CO-OPERATOR EXPERIMENTS WITH AN REG DEVICE

Brenda J. Dunne

Princeton Engineering Anomalies Research
School of Engineering and Applied Science
Princeton University
Princeton, NJ 08544-5263

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ABSTRACT

Experiments in anomalous human/machine interaction wherein two operators simultaneously attempt to shift the means of output distributions produced by a microelectronic random event generator (REG) yield statistically significant correlations with the operators' shared intentions. The overall results of 256,500 trials of 200 binaries each, produced by 15 co-operator pairs in 42 independent experimental series, are consistent with those of a benchmark database of 2,520,000 trials generated on the same device by 91 individual operators. The patterns of achievement are characteristic of the particular operator pairs, but bear no evident resemblance to those of either of the two individuals operating separately, or to any simple combinations thereof. The composite performance of eight operator pairs of the same sex is opposite to intention, while that of seven opposite-sex pairs conforms significantly to intention, with an average effect size 3.7 times larger than that of the single operator data. Of the opposite-sex pairs, four "bonded" couples achieve average effects more than twice the size of those of three unbonded pairs, and nearly six times those of the single operators. These results contrast with those of a substantial body of remote perception data, where effects produced by agent/percipient pairs of opposite sex are smaller than those generated by pairs of the same sex, suggesting that gender-pairing is a complex parameter in consciousness-related anomalies research.

I. Experimental Background

Since 1979, the Princeton Engineering Anomalies Research (PEAR) laboratory has been exploring the effects of human intention on the behavior of random physical systems and devices. The most extensive of these investigations has involved a microelectronic random event generator (REG) that produces a string of random binary samples, or bits, at a rate of 1000 per second, in trials of 200 bits each, and counts the number that conform to a regular positive/negative alternation[1-4]. A human operator, seated in front of the device and observing the sequence of count numbers via an LED display on its face, attempts to influence the output distribution in accordance with his or her pre-recorded intentions. The experimental protocol requires the operator to perform equal numbers of trials under intentions to produce higher counts, lower counts, or a baseline (that is, to allow the machine to operate without any explicit intention), with all other conditions held constant. Data are generated in series of pre-specified length, and are then examined for correlations between those intentions and the output of the device. The results of some 840,000 trials per intention (a total of more than 504,000,000 binary samples) generated on this REG by 91 different individuals over a twelve year period, show statistically significant correlations between operator intentions and the mean counts of these 200-sample trials. Although the observed effects are quite small (the mean of the high efforts is 100.026, and that of the low efforts 99.984), given the magnitude of the database, the likelihood of this large a separation occurring by chance is less than 5×10^{-5}. Equally important is the observation that many individual operators tend to establish characteristic patterns of achievement, as distinguished by their effect sizes and preferred directions of effort. These can best be displayed as cumulative deviation graphs that are sufficiently repeatable to be termed operator "signatures." Despite the individual disparities, when all operators' data are concatenated into a grand cumulation (Fig. 1), the correlations of the composite deviations with intentions remain quite robust[1-6].

