1998) or field consciousness studies (Radin, 1997, Radin, 2002). In Japan, several field RNG studies have conducted measurements during the New Year celebration (Yoichi, Kokubo, & Yamamoto, 2002, Yoichi, Kokubo, & Yamamoto, 2004), at the Nebuta Festival (Hirukawa & Ishikawa, 2004), and at a baseball stadium (Ishikawa, 2004). Significant deviations were found when many people shared an emotion, a focus of attention, or a specific state of consciousness.

Movie Theater as a Field

One challenge in conducting field RNG research involves obtaining reproducible results given that different studies have focused on different events occurring at different times. Indeed, it is necessary to separate the effects of the events from the effects of the particular time at which these events occurred. However, the replication of events becomes more difficult when the events are larger, because large events such as the Olympic Games or World Cup soccer matches do not occur every year.

To mitigate the impact of this problem, this study used movie theaters as the experimental venue. To date, only one study, the CinEgg project (Varvoglis, 2006), has involved the generation of random numbers at theaters, an approach to field RNG studies that has been adopted quite recently.

In such contexts, people have many opportunities to experience and share emotions while viewing a movie. Additionally, repeated measures can be designed because multiple theaters can show the same film, which serves as a psychological stimulus, many times. It could be hypothesized that repeated measurements would show that the emotional changes experienced by different audiences would be similar. The approach adopted in the current study differs from that used in previous PK experiments in that no participant was asked to engage in a goal-oriented task. This study also differed from most field RNG studies in that the RNG was used repeatedly to measure the same event. We focused on repetitive events because the analysis could be stronger than those using non-repetitive events.

Furthermore, the maximum audience at each theater was set at 100 individuals. Although large audiences have tended to bias RNG output (Radin, 2006), the effect of smaller audiences has remained unclear. However, several studies investigating whether emotional expression could affect RNG output

have reported a bias in RNG behavior even in the context of small numbers of attendees (Blasband, 2000, Lumsden-Cook, 2005a, 2005b).

Film as an Emotional Stimulus

This study assumed that RNGs could detect the emotions experienced by humans while watching a movie at a theater. Additionally, we expected that the emotions sensed during this process would probably relate to the story depicted in the movie.

Moreover, we hypothesized that a field experiment involving repeated showings of the same movie might find a consistent bias in the RNG data if RNG deviations were somewhat reproducible. Within-movie analysis was employed to examine RNG deviations between sections of the movie during a single viewing because the storyline of the film might produce variations in these data.

We also compared the RNG data generated during the period in which participants were viewing the movie with those generated while the movie was not being shown. It would be noteworthy if the RNG data generated during viewing differed from that generated in the absence of the movie. Varvoglis (2006) examined RNG data by using two conditions, "off-show" and "off-site," as controls. The former involved an empty theater, which would have been ideal but difficult to execute. For this reason, "off-site" was the only control condition in this study.

The current study also considered the effect of audience size. The audience size for periods of non-viewing was assumed to be zero because the RNG was located outside of the theater. Thus, we regarded audience as a variable that was present only during those portions of the experiment in which participants were viewing the movie.

Pseudo Random Numbers Generated by Software

The current study used pseudo random numbers produced by software as well as those produced by the physical RNG device. Most field RNG studies have not used pseudo random numbers generated by software in their analyses.

However, it is still possible that the pseudo random numbers generated by software would be able to detect field consciousness. The results of several PK experiments (Schmidt, 1981, 1993, Schmidt, Morris, & Rudolph, 1986) showed that PK manifested in prerecorded random numbers in terms of a quasi random algorithm, even when seed numbers had been observed before the PK session. Thorough pre-inspection by an observer would otherwise inhibit the PK effect (Schmidt, 1985). At least a few studies have found positive (micro-) PK influences in real-time using algorithm-based pseudo random number

sequences (e.g., Lowry, 1981, Radin, 1982). In contrast, experiments by the Princeton Engineering Anomalies Research (PEAR) group using pseudo random sources have generally not found evidence for a PK influence on the output of such sources (Nelson, Jahn, Dobyns, & Dunne, 2000). Thus, it is necessary to examine this issue further.

