# Managing the Target Pool Bandwidth: Possible Noise Reduction for Anomalous Cognition Experiments*

by

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## Abstract

Lantz, Luke, and May (1994) reported in the first of two studies that experienced receivers from the Cognitive Sciences Laboratory produced significant evidence for anomalous cognition (*AC*) of static targets, but showed little evidence for *AC* of dynamic targets. This result was surprising—it was directly opposite to the results that were derived from the ganzfeld database (Bem and Honorton, 1994). In Lantz, Luke, and May's experiment, the topics of the dynamic targets were virtually unlimited, whereas the topics for the static targets were constrained in content, size of cognitive elements, and range of affect. In a second experiment, Lantz, Luke, and May redesigned the target pools to correct this unbalance and observed significant improvement of *AC* functioning. We incorporate these findings into a definition of *target pool bandwidth* and propose that the proper selection of bandwidth will lead to a reduction of incorrect information in free-response *AC*.

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## Introduction

Effect sizes from forced-choice experiments are much lower than those from free-response studies. For example, in precognition (Honorton and Ferrari, 1989) and real-time (Honorton, 1975) forced-choice experiments, the effect size (i.e., $Z/\sqrt{n}$) is 0.02, while in the free-response ganzfeld (Bem and Honorton, 1994), the effect size is 0.159. Even if we consider the ganzfeld response as a "forced-choice" among four alternatives, the $\pi$ effect size, which converts 1-in-*n* into an effective binary choice hitting rate (Rosenthal and Rubin, 1989 and Rosenthal, 1991), is $0.5123\pm0.0004$ for card guessing and $0.5854\pm0.0287$ for the ganzfeld ($t = 46.2,\ df \simeq 2\times10^6,\ p \simeq 0$). The large *t*-score is probably due to the large number of forced-choice trials (i.e., $2\times10^6$). Considering that the mean of the forced-choice effect size is $2.5\sigma$ smaller than that of the ganzfeld, however, there is clearly a meaningful difference. One potential source of noise in forced-choice experiments, particularly when trial-by-trial feedback is given, is memory of the previous trial and knowledge of the complete set of possibilities. For example, suppose a receiver (i.e., participant, subject) is asked to guess if a particular card from a normal deck of playing cards is red or black. Suppose further that there is some putative information coming either from the card or from the mind of a sender, and that the receiver is a "good" imager (i.e., can easily picture a brilliant image of a playing card in her/his mind). The receiver's task, then, can be reduced to simple signal detection. Yet, if anomalous cognition (*AC*)[*] is *not* a robust information transfer mechanism, and it appears that it is not, the "signal" is easily lost among the vibrant internal imagery from the memory of all alternative playing cards. The resulting effect sizes, therefore, are reduced.

The ganzfeld itself was developed as a somatic-sensory noise reduction procedure (Honorton and Harper, 1974). Honorton argued that by placing a receiver in a sensory-reduced environment, her/his reactions to the environment would be sharply reduced, encouraging a commensurate reduction of noise. Based upon the results of our current work, we argue that a major contributor of noise in any free-response study is cognitive and arises, in part, because of the target pool design.

One result from the ganzfeld experiments suggests that dynamic targets produce stronger results than static targets (Bem and Honorton, 1994). Lantz, Luke, and May (1994) attempted to replicate this finding in two lengthy experiments in 1992 and 1993. The first of these explored, in a $2\times2$ design, the relationship of sender vs no-sender and static vs dynamic target type on the quality of the AC. Since Lantz, Luke, and May reported no significant effects or interactions due to the sender condition, we will ignore that aspect of this first experiment. In the second experiment, they conducted all trials without a sender and changed the characteristics of the target pool. This paper describes the insights gained from these two studies which led both to the concept of *target pool bandwidth*, and to a potential way of reducing noise in free-response *AC*.

## Summary of the first Anomalous Cognition Experiment – 1992

We begin by summarizing the experiment and pertinent results from a study that was conducted in 1992, the details of which may be found in Lantz, Luke, and May (1994). In the experiment, a static vs dynamic target condition was included to replicate the findings from the ganzfeld.

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[*] The Cognitive Sciences Laboratory has adopted the term *anomalous mentalphenomena* instead of the more widely known *psi*. Likewise, we use the terms *anomalous cognition* and *anomalous perturbation* for *ESP* and *PK*, respectively. We have done so because we believe that these terms are more naturally descriptive of the observables and are neutral in that they do not imply mechanisms. These new terms will be used throughout this paper.

