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Examination of Retroactive Effects in a Field RNG Experiment Using Prerecorded Files

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Abstract: We conducted a random effect generator/random number generator (REG/RNG) field experiment to test the retroactive effects of field consciousness and unintentional psychokinesis (PK) on targets consisting of prerecorded physical random numbers. An experimenter entered ballparks during eight Japanese professional baseball games. Multiple prerecorded random number targets were presented, and true random numbers were also generated. Unexpectedly, we found no retroactive effects on the target random numbers, and no statistical biases were evident under the generated condition, including when several other methods were applied. Future tasks related to field consciousness are discussed.

Keywords: Field RNG

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事前記録ファイルを使用したフィールドRNGにおける過去遡及的効果の検討

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要旨：本研究では、乱数生成器（ＲＮＧ）によるフィールドＲＮＧ実験により、フィールド意識における意図せざるＰＫが、事前に記録された物理乱数に対して、過去遡及的に働き、偏りを与える可能性を検討した。実験者は、日本のプロ野球の試合をフィールドとして、合計 8 試合にエントリーした。事前記録された複数の乱数ターゲットが提示され、同様に物理乱数も生成された。実験の結果からは残念ながら、事前記録のターゲットに対して、過去遡及的な効果はみられなかった。加えて、実際に生成した物理乱数においても偏りは見られなかった。最後に、フィールド意識に関連した今後の課題が議論された。

Keywords: フィールドＲＮＧ

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EXAMINATION OF RETROACTIVE EFFECTS IN A FIELD RNG EXPERIMENT USING PRERECORDED FILES

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Introduction

One question addressed by this study concerns whether retroactive effects exist when people near the field do not have intentions toward or knowledge about the RNG, integrating previous micro PK studies. Two possibilities are considered in what follows. One concerns the effects of the experimenter on the series of field RNG studies, as discussed by Schmidt. The current study examined that unintentional PK or field consciousness affected the outputs of prerecorded random numbers. Following Ishikawa, we used ballparks during baseball games as fields. Japanese professional baseball games offer several advantages in this regard because regular season games consistently draw large audiences.

Method

Procedure The experiments were conducted during home games played at Kanto Arena, by the Giants, Lions, and Marines, Japanese professional baseball teams. Between September and November 2010, the experimenter entered the ballpark on eight occasions (six night games and two day games). Table 1 presents more detailed information on the games.

Reread condition. Prerecorded random numbers were generated and recorded before the field experiment. Rpg102 hardware was used as the physical RNG. This device uses thermal noise as the source of randomness and generates high-quality random numbers that meet the standards of the federal information-processing publication (FIPS PUB 140-2). Each of the random numbers was assigned a virtual time in the day as a key; these keys constituted the sample of 86,400 ($N = 24 \times 60 \times 60$). A total of 192 prerecorded files were simultaneously streamed between 0:00 a.m. and 6:00 a.m. on September 16. Each field entry involved 32 files that were randomly selected from a PC directory containing a pool of 192 files. After eight repetitions, the numbers of reread files followed a binominal distribution:$\pi = 1/6, n = 8$.

Generated condition. We used Rpg105 hardware, which has 32 independent high-speed RNGs (IC RPG100), and used a notebook PC (VAIO type-G) to control the RPG105, which was attached to the notebook PC via a USB port.

Analysis The RNG devices produce bits (1 s or 0 s) during real-time processing using thermal noise as the source of randomness. All the outputs by the RNGs were converted into *z*-scores. When 512 bits per second were generated, a *Z*-score based on chance was calculated as $z = (x_i - n\pi)/\sqrt{n\pi(1-\pi)} = (x_i - 256)/\sqrt{128}$, when π was 0.5, the probability of obtaining 1 s and 0 s was equal; and when *n* was 512, the total number of bits per second generated by the RNG and x_i was the sum of 512 bits per second. Because x_i was approximately normally distributed in a binomial distribution (the expected mean of *np* was 256 bits in this study), standardized *Z*-scores were available from *x*. The *chi*-squares of 32 values were converted into z-scores as follows:

$$z_{chisq} = \sum_{i=1}^{32} (z_i^2 - 1)/\sqrt{2 \times 32} = \chi^2/8,$$

where *z* indicates the average of the *chi*-squares calculated from the 32 RNGs. Finally, the accumulated *Z*-score for all events over the time of the study was calculated as follows:

$$Z_{device\ variance} = \frac{\sum_{t=1}^{GameEnd} z_{chisq}}{\sqrt{T}}$$

This cumulative *z*-score is essentially equal to the device-variance statistics (Nelson et al.).[13] These device variances, or cumulative *Z*-scores, were calculated under both the generated and reread conditions.

Analysis of overlap with prerecorded targets

The eight games took place between 13:00 and 23:00. Thus, we limited the range of analysis to 36,000 sec (10 h). Because of the repeated-measures design, prerecorded targets overlapped at times. The number of files with no reread was 52, and 140 files were used in one or more games. We identified overlap among these 140 prerecorded files, although the lengths of games (from start to finish) differed (Table 2). We divided the raw data obtained from the 192 prerecorded targets presented during periods of overlap. Accumulated *chi*-square values, sample sizes, and device-variance *z*-scores were calculated as follows:

$$Z_k = \frac{\chi_k^2}{\sqrt{2 \times n_k}} = \frac{\sum_{f=1}^{192} \sum_{t=s_{fk}}^{e_{fk}} (z^2 - 1)}{\sqrt{2 \times n_k}}$$

When k was the number of overlapping targets, six z-scores, ranging from 0 to 5, were available. The overlap period depended on the file, and n_k represented the total number of samples (sec). No analyses were conducted until all field experiments had been completed, thereby preventing any observer effects. A new software application was written to analyze all data simultaneously.

3. Results

A total of eight field experiments were conducted in several ballparks. Table 3 shows the device variances of the random numbers actually generated by Rpg105 and the integration of the 32 prerecorded random numbers by Rpg102. Although the results for prerecorded targets were significant ($z = 3.06$, $p < 0.01$), we must consider the following two *caveats*. First, significant *z*-scores were not found under the generated condition ($z = 0.41$, n.s.). The second *caveat* relates to the results under the reread condition. This study predicted that more overlap would involve a greater number of files susceptible to bias and that those periods containing no overlap or no reread would show no bias. However, the results showed that greater bias was associated with less overlap, rendering the retroactive influence of field consciousness on prerecorded targets unclear. No retro-active effects were shown in the experiment.

Table 1 Results of the field experiment

	Prerecorded	Generate condition							
	device variance (z)	device variance (z)	N	sec	taken ratio	Length of the game	Audience size	home	visitor
2010/9/21	1.757	0.386	13479	15256	0.88	4:14:15 12 innings	41459	Giants	Baystars
2010/9/22	2.270	−0.510	10696	10726	1.00	2:58:45	44545	Giants	Baystars
2010/9/23	0.233	1.163	13356	13356	1.00	3:42:35	33917	Lions	Eagles
2010/10/8	0.508	1.104	10803	15211	0.71	4:13:30 10 innings	44136	Giants	Swallows
2010/10/9	1.091	0.419	15842	15842	1.00	4:24:01 11 innings	33918	Lions	Marines
2010/10/10	0.472	0.641	15550	15550	1.00	4:19:09 11 innings	33911	Lions	Marines
2010/11/2	−0.263	−1.192	10201	10201	1.00	2:50:00	26923	Marines	Dragons
2010/11/3	2.574	−0.841	16921	16921	1.00	4:42:00 11 innings	27197	Marines	Dragons
Total	3.056	0.414							

Table 2 Retro active effects

	Overlap (k)	Z_k	Chisq_k	n_k	number of files
not read at all		2.16	1876187.0	1872000	52
off field period		3.24	2400429.0	2393349	140
	1	2.72	1952350.0	1946991	140
	2	2.50	485280.9	482820	55
on field period	3	−1.27	172044.9	172791	20
	4	0.75	35350.9	35153	4
	5	−0.83	8785.4	8896	1