If pseudo random numbers could reflect field consciousness, we would expect that the output produced by software would correlate with that produced by the physical RNG using hardware. We would predict that both instruments would show some biased behavior during only the sections involving viewing of the movie.

Experimental Controls

One advantage associated with using theaters as the field is that the experimenter can control certain variables that could otherwise contribute to measurement errors, including location, the repeated measures themselves, confederates, and so on. This study regarded these factors as error variables.

However, neither the conversations nor the expressions of audience members were measured; the only measurements obtained by confederates were those reflected in the random numbers during the viewing of the film. It might be expected that a film that strongly appealed to the mind states of many people would cause some significant deviations in RNG data if the RNG could detect human emotions (sadness, happiness, etc.) or consciousness (shared attention, mental coherence, etc.). If the RNG measurements were reproducible, data adjusted according to the time at which the film started might show consistent results in terms of *Z*-scores or *chi*-squared values.

Methods

Movie

The experiments were conducted primarily on weekends during the opening month of the movie *Departures* (*Okuribito* in Japanese). The movie, directed by Yojiro Takita, won the award for the best foreign language film at the 81st Academy Awards. The story was as follows: Daigo Kobayashi, who plays the cello in an orchestra, has just been fired. He decides to move back to his hometown with his wife, where he gets a job as an undertaker and sees himself as a sort of gatekeeper between life and death. At times humorous and at times emotional, the film paradoxically approaches the pleasures and burdens of life through death. In general, this plot attracted audiences that included many elderly people.

Dates, Theaters, and Confederates

We conducted a total of 10 RNG measurements, as shown in Table 1. The study included four movie theaters and seven confederates (the first author and six assistants, who were acquaintances of the first author). We planned a total of 10 measurements to accommodate the assistants' schedules.

During the final week, we performed measurements on both Wednesday and Friday, which represented a change in the schedule, because the theater ended the run of the film earlier than we had expected. Only one measurement per day was conducted because the pre-view and post-view control conditions were time-consuming.

Table 1
Location, Confederates, and Recorded Times in the Measurements

		FIRST			SECOND							
Theater	City	Date	Ps	N**	Date	Ps	N**	Pre-View Start	View Start	Movie Start	Post-View Start	Post-View End
Warner Mycal	Musashi-Murayama	3/21	C1*	50	3/22	C2*	60	10:48:34	13:18:34	13:43:34	15:48:34	18:18:33
Movix	Rifu Miyagi	3/28	C3	50	3/29	C1*	70	8:01:12	10:31:12	10:46:12	13:01:12	15:31:11
Cine Libre	Ikebukuro	4/4	C4	19	4/5	C2*	20	10:32:33	13:02:33	13:17:33	15:32:33	18:02:32
Cine Libre	Ikebukuro	4/11	C5	30	4/12	C1*	28	8:28:14	10:58:14	11:13:14	13:28:14	15:58:13
Cinema Sunshine	Ikebukuro	4/15	C6	65	4/17	C7	36	13:16:41	15:46:14	16:01:14	18:16:41	20:46:40

* C1, Confederate 1, the first author. C2, Confederate 2, the second author. **, the number of people in the audience.

Materials

We used a Sony VAIO Type-G (Intel Core Solo CPU U1500, 1.33 GHz) notebook PC for all measurements and attached a large battery to enable 8 hours of continuous operation.

The RPG102 hardware, produced by FDK Corporation, was used as the physical random number generator (Figure 1). It was attached to the notebook PC via a USB port, using high-speed random number generator IC RPG100 [http://www.fdk.co.jp/cyber-j/pi_ic_rpg100.htm (Japanese)].

Figure 1. FDK RPG102.