## Target Pools – 1992

For the static targets, Lantz, Luke, and May used a subset of 50 of our traditional *National Geographic* magazine collection of photographs (May, Utts, Humphrey, Luke, Frivold, and Trask, 1990). These targets had the following characteristics:

- Topic homogeneity. The photographs contained outdoor scenes of settlements (e.g., villages, towns, cities, etc.), water (e.g., coasts, rivers and streams, waterfalls, etc.), and topography (e.g., mountains, hills, desserts, etc.).
- Size homogeneity. Target elements are all roughly the same size. That is, there are no size surprises such as an ant in one photograph and the moon in another.
- Affectivity homogeneity. As much as possible, the targets included materials which invoke neutral affectivity.

This pool is perhaps better characterized by what it does *not* contain. There are no people, animals, transportation devices or situations in which one would find these items—and no emotionally arousing pictures.

The dynamic targets, on the other hand, followed similar lines to those from the ganzfeld studies. Lantz, Luke, and May digitized and compressed video clips from a variety of popular movies or documentaries. With the exception of cartoons and sexually-oriented material, the clips could contain virtually anything. Examples included an indoor motor bike race and a slow panoramic scan of the statues on Easter island. Almost all of the characteristics of the static target pool were violated. The only common characteristic was thematic homogeneity within any given dynamic clip; across targets there were no restrictions on content.

## Data Analysis and Results – 1992

For each response, a single analyst conducted a blind ranking of five targets—the intended one and four decoys—in the usual way. The expected mean-chance rank was three. Effect sizes were computed by:

$$ES = \frac{(\bar{R}_e - \bar{R}_o)}{\sqrt{\frac{N^2-1}{12}}},$$

where $N$ is the number of rank possibilities (i.e., five in our case) and $\bar{R}_e$ and $\bar{R}_o$ are the expected and observed average ranks, respectively. The p-values were computed from $Z = ES \times \sqrt{n}$, where $n$ is the number of trials.

Each receiver participated in 20 trials for each target type, regardless of sender condition. Table 1 shows the average rank, the effect size, and its associated p-value for the static target condition. We see that the combined data is significant and that two of our most experienced receivers, 9 and 372, produced independently significant results.

Table 1.

Results for Static Targets – 1992 Experiment

| Receiver | <Rank> | ES | p-value |
|---|---|---|---|
| 9 | 2.40 | 0.424 | 0.034 |
| 131 | 3.10 | −0.071 | 0.653 |
| 372 | 2.40 | 0.424 | 0.034 |
| 389 | 2.75 | 0.177 | 0.240 |
| 518 | 2.60 | 0.283 | 0.119 |
| Totals* | 2.65 | 0.247 | $6.8 \times 10^{-3}$ |

* Totals are *post hoc.*

Table 2 shows the same data for the dynamic target condition.

Table 2.

Results for Dynamic Targets – 1992 Experiment

| Receiver | <Rank> | ES | p-value |
|---|---|---|---|
| 9 | 3.00 | 0.000 | 0.500 |
| 131 | 2.50 | 0.354 | 0.057 |
| 372 | 3.40 | −0.283 | 0.897 |
| 389 | 3.00 | 0.000 | 0.500 |
| 518 | 3.10 | −0.071 | 0.624 |
| Totals* | 3.00 | 0.000 | 0.500 |

* Totals are *post hoc.*

With the possible exception of receiver 131, *AC* on the dynamic targets failed to show any evidence of functioning. The difference between these two target conditions favors the static targets ($t = 1.75$, $df = 198$, $p \leq 0.08$ *2-t*).

## Hypothesis Formulation and Discussion – 1992

Static targets being better than dynamic ones is surprising—not only because it fails to support the ganzfeld result, but also because it suggests the opposite. There are a number of possible contributing factors for this outcome. They include statistical artifacts, idiosyncrasies of our receivers compared to the ganzfeld participants, and procedural differences. Another possibility may be that, as in the ganzfeld, participants used a rank-order technique for judging even though only the first-place matches were used for the statistic. Since absolute measures of AC are better than relative measures in process-oriented research, and since the target-type inference was based on relative measures, perhaps this accounts for some of the result. A full discussion of these points may be found in Lantz, Luke, and May (1994).

We propose a different explanation: a fundamental difference between the experiment's dynamic and static target pools are, in themselves, a source of noise.