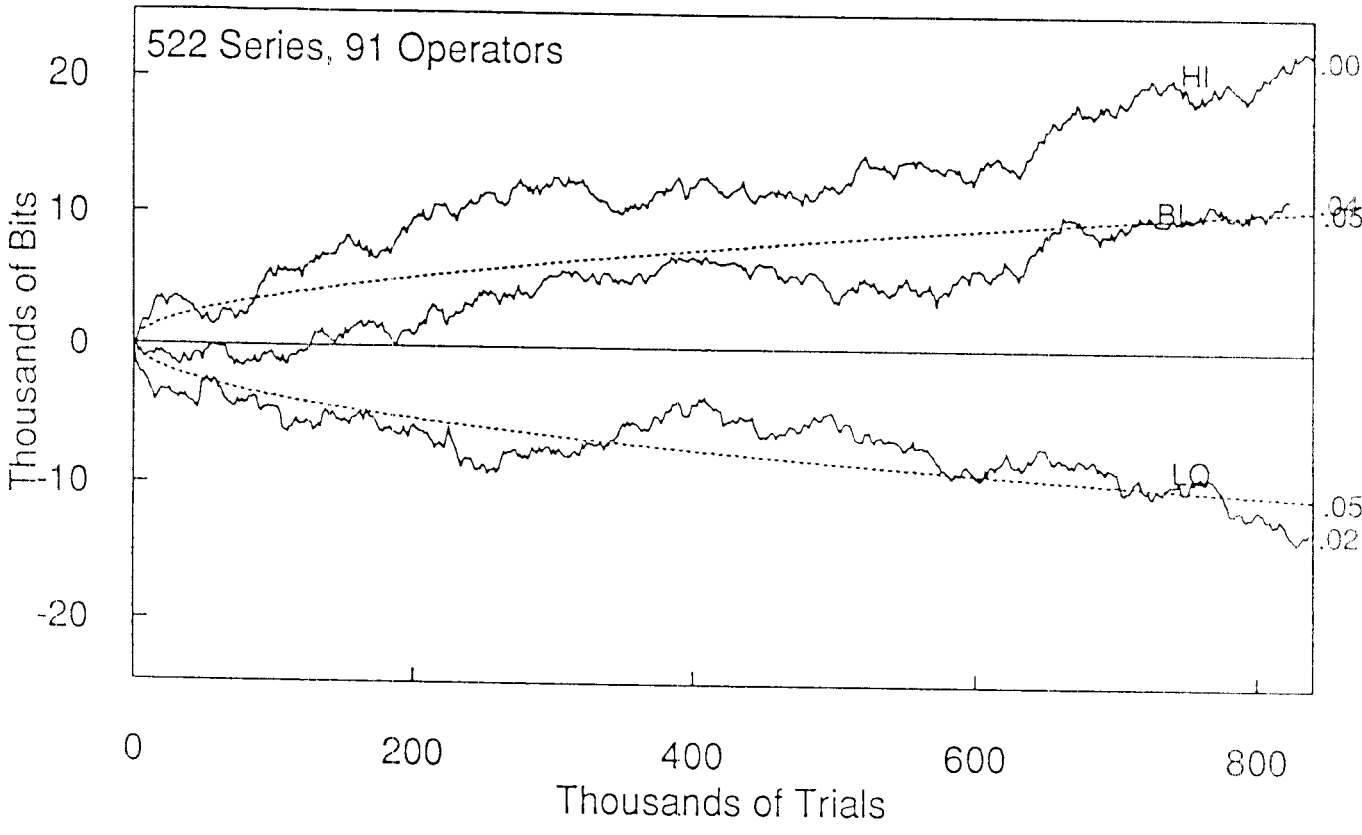

Fig. 1: All Local, Single Operator, Diode REG

II. Theoretical Background

Evidence such as this, which is consistent with the results of many other such experiments conducted in our laboratory and elsewhere[7], indicates that human consciousness can participate actively, albeit modestly, in the establishment of physical reality. In so doing, it would appear to violate some basic premises of established physical theories, suggesting that these may merit some reconsideration. In another component of the PEAR program, we have attempted such reexamination of certain physical presumptions, and have proposed a rudimentary model that represents reality as the product of the interpenetration of consciousness and its environment[1,8-10]. In this approach, all physical theory is regarded as an attempt by human consciousness to describe its experience of its physical environment, rather than an "objective" description of an abstract physical world, per se, and thus reflects the describing consciousness as much as the environment being described.

Following this path, we have invoked the concepts and formalisms of quantum wave mechanics via metaphor to describe such cooperative reality. For example, considerable use is made of the Complementarity Principle, one form of which essentially states that atomic scale events can be described in two different frames of reference - as particles or as waves - and that a complete description must incorporate both perspectives. We interpret this to imply that a wave/particle complementarity may also reasonably be invoked to describe the phenomena of consciousness itself; indeed, it may well be as much a property of consciousness as of the physical world[10]. The prevailing models of consciousness are essentially particulate in nature, but if these are expanded to permit it the option of functioning in a wave-like fashion as well, a number of otherwise anomalous phenomena, such as those observed in these human/machine interactions, may be more parsimoniously represented in terms of such processes as diffraction, interference, barrier penetration, and resonance, without recourse to "paranormal" explanations.

III. Co-Operator Experiments

The operator-specific signatures found in the individual REG experiments suggest one means of testing the consciousness wave hypothesis. If these human/machine interactions are strictly particulate in nature, the results of two operators attempting the task in concert would be expected to exhibit linear combinations of the individual signatures. If, on the other hand, some wave-like processes are operating, the composite signatures could involve more complex superposition properties such as interference and phasing. To explore this, a program of "co-operator" REG experiments has been undertaken wherein two operators, each of whom has established an individual signature, address the task together with the same intention.

The overall co-operator database as of January 1991 consists of a total of 85,500 trials per intention, generated by 15 different operator pairs in 42 independent experimental series, and yields an overall effect size that is slightly larger than that of the single operator results. Specifically, the mean of the co-operator high intention efforts is 100.033, compared with the single operator mean of 100.026; that of the low efforts is 99.969, compared with 99.984 for the single operator data. Figure 2 displays these results again in the form of chronologically ordered traces of the cumulative deviations of the means from their theoretical expectations. Like the single operator data displayed in Fig. 1, the statistical significance of the incremental effect is

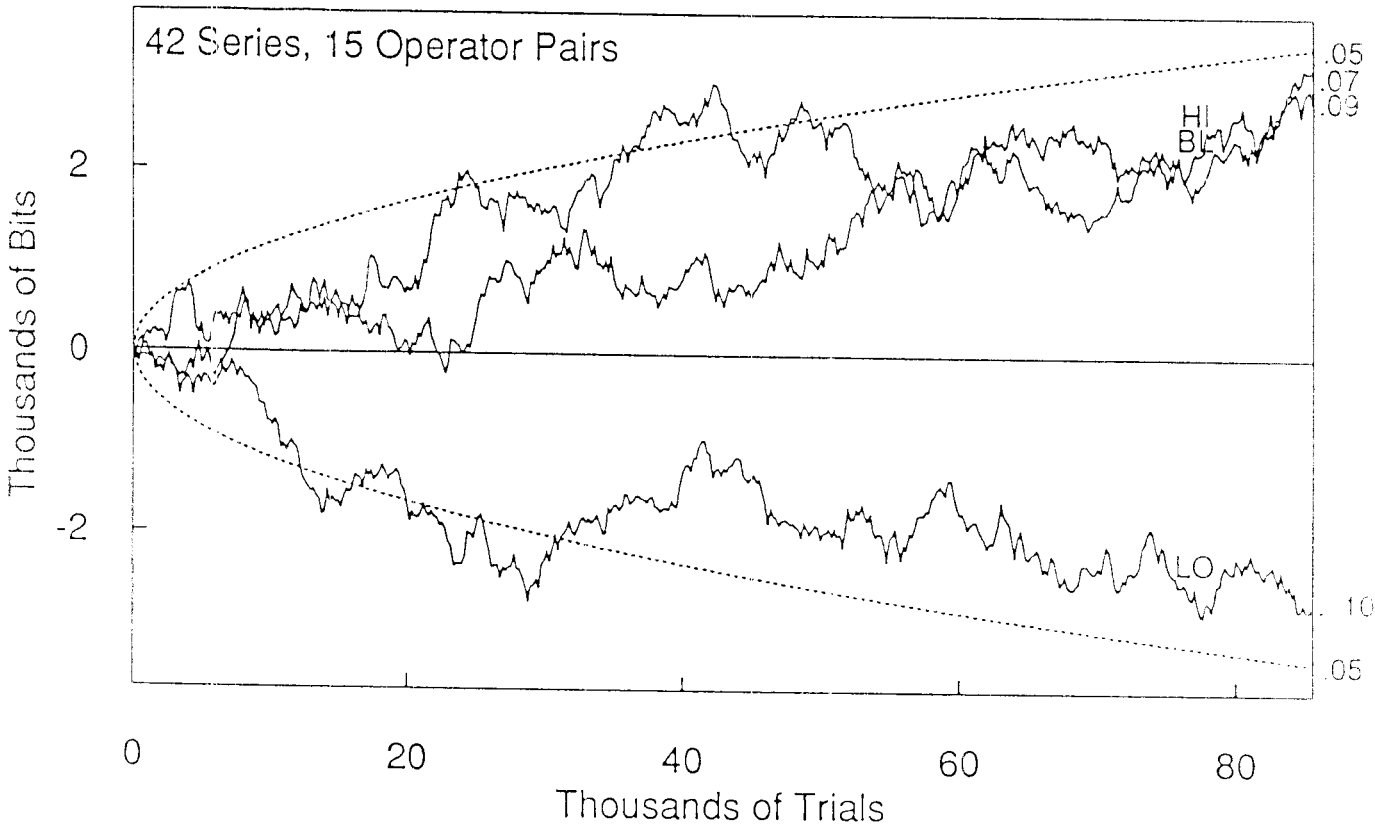

Fig. 2: All Diode REG, Co-Operator Pairs

seen to increase steadily as the size of the database grows. Although neither of the co-operator directional efforts independently achieves statistical significance over this smaller data base, the probability of the high-low split in direction of intention is less than .03 ($z = 1.883$).