This device generates high-quality random numbers that meet the standards contained in the

federal information processing publication (FIPS PUB 140-2). We developed a GUI application with Visual C# (.Net Framework 3.5) in Microsoft Visual Studio 2008 to manage the RPG102 (Figure 2). Two types of random numbers were generated by the Visual Studio software, which can provide random numbers in two ways: "RngCrypto Service Provider" (RngCrypto) and "Random." No seed controls were provided by the application for the initiation of the random numbers.[1] Because these pseudo random number classes were not initialized by seeds, they did not represent deterministic sequences.

The application generated three kinds of random numbers, from the RPG102 (hardware), RngCrypto (software), and Random (software), at 512 bits per second, recording them into a csv text file at 2-minute intervals.

Although the Intel Centrino 2 CPU produced by "vPro technology" has a

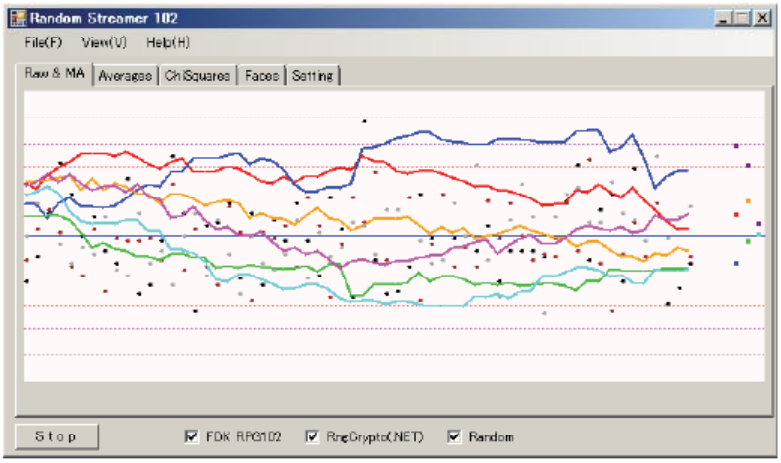

Figure 2. Appearance of the GUI application "Random Streamer 102."

physical random number generator (Levy, Kumar, & Goel, 2008), the processor in our notebook, Intel Centrino, had no mechanism for generating physical random numbers. It is difficult to generate physical random numbers with the software currently available, but future technology will make it possible to use RNG bits without attaching extra hardware.

Procedure

The application was started about 3 hours before arrival at the movie theater. The notebook was kept by one of the confederates in a bag during viewing and returned to us after the movie concluded. Before the movie started, this confederate counted the number of people in the theater (Table 1). The

numbers are approximate because it was difficult to accurately count the people entering after the theater became dark.

It was necessary to adjust the starting times of the movie between repetitions for purposes of analysis. The public time schedules of the theaters were inappropriate because the length of the advertising preceding the movie differed among theaters. The designated confederate recorded the time at which the main scene, involving a white blizzard, appeared on the screen.

The total length of *Departures* is 129 minutes. The confederates entered the theater at least 15 minutes before the start of the movie. We added 15 minutes to the beginning and 6 minutes to the end of the viewing time to make a total of 150 minutes in the "view" section. For purposes of analysis, we divided the total 450 minutes into three 150-minute sections. Moreover, the view section was then divided into 30-minute subsections (referred to as "periods" hereafter). This period factor is to test differences of average *Z*-scores from random sequences among subsections. If the sequences deviated coincident with the film story, *Z*-scores in each subsection could be different from those in the other ones.

Both pre-view and post-view sections included the time involved in traveling to and from the theater by train or car, during which time we performed no experimental procedures, nor did we control any experimental variables.

Missing Data

One measurement consisted of 450 minutes, comprising three sections (pre-view, view, and post-view). Although the total of 10 measurements would be expected to last 270,000 seconds (4,500 minutes), 5,121 seconds (about 2% of the total time) were missing from the data (264,879 seconds; Table 2).

Because the notebook was started two hours before the movie on March 21, the data on previews lasted less than 20 minutes. On March 22, some RNG bits were dropped. On April 5, an unexpected computer shutdown, of which we were unaware for an hour, occurred just before the movie ended, possibly as a result of the high temperature of the notebook, which was sealed tightly in a bag at the time. We restarted the PC and the application immediately after we became aware of the shutdown, and processing improved after we changed the notebook battery operating setting to heat-release priority mode. Most of the missing data were attributable to this shutdown.