In response to our particular theoretical query, however, the cumulative deviation patterns of specific operator pairs, while again internally consistent, show no indications of simple linear combinations of the signatures of the participating individuals. Indeed, some of our most successful individual operators produce null effects when working together, while others with minimal or even negative individual results are able to produce strong positive yields as a pair. The signature superposition thus would appear to be more wave-like than particle-like in character.

IV. Gender Effects

Of the 15 co-operator pairs contributing to this database, eight of the same sex generated a total of 39,500 trials per intention in 22 independent series, while seven pairs of opposite-sex generated 46,000 trials per intention in 20 series. The results of the same-sex pairs are non-significant, and tend to be opposite to intention in both directions of effort, with effect sizes nearly identical to those of the single operator data, albeit in the reverse direction (Fig. 3). Specifically, the high efforts have a mean of 99.984, and the low efforts a mean of 100.025, with a composite z-score in the direction of intention of -0.810. The opposite-sex pairs, on the other hand, produce results consistent with their intentions, with effect sizes considerably larger than those of the single operator results (Fig. 4). Their overall high efforts have a mean of 100.075, nearly three times the single operator effect size, and the low efforts a mean of 99.920, an effect five times that of the single operators. The composite z-score for this subset is 3.317 ($p<5x10^{-4}$). Despite the relatively small sizes of these data subsets, the difference between the same-and-opposite-sex data, computed by a t-test comparing the high-low mean differences between the two populations, is statistically significant, with a two-tailed probability of chance occurrence of .004 ($t_{\#} = 2.849$).

Of the seven opposite-sex pairs, four consist of couples who share a bonded relationship, while the other three pairs are simply friends or acquaintances. In 11 series, comprising 31,000 trials per intention, the three unbonded pairs show strong results in both directions of intention: 100.058 in the high efforts (2.2 times larger than the single operator efforts), and 99.946 in the low (3.4 times the single operator effect), with a combined effect in direction of effort that is significant at $p < .025$ ($z = 1.968$). Results of the nine series generated by the bonded pairs are nearly twice again as strong as those of the unbonded pairs in the high intention, with a mean of 100.111, and nearly two and a half times as strong in the low, with a mean of 99.868. The combined effect in direction of effort has a probability of less than .002 ($z = 2.980$). Compared with the single operator results, the effects of the bonded pair high efforts are 4.3 times larger, and those of the low efforts 8.3 times larger. Figures 5 and 6 compare the results of the unbonded and bonded co-operator pairs. Clearly, each of these sub-divisions of the co-operator database substantially reduces the size of the various subsets and thereby the statistical leverage of these small effects, but even as a pilot study they are provocative.

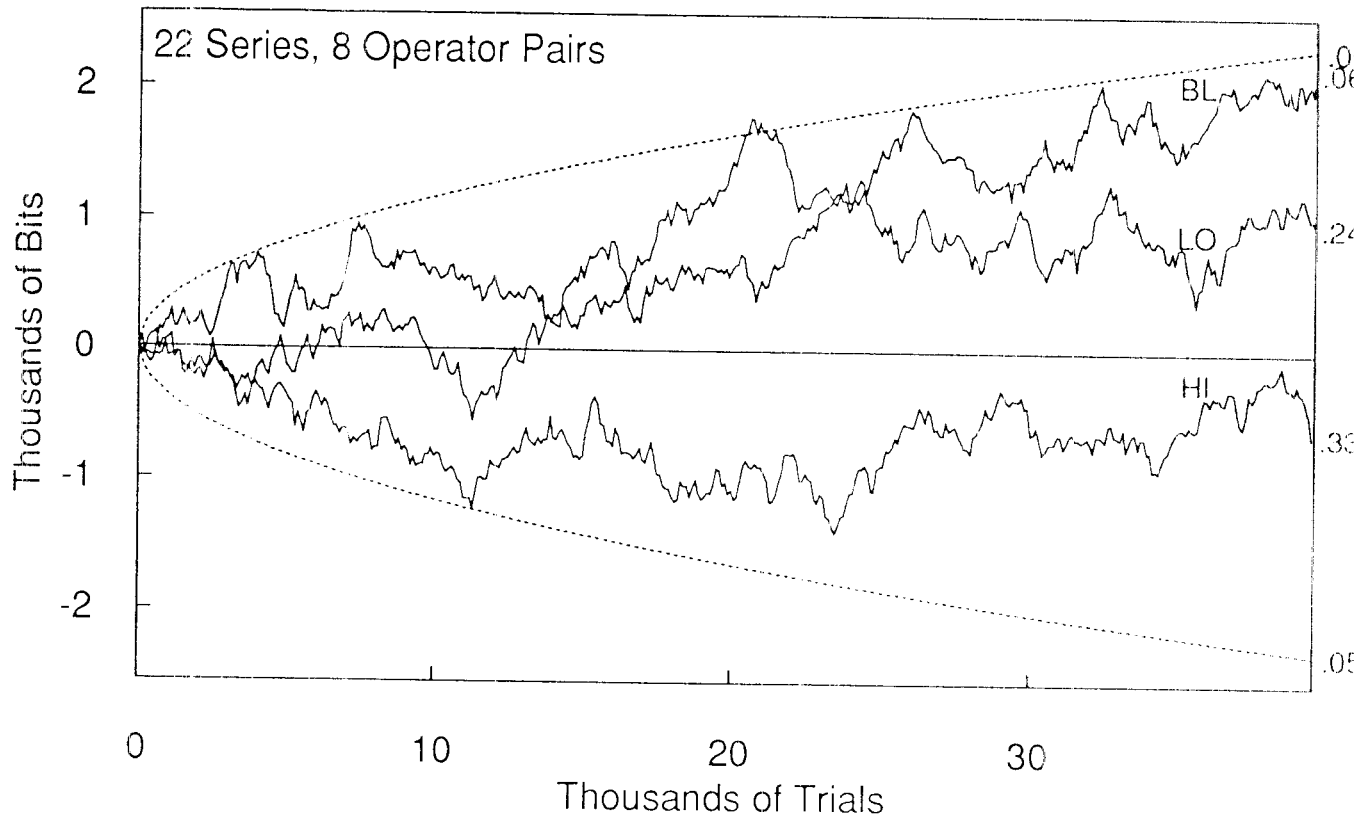

Fig. 3: REG Co-Operator Data: Same-Sex Pairs

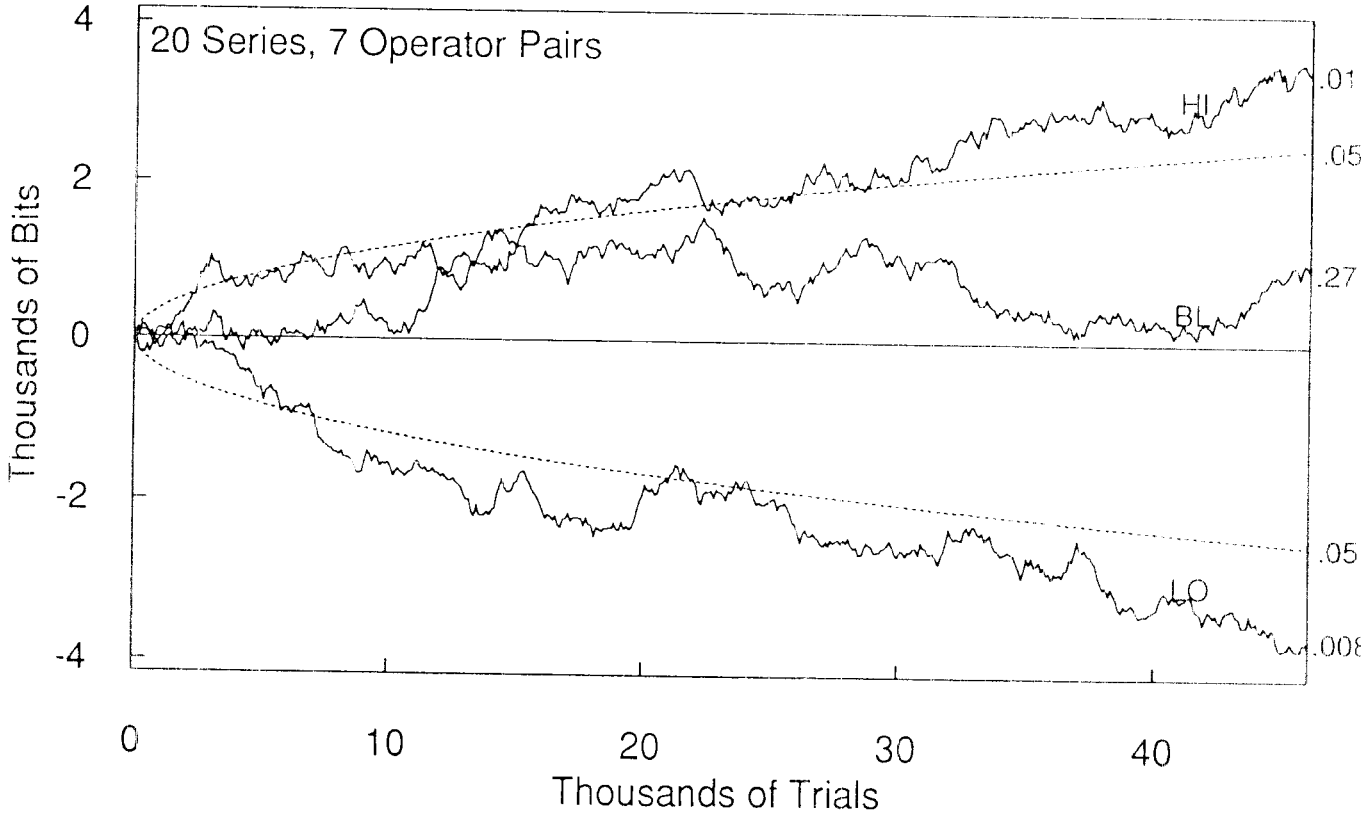

Fig. 4: REG Co-Operator Data: Opposite-Sex Pairs

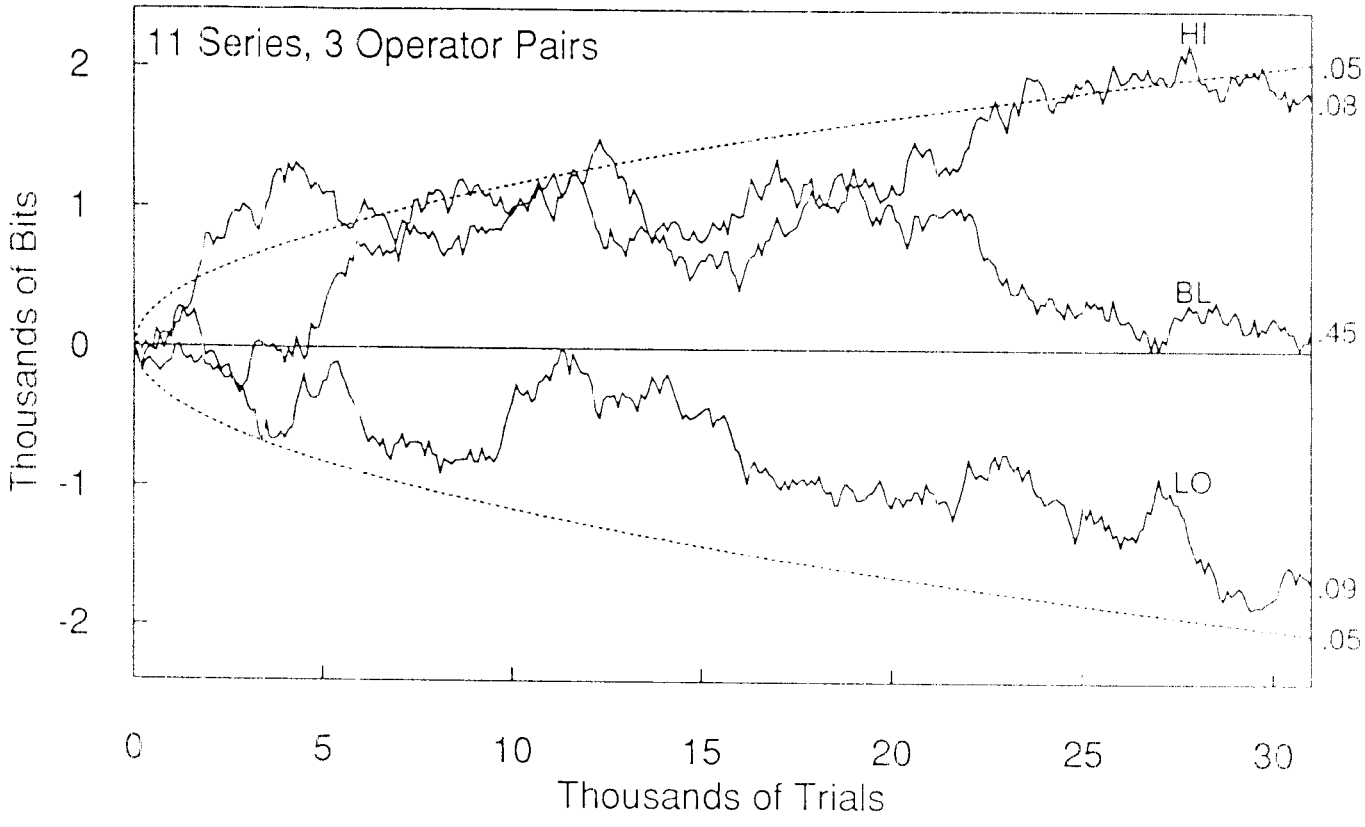

Fig. 5: REG Co-Operator Data: Unbonded Opposite-Sex Pairs

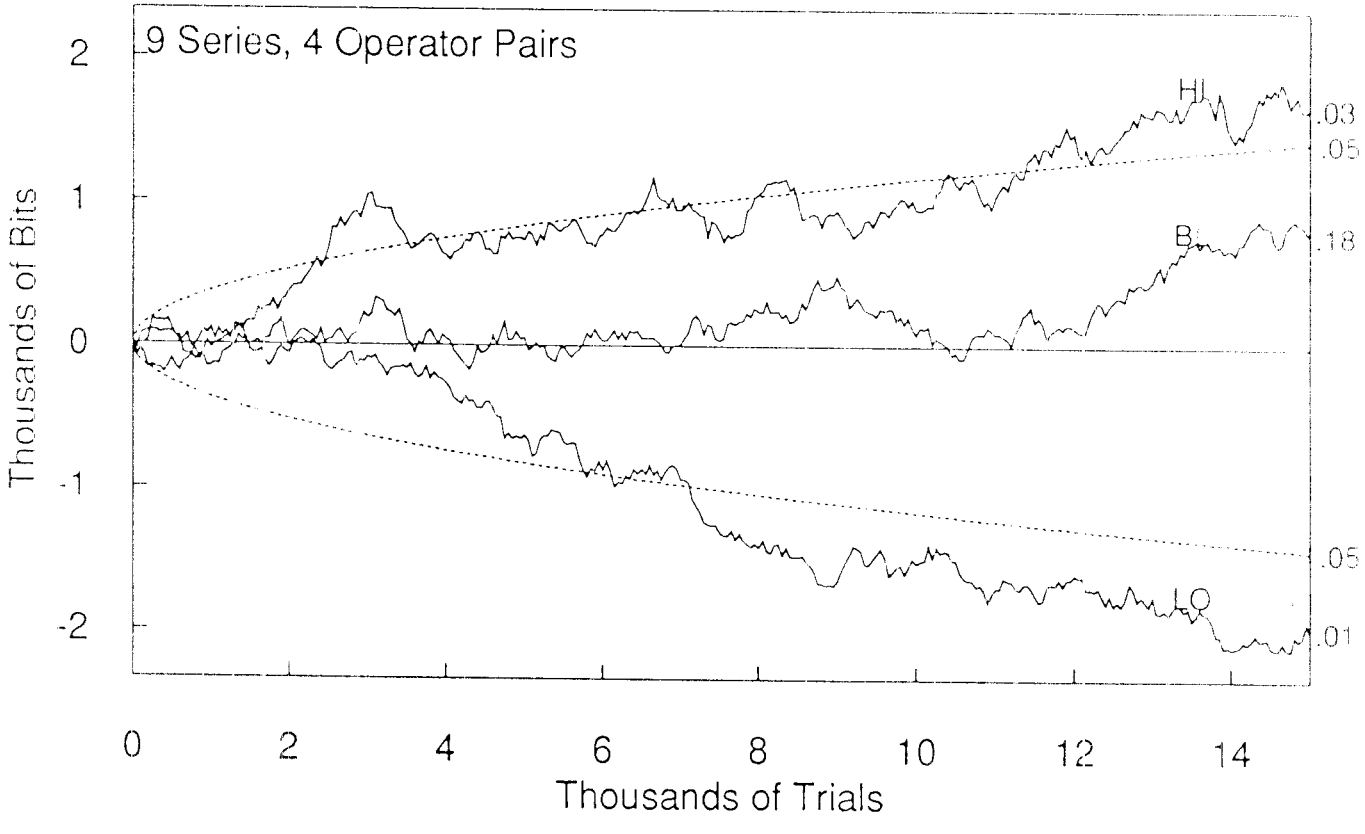

Fig. 6: REG Co-Operator Data: Bonded Opposite-Sex Pairs

The relative effect sizes of the various co-operator subsets and those of the single operator data are summarized in Table 1 and portrayed graphically in Fig. 7. In the table, those data sets that demonstrate one-tailed statistical probabilities of less than .05 ($z > 1.645$ in the direction of effort) are noted by an asterisk. In the graph, one standard deviation error bars provide an estimate of the reliability of the mean for each subset as a function of database size. (More comprehensive summary tables, along with details of the individual pair results and variations of the experimental protocol, are provided in the appendix.)