Variables

Sampling from the RNG, a *Z*-score based on chance was calculated as follows:

TABLE 2
Number of Samples (Seconds) in Each Time Section

	Pre-View					View					Post-View					
2009	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
3/21	728	1798	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	25926
3/22	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	26973
3/28	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	27000
3/29	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	27000
4/4	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	27000
4/5	1800	1800	1800	1800	1800	1800	1800	1800	1800	1677	0	0	1516	1800	1800	22993
4/11	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	27000
4/12	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1795	26995
4/15	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1792	1800	26992
4/17	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	27000
	16928	17998	18000	18000	18000	18000	18000	18000	18000	17877	16200	16200	17689	17992	17995	264879

All sections didn't fill 1800 seconds (30 minutes) because of the "drop out" in obtaining bits, or some irregular factor such as unexpected shutdown of the notebook computer. Number "0" means range of the time 150 minutes before the movie starts to the time before 120 minutes ("1" means range of the time 120 minutes before the movie starts to the time before 90 minutes).

$$Z_{raw} = (x - np) / \sqrt{np(1-p)},$$

where p was 0.5, the probability of obtaining 1 second; and n was 512, the total number of bits per second generated by the RNG; and x was the sum of 512 bits in a second. Because x is approximately normal distributed in a binomial distribution (the expected mean of np was 256 bits in this study), standardized Z-scores are available from x.

Dependent variables were the sums of the Z-scores for 60 seconds:

$$\text{Stouffer's } Z = \frac{1}{\sqrt{60}} \sum_{i=1}^{60} Z_{raw \cdot i}^2,$$

which were based on a normal distribution.

Chi-squared values (Z_{raw}^2) could not be directly used for the ANOVA because they were distributed in terms of a *chi*-square of one degree of freedom (mean = 1, variance = 2). For purposes of normalization, Z-scores derived from *chi*-squared values (Z-*chi*) were calculated as follows:

$$Z_{chi} = \frac{1}{\sqrt{2*60}} \sum_{i=1}^{60} (Z_{raw \cdot i}^2 - 1).$$

This can be regarded as an approximately normal distribution, even though it reflected the *chi*-squared distribution ($df = 60$).

Several *Z*-scores were less than 60 seconds, due to the missing data mentioned above. In these cases, we calculated *Z*-scores according to the number of Z_{raw} instead of 60. After data processing, total samples equaled 4500 minutes (= 27,000/60 × 10 measurements), which decreased to 4,417 minutes due to the aforementioned "dropouts". Two other software variables were calculated in the same way.

MANOVA Model

For the purpose of the experiment, we tested film view effects, and period effects within view sections. This study regarded the following factors as residual variables: four movie theaters, two repetitions under the same conditions, and the confederates.

MANOVA models were designed for secondary or exploratory analyses. These models showed similarities in changes over time (Figure 3). According to the analysis using sample average scores from the 10-minute intervals, the pseudo random sequences generated by the software have similar variances to those for the random sequences generated by the hardware.

With the caveat that the analyses are post hoc explorations, these results suggest all the bit sequences might have been affected equally by a latent background factor: field consciousness evoked by the story depicted in the film. These similarities of sample averages suggest, tentatively, that pseudo random sequences could detect field consciousness. If so, the pseudo random sequences were able to respond to the emotional changes, attention, or common mental state of audience members. Thus, the current results appear to be consistent with those of the PK experiment using pseudo random sequences (Lowry, 1981, Radin, 1982) or prerecorded random number sequences (Schmidt, 1981). The similarities of sample averages revealed by our data seem to offer a preliminary indication that this phenomenon extends to field RNG effects as well.

Results

Stouffer's *Z*- and the *Z-chi* scores were calculated based on each condition (pre-view, view, and post-view) and periods within view section, respectively (Table 3). The *Z-chi* scores of RPG102 (physical random number sequences) showed noticeable values under the viewing condition ($Z = 2.01$, $p = 0.04$, two-tailed) compared with theoretical expectation.