Table 1

Summary of Co-Operator REG Data

Subset	# Oprs. or Pairs	# Trials per Int.	# Srs.	High Mean	Low Mean	Mean Diff.
Single Oprs	91	840,000	522	100.026*	99.984*	.042*
Co-Oprs.	15	85,500	42	100.033	99.969	.064*
Same-Sex	8	39,500	22	99.984	100.025	-.041
Opp.-Sex	7	46,000	20	100.075*	99.920*	.155*
Unbonded	3	31,000	11	100.058	99.946	.112*
Bonded	4	15,000	9	100.111*	99.868*	.243*

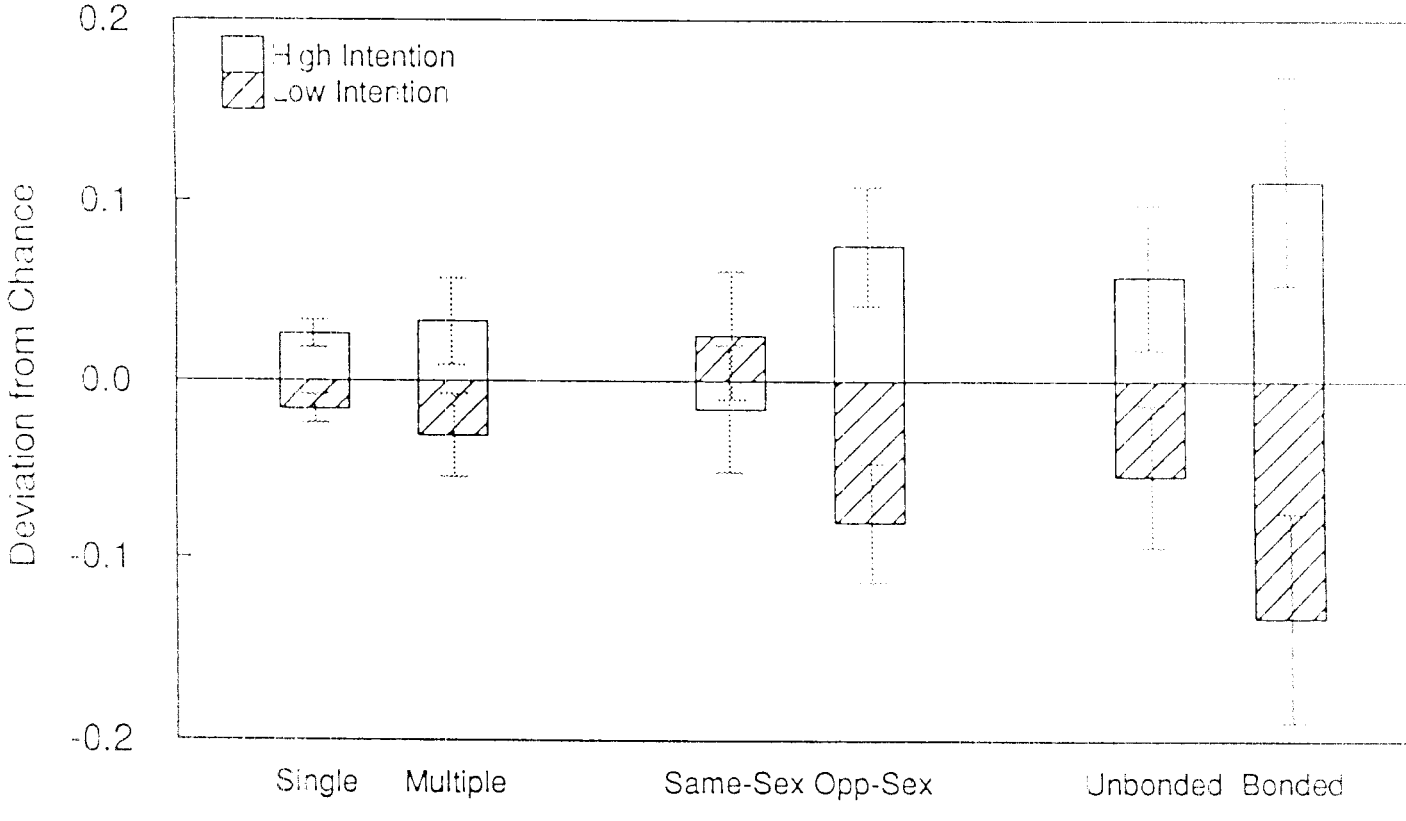

Fig. 7: Effect Sizes in Co-Operator REG Experiments

While these gender-related effects seem robust and potentially important, their interpretation is far from clear. In the theoretical model mentioned above, a consciousness "exclusion principle" emerges, relating to the pairing of passive/assertive or yin/yang characteristics, which in some cases devolves to simple feminine/masculine propensities in the bonding of two consciousnesses in a given environmental context[8,9]. Whether the same/opposite, unbonded/bonded disparities of performance illustrated above constitute evidence for such a principle is at this point speculative at best, but perhaps worthy of further attention.

V. Comparisons with Remote Perception Experiments

The sharp distinctions in the same- and opposite-sex co-operator REG results prompted re-examination of our precognitive remote perception (PRP) database for indications of any similar effects. These experiments, described in detail in Refs. 3, 11, and 12, also involve two participants, one of whom, the "percipient," attempts to acquire information about the geographical location of the other, the "agent," at a specified date and time, without recourse to any known sensory means of communication. The main thrust of this component of the PEAR program has been the development of analytical scoring methodologies to codify the impressionistic free-response descriptions in a standardized manner, and thereby to quantify the amount of anomalous information acquired under these protocols.

Some 336 such trials, involving 24 females and 21 males, yield a composite z-score of 6.355 ($p = 10^{-10}$), with an average effect size (calculated as $z/\sqrt{N}$) of .347. Of these, the 102 trials involving agent/percipient pairs of the same sex produce an effect size of .467, and the 234 trials involving opposite-sex pairs an effect size of .302. Both subsets are independently significant ($z = 4.717$ and 4.623, respectively), but are not statistically distinguishable.

Unfortunately, only one of the opposite-sex pairs, who generated a total of 36 trials together, qualifies as a "bonded" couple. Their small subset is non-significant ($z = 0.905$) and has an effect size of only .151. Although the remaining 198 opposite sex trials produce a combined effect of .326 ($z = 4.590$), due to the small sizes of the datasets these differences are not statistically significant.

Table 2 and Fig. 8 summarize these PRP results:

Table 2

Summary of Remote Perception Data

Agent/Percipient Pairs	No. Pairs	No. Trials	Composite z-score	Effect Size
All data	52	336	6.355	.347
Same-sex	26	102	4.717	.467
Opposite-sex	26	234	4.623	.302
Unbonded	25	198	4.590	.326
Bonded	1	36	0.905	.151

*Effect size calculated by $z/\sqrt{N}$

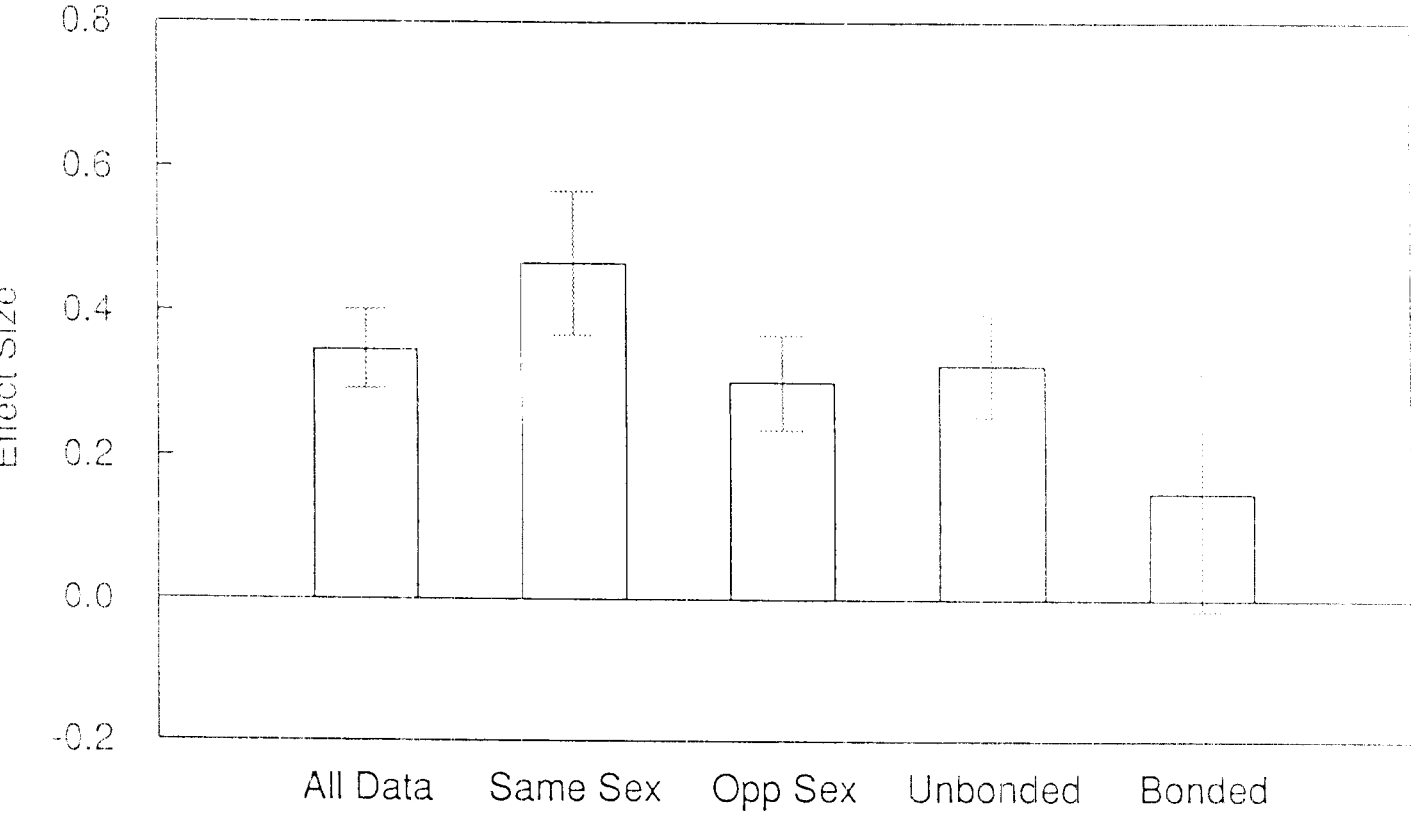

Fig. 8 PRP Effect Sizes by Type of Agent-Percipient Pair

Although these comparisons are not statistically persuasive and could readily be interpreted in terms of gender-specific commonalities in perceptual and communicational styles, their lack of reinforcement of the REG results may nonetheless bear on the latter's interpretation. Two distinctions need to be noted: First, in the REG experiments, the two participants are performing identical tasks, i.e. imposing a common intention on the device; in the PRP experiments they are performing quite different roles, i.e. one is attempting to acquire information and the other to communicate it. Second, in the REG experiment, the context is established by an electronic machine; in the PRP protocol, it is established by a geographic scene. Whether these distinctions are sufficient grounds to inhibit, or even to reverse, the gender pairing effects is far from obvious, but again worth further study.

VI. Summary

Three implications emerge from these co-operator REG experiments: First, taken in total, the database constitutes yet another replication of many previous studies demonstrating that human intention can produce tangible effects on the behavior of such random physical processes. Second, the patterns of effect produced by the combined efforts of two operators of common intention are sufficiently distinct from their individual signatures of achievement to suggest that the phenomenon may have some wave mechanical aspects, thus supporting a basic premise of our theoretical model. Finally, the superior performance of bonded opposite-sex pairs draws attention to other specific predictions of the model, such as the relevance of a consciousness exclusion principle to such bonded situations. Admittedly, these last two inferences are based on post hoc observations of relatively small databases that will require substantial replication before firmer conclusions may be drawn. Nevertheless, the sharpness and scale of the effects strongly suggests that further investigations of the role of gender pairing in both REG and PRP experiments could prove fruitful.

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APPENDIX

Note:

The data reported in this paper comprise all the co-operator experiments conducted in the PEAR laboratory between September 1983 and January 1991 using a diode-based microelectronic random event generator. Seven other series, comprising a total of 7000 trials per intention, were generated by two operator pairs on an algorithm-based pseudo-REG computer program, and two series (2000 trials per intention) were generated by one operator pair on the diode device following a remote protocol, where the operators were situated at a location several hundred miles away. Due to the small size of these databases and the substantial differences in the experimental conditions, these have not been included in this analysis, but are retained in our comprehensive data management system.