View versus Non-View Conditions

To test the view factor, pre-view and post-view sections were integrated

TABLE 3
3 *Z*-Scores of Whole and Each Condition

		Pre-View	View					Post-View	Whole
Stouffer's *Z*	FDK RPG102	1.25			−0.65			0.79	0.80
			−1.47	2.10	−0.17	−0.72	−1.19		
	RngCrypto	−0.42			−0.83			−0.90	−1.24
			−0.11	1.57	−0.90	−1.75	−0.68		
	Random	1.49			1.65			−0.63	1.46
			1.71	2.05	−0.86	−0.23	1.00		
Z-chi	FDK RPG102	0.89			2.01			−0.02	1.67
			1.71	1.51	−0.81	1.45	0.64		
	RngCrypto	−0.53			0.67			−0.78	−0.36
			0.41	−0.82	0.42	1.00	0.48		
	Random	0.47			−1.89			−0.74	−0.26
			0.95	0.04	−0.67	−0.56	−0.20		
	N (minute)	1483			1498			1436	4417
			300	300	300	300	298		

into a non-view section. MANOVA showed no differences between view and non-view sections, in the case of using only Z-scores of RPG102 ($F(2, 4415) = 1.39$, $p = 0.248$), nor sum of all the RNGs ($F(2, 4415) = 0.65$, $p = 0.520$).

Period Effects

MANOVA with RPG102 showed no effect for period ($F(8, 2986) = 1.54$, $p = 0.138$). However, MANOVA using the sum of the three revealed significance ($F(8, 2986) = 2.23$, $p = 0.023 < 0.025 = 0.05/2$; p-value was corrected for 2 times multiple tests).

Correlation between Sample Averages

Figure 3 demonstrates the changes over time of the three kinds of random number sequences. It shows some peaks and troughs, and the variations in the two software sequences seem similar to those of the RPG102, especially in the Stouffer's *Z*-scores.

A post hoc analysis was conducted, to evaluate correlation statistics between sample averages of *Z*-scores of these random variables (RPG102, RngCrypto, and Random). We changed the time unit in exploratory analysis from 30 minutes to 5 minutes and 10 minutes, and calculated *Z*-scores and *chi*-squared scores, respectively (Tables 4 and 5). We focused on view conditions which

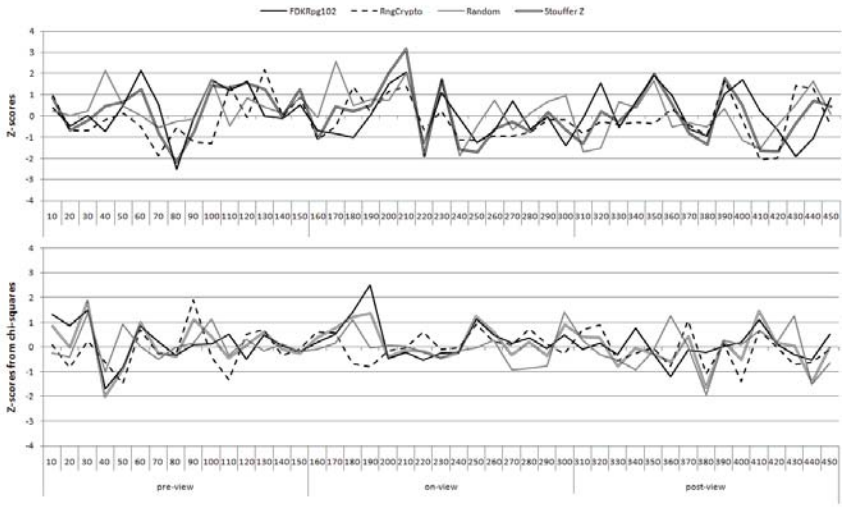

Figure 3. Variation in all *Z*-scores in elapsed time.

are the highlighted matrices in the tables. Table 4 shows that the correlations are positive during the view conditions. Table 6 examined 10-minute averages during the view condition in Table 4. Total *Z*-scores of correlation from Stouffer's *Z* showed significance ($Z = 3.051$, $p = 0.002 < 0.008 = 0.05/6$; 6 = 3

TABLE 4
Correlation Matrices of Stouffer's *Z*-Scores (5, 10, and 30 Minutes)

FDK RPG102	1.000			1.000			1.000		
RngCrypto	−0.020	1.000		0.139	1.000		0.208	1.000	
Random	0.013	0.241	1.000	0.072	0.373	1.000	0.168	0.705	1.000
	Pre-view (N=30)			**Pre-view (N=15)**			**Pre-view (N=5)**		
FDK RPG102	1.000			1.000			1.000		
RngCrypto	−0.166	1.000		0.028	1.000		0.388	1.000	
Random	0.060	0.086	1.000	0.131	0.026	1.000	0.840	0.595	1.000
	View (N=30)			**View (N=15)**			**View (N=5)**		
FDK RPG102	1.000			1.000			1.000		
RngCrypto	0.348	1.000		0.533	1.000		0.729	1.000	
Random	0.182	0.252	1.000	0.322	0.535	1.000	0.277	0.795	1.000
	Post-view (N=30)			**Post-view (N=15)**			**Post-View (N=5)**		
FDK RPG102	1.000			1.000			1.000		
RngCrypto	−0.138	1.000		−0.063	1.000		−0.509	1.000	
Random	−0.126	0.345	1.000	−0.146	0.509	1.000	−0.154	0.853	1.000

TABLE 5
Correlation Matrices of Stouffer's *Z*-Chi Scores in 5, 10, and 30 Minutes

FDK RPG102	1.000			1.000			1.000		
RngCrypto	0.074	1.000		0.134	1.000		0.132	1.000	
Random	0.160	0.095	1.000	0.166	0.020	1.000	0.489	−0.308	1.000
	Pre-view (N=30)			**Pre-view (N=15)**			**Pre-view (N=5)**		
FDK RPG102	1.000			1.000			1.000		
RngCrypto	0.162	1.000		0.259	1.000		0.119	1.000	
Random	0.124	0.079	1.000	0.259	0.068	1.000	0.490	−0.603	1.000
	View (N=30)			**View (N=15)**			**View (N=5)**		
FDK RPG102	1.000			1.000			1.000		
RngCrypto	−0.291	1.000		−0.381	1.000		−0.163	1.000	
Random	0.158	0.116	1.000	0.321	−0.421	1.000	0.630	−0.257	1.000
	Post-view (N=30)			**Post-view (N=15)**			**Post-View (N=5)**		
FDK RPG102	1.000			1.000			1.000		
RngCrypto	0.271	1.000		0.362	1.000		−0.055	1.000	
Random	0.189	0.094	1.000	−0.092	0.202	1.000	−0.587	−0.306	1.000

window sizes * 2 statistics, two-tailed). We note that this is a result from a post hoc, rather than a pre-planned, formal analysis.

Audience Size

Finally, effects of audience size were examined. Table 7 showed correlation statistics between the number in the theater audience each day ($N = 10$) and the *Z*-scores during the view section. All correlations statistics were translated into Fisher's *Z*-scores.

No relations were found using only physical RNG (Fisher's Z from Stouffer's $Z = 0.588$, Fisher's Z from Z-chi $=1.729$). Total *Z*-scores from all RNGs showed a non-significant but noticeable level using Stouffer's Z ($Z = 2.370$, $p = 0.018 > 0.0125 = 0.05/4$; 2 kinds of statistics * 2 calculations were tested). Total *Z*-scores from *Z-chi* scores showed significance ($Z = 2.669$, $p = 0.008 < 0.0125$, as in the same).