* * * * *

Table 1.A summarizes the contributions of each of the same-sex co-operator pairs to the composite database: Table 2.A those of the opposite-sex pairs, where the bonded pairs are indicated by B. Over the seven and one-half year period of experimentation three distinct protocols were explored, all of which employed the same basic tri-polar design, 200-sample trial size, and 1000-sample per second counting rate, but differed in series size and run length. The original "REG" protocol required 2500 trials per intention generated in 50-trial runs; the "REM" protocol required 3000 trials per intention generated in 1000-trial runs; and the "Thou" protocol required 1000 trials per intention, with the options of 50, 100, or 1000 trials per run left to the operators' discretion, provided that the run length remained constant throughout the course of any given series. All data were generated in the automatic counting mode, where a single button push initiated an automatically sequenced run of pre-determined length.

In all but two series, the sequence of pre-recorded intentions was volitionally chosen by the operators, with the understanding that equal numbers of runs would be generated for each of the three intentions. Two "instructed" series were also generated, by co-operators 277 and 295, wherein the intentions for each run were randomly assigned by an independently generated seed

for a simple computer algorithm. For these two pairs, the results for both the volitional and instructed series are listed separately.

Table 3.A summarizes the data as a function of the experimental protocol employed, none of which yields results statistically distinguishable from the others.

In all the tables, results exceeding the .05 significance criteria in the direction of intention are noted by an asterisk (*).

Table 1.A
Summary of Results
Same Sex Co-Operator Pairs

Type	Expt	# Srs	# Tr/ Int	High Mean	High (z)	Baseline Mean	Baseline (z)	Low Mean	Low (z)	Δ Hi-Lo Mean	Δ Hi-Lo (z)
[illegible]	REG	2	5000	99.907	(-0.932)	100.216	(2.160)	100.098	(0.978)	-.191	(-1.[illegible]
[illegible]	REG	2	5000	100.032	(0.320)	99.911	(-0.892)	100.063	(0.632)	-.031	(-0.[illegible]
	REM	1	3000	99.994	(-0.044)	99.930	(-0.545)	100.153	(1.189)	-.159	(-0.[illegible]
	Thou	1	1000	99.614	(-1.726)	100.210	(0.939)	99.515	(-2.169)*	.099	(0
	All	4	9000	99.973	(-0.362)	99.950	(-0.666)	100.032	(0.432)	-.059	(0.[illegible]
[illegible]	REG	1	2500	99.946	(-0.382)	99.890	(-0.778)	99.829	(-1.211)	.117	(0.
[illegible]	REG	1	2500	100.000	(0.000)	99.930	(-0.492)	100.034	(0.243)	-.034	(-0.[illegible]
[illegible]	Thou	2	2000	100.069	(0.433)	100.078	(0.493)	[illegible]	(1.03[illegible]	-.095	(-[illegible]
[illegible]	Thou	2	8000	100.005	(0.065)	100.062	(0.786)	100.047	(0.539)	-.035	([illegible]
[illegible]	REG	1	2500	99.946	(-0.382)	100.175	(1.236)	100.108	(0.764)	-.162	(-1.[illegible]
	REM	1	3000	100.177	(1.368)	100.201	(1.554)	99.913	(-0.674)	.264	(1.[illegible]
	All	2	5500	100.072	(0.753)	100.189	(1.981)	100.002	(0.017)	.070	(1.[illegible]
[illegible]	REG	2	5000	99.928	(-0.718)	100.056	(0.558)	99.975	(-0.270)	-.049	(-0.[illegible]
	Vol	1	2500	99.959	(-0.288)	100.046	(0.322)	100.022	(0.156)	-.063	(-0.[illegible]
	Inst	1	2500	99.897	(-0.727)	100.066	(0.467)	99.924	(-0.537)	-.027	(-0.[illegible]
[illegible]	Data	12	39500	99.984	(-0.448)	100.055	(1.533)	100.025	(0.677)	-.041	(-0.[illegible]
	* p<.05										

Table 2.A
Summary of Results
Opposite Sex Co-Operator Pairs

Co-operator	Expt	# Sess	# Tr/ Int	High Mean	(z)	Baseline Mean	(z)	Low Mean	(z)	A Hi-Lo Mean	
[illegible]	Thou	1	3000	100.149	(1.152)	100.193	(1.492)	99.862	(-1.072)	.287	(1
[illegible]	REG	1	5000	100.190	(1.900)*	100.032	(0.316)	99.908	(-0.922)	.282	(1
	REM	3	9000	100.049	(0.654)	99.857	(-1.914)	99.923	(-1.036)	.125	(.
	All	4	14000	100.099	(1.660)*	99.920	(-1.346)	99.917	(-1.387)	.182	(1
[illegible]-B	REG	1	2500	100.063	(0.447)	100.016	(0.116)	99.914	(-0.605)	.149	(.
	Thou	1	1000	100.090	(0.402)	100.009	(0.040)	99.828	(-0.769)	.262	(.
	All	2	3500	100.071	(0.593)	100.014	(0.120)	99.890	(-0.923)	.182	(.
[illegible]	REM	1	3000	100.033	(0.258)	100.008	(0.059)	99.869	(-1.0[illegible]	.164	(.
[illegible]B	REG	2	5000	100.025	(0.246)	100.001	(0.012)	99.771	(-2.288)*	.254	(2
	Vol	1	2500	100.022	(0.153)	100.007	(0.048)	99.815	(-1.307)	.207	(1
	Inst	1	2500	100.028	(0.195)	99.996	(-0.031)	99.727	(-1.929)*	.301	(1
[illegible]	REG	2	5000	100.001	(0.012)	100.168	(1.676)	100.014	(0.144)	-.013	(-.
	REM	3	9000	100.032	(0.435)	100.048	(0.640)	99.978	(-0.300)	.054	(.
	All	5	14000	100.021	(0.356)	100.091	(1.514)	99.991	(-0.154)	.030	(.
[illegible]-B	REG	1	2500	100.267	(1.887)*	100.015	(0.107)	99.936	(-0.455)	.331	(2
	Thou	1	1000	100.185	(0.827)	100.107	(0.479)	100.125	(0.559)	.060	(.
	All	2	3500	100.243	(2.037)*	100.041	(0.347)	99.990	(-0.086)	.253	(2
All Data (20 prs)		20	46000	100.075	(2.279)*	100.020	(0.622)	99.920	(-2.413)*	.155	(2.
Unbonded (11 prs)		11	31000	100.058	(1.435)	100.005	(0.132)	99.946	(-1.348)	.112	(1.
Bonded (9 prs)		9	15000	100.111	(1.927)*	100.052	(0.900)	99.868	(-2.287)*	.243	(2.