Discussion

This study involved a field RNG experiment conducted at movie theaters showing the film *Departures* (*Okuribito*). The analysis was designed to include two time-related factors, condition and period. The results showed noticeable *Z-chi* scores during the view condition in which the hardware was generating

TABLE 6
Test for 3 Correlations in 10-Minute Sample Averages Only during View

		r	Fisher's *Z*	*Z* (total)	*p*
Stouffer's *Z*	RPG102 – RngCrypto	0.533	2.059		
	RngCrypto – Random	0.535	2.068	3.051	0.002 *
	Random – RPG102	0.322	1.157		
Z-Chi	RPG102 – RngCrypto	−0.381	−1.389		
	RngCrypto – Random	−0.421	−1.555	−1.035	0.301
	Random – RPG102	0.321	1.153		
			(N=15)		

* Corrected significance levels for multiple tests were 0.008 (=0.05/6; 6=3 window sizes * 2 statistics)

TABLE 7
Correlation between Audience Size and *Z*-Scores

		r	Fisher's *Z*	*Z* (total)	*p*
Stouffer's *Z*	RPG102	0.219	0.588		
	RngCrypto	0.315	0.864	2.370	0.018
	Random	0.763	2.653		
Z-Chi	RPG102	0.574	1.729		
	RngCrypto	0.500	1.453	2.669	0.008 *
	Random	0.497	1.441		
			(N=10)		

* Corrected significance levels for multiple tests were 0.0125 (=0.05/4 statisticcs).

sequences, but MANOVAs found no significant effect for the view factor.

We also examined effects of period, which was obtained by segmenting the view condition into five subsections. It was significant only when the sum of all three random sequences was used in MANOVA. If the data were produced by human minds, audience emotions such as sadness or empathy might constitute influential factors. Large variations in Stouffer's *Z*-scores were observed for the period of time from 200 minutes to 230 minutes (Figure 3). This segment of the film included some scenes evoking much laughter in the audience (Table 8). Subsequent periods showed a little variance, but these results could not be interpreted with certainty. The last scene and the penultimate episode produced no variance.

TABLE 8
The Relation between Movie Times and Episode

Elapsed Time (min), Whole View *		Episode
160	0–10	(Participants enter the theater.) The movie starts with a scene of a white blizzard. Daigo engages in his first unsupervised operations (called *nokan*) at a funeral.
170	–20	A body turns out to be of the opposite sex from the one he had expected. The scene returns to the past, when he lost his job as a cellist in an orchestra, and decides to move back to his hometown with his wife Mika, to look for work.
180	–30	He goes to a job interview, without knowing that the position is for an undertaker. He is instantly hired by the undertaker's agent, but tries to keep his job secret from his wife.
190	–40	He plays the role of a dead person in a *nokan* video showing a group of undertakers at work (applying make-up, cleaning, and dressing). On a summer day, he has to move a decomposed corpse.
200	–50	He goes to a public bath (*Sento*) to wash himself. He coincidentally encounters his childhood friend Yamashita at the bath.
210	–60	President Sasaki says: "It is your natural calling," but Daigo is ambivalent about his job. The patriarch at a funeral becomes angry because the president and Daigo were laughing.
220	–70	President Sasaki's sophisticated efforts satisfy the bereaved family. Daigo converses with people at the public bath (*Sento*).
230	–80	In general, the undertaker's job is not as widely respected as it should be. He has to deal with his wife's and his friend's prejudices and disapproval of such a "shameless" profession. She leaves him.
240	–90	After lunch with the president, he decides to remain in the undertaker job. The opening blizzard scene is shown again. He engages in his first *nokan*.
250	–100	On Christmas night, he plays the cello at the office. Mika returns to their home because she is pregnant.
260	–110	He suddenly hears of the death of the wife of the manager of the public bath. Mika and Yamashita view Daigo's *nokan* with their own eyes for the first time.
270	–120	He hears of the death of his father, who had abandoned the family when Daigo was six years old. There had been no contact between them for 30 years.
280	–130	He decides to prepare his father with his own hands. He finds a stone letter in his father's hand.
290	–140	Ending credits; a sequence depicting the *nokan* performed by Daigo (Masahiro Motoki).

* Elapsed time from the starting data recorded.

It was also found that the audience size affected the outputs of RNGs, although this is not associated directly with the time-related factors, or the story in the film. Not only the physical RNG, but also pseudo random sequences (RngCrypto and Random), were affected to a noticeable degree in the positive direction (Table 4).

Similar Variances among Three Random Sequences

In the results from post hoc analyses, three Stouffer's *Z*-scores reflected similarities in changes over time (Figure 3). According to the analysis using sample average scores from the 10-minute intervals, the pseudo random sequences generated by the software have similar variances to those for the random sequences generated by the hardware.

With the caveat that the analyses are post hoc explorations, these results suggest all the bit sequences might have been affected equally by a latent background factor: field consciousness evoked by the story depicted in the film. These similarities of sample averages suggest, tentatively, that pseudo random sequences could detect field consciousness. If so, the pseudo random sequences were able to respond to the emotional changes, attention, or common mental state of audience members. Thus, the current results appear to be consistent with those of the PK experiment using pseudo random sequences (Lowry, 1981, Radin, 1982) or prerecorded random number sequences (Schmidt, 1981). The similarities of sample averages revealed by our data seem to offer a preliminary indication that this phenomenon extends to field RNG effects as well.

The overall findings resemble those reported by Radin and Atwater (2009), where those authors considered the effect of group coherence, showing that *Z-chi* scores of many RNGs were positively correlated with each other.

Our results have some differences from those of the CinEgg project (Varvoglis, 2006) which obtained null results. This may be due, at least in part, to our choices for the analysis. Another possible reason would be related to the film contents. *Departures* (*Okuribito*) might contribute to our results, because it has a simpler story and more touching scenes than the movies used in the CinEgg project, which range from humorous parodies to detective type stories such as *The DaVinci Code*. Varvoglis gave another explanation for null results which was that the CinEgg project prevented the experimenter effect by having the RNG installed in the movie theaters. In our study, the RNG brought by a confederate could be affected by the experimenter effect. Because the confederate or experimenter was aware of the size of the audience and also was a member of the audience, the results might be attributable at least partly to experimenter effect.

Emotion and Other Factors

Emotional expression might not constitute the only factor contributing to field RNG effects. Indeed, the findings of the current study are consistent with other explanations. The audience focused on the same screen and had a common mental state because they were viewing the same film. The film itself, *Departures*, might have led to connections among some members of the audience, creating conditions favorable to bias in RNG output.

Movie theaters seem to offer several advantages as locations for field studies of this sort. Certain movies might evoke not only strong emotions but also focused attention and a common mental state among audience members. On the other hand, sports events would evoke strong emotions, but would not elicit a common mental state among audience members due to the divided loyalties of those attending games.

Although the results of the current study support all these hypotheses, our results seem to fit best with the emotional hypothesis because the results were consistent with those of Blasband (2000) and Lumsden-Cook (2005a, 2005b), which showed that participants expressing sadness or exhibiting tears obtained low *Z*-scores.

Future Research

The current study obtained encouraging results in field RNG measurements performed in movie theaters. The significant result of the period factor within the view condition suggested that some elements of the film story might influence *Z*-scores in different ways. Emotion would be the most influential candidate element. Investigation of the emotional changes over the course of the film would have added immeasurably to this study, but we were unable to analyze the relationships between periods and the emotions evoked by the film (*Okuribito*) because transitions between scenes occurred too rapidly to address the distinct emotional features of each scene. All target periods included many different and often opposite types of emotions, rendering a quantitative approach to this phenomenon problematic. However, development of such a method constitutes an important task for future research.

Other future tasks include examining the effects of particular psychological stimuli that have evoked particular emotions (e.g., sadness, anger, happiness, etc.). We hope to arrange for a smaller audience to view DVDs or video clips to examine the deviations in the RNG output as a function of the identified emotions. Repeated measures, as performed in the current study, offer many opportunities to elucidate the subtle effects of field consciousness.

Notes

[1] In our application, the program didn't use any seed initialization when the random classes were instanced. It is perhaps dependent on some time-related variable. The program takes 512 bits per second as an array of 64 bytes. The bits are collected as fast as possible, and then it waits one second.

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