The sources of noise in the forced-choice domain are reasonably understood (i.e., memory in conjunction with complete knowledge of the target pool elements). A new insight for us was another potential source of noise in the free-response domain. To understand this noise source, we must first assume that $AC$ data are weak and difficult to recognize. Target pools which contain a large number of diverse cognitive elements, in conjunction with receivers who believe that this is the case, are a source of noise. Receivers will tend to report *any* imagined impressions, since those impressions might be part of the target. Since $AC$ is assumed to be weak, most of the generated impressions are from the receiver's imagination rather than from the target. Furthermore, it follows that the noise will increase when these impressions are unable to be internally edited and must be reported. That is, noise is generated not so much from an active imagination, but imagination coupled with an agreement not to edit the internal experience.

Editing our internal experience is something we all do in our daily communication: we rarely report to a friend that our mind momentarily wandered during an interesting discussion. Humans appear to have an ability for multi-processing, but we use situational filters to communicate coherently. So, why would we deny this same ability to participants in $AC$ experiments? In Figure 1, we represent schematically the contributions to the noise produced by memory and the noise produced by not editing imagination.

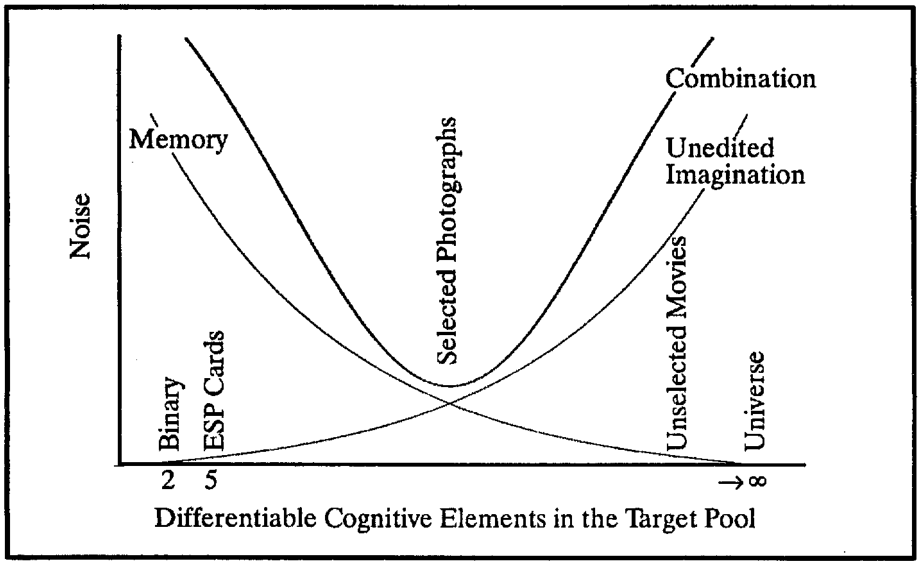

Figure 1. Schematic Representation of Sources of Cognitive Noise

As the number of differentiable cognitive elements in a target pool increases from two (for a binary choice) to nearly infinite (for the universe), we propose that there is a trade-off between noise arising from memory and noise arising from unedited imagination. For target pools containing fewer elements, the noise contribution from memory (i.e., the curve labeled "Memory" in Figure 1) exceeds impressions arising from edited imagination. Regardless of one's internal fantasies, there is usually a complete protocol restriction on allowable responses. The reverse is true for target pools that contain a large number of cognitive elements: the contribution to the noise because of unedited imagination exceeds that arising from memory. In this case, protocols usually suggest that receivers report nearly all internal impressions (e.g., in the ganzfeld protocol), and since there will likely be far more of these impressions than there are target elements, the noise is increased. At the same time, since there are a large number of elements, and because it is difficult to remember all possible elements and their factorial combinations, the contribution to the noise due to memory is reduced.

We represent schematically, the combination of these two sources of noise by the "U" shaped curve in Figure 1 labeled "Combination." Without stretching the schematic nature of this argument, we propose that there may be a target pool that minimizes the two noise contributions *simultaneously*. That is, if we can accept some noise from each source, we may be able to prevent either from overwhelming the signal themselves.

We suggest that our *National Geographic* magazine target pool represents one good example: there are enough differentiable elements to reduce the effects of memory, but few enough to allow reasonable editing of internal experiences that arise from imagination.

The receivers in our experiments have, over time, learned the natural limitations of the *National Geographic* target pool by experience and by instruction. They have become skilled at internal editing and do not report impressions that they know are absent from the overall target pool—thus there is less incorrect material in their responses.

In Lantz, Luke, and May's 1992 experiment, where the dynamic targets could be virtually anything, the receivers were unable to produce significant evidence of *AC*. They also produced, what is for us, significantly reduced functioning with static targets. We speculate that this drop of functioning in both target conditions arose because the protocol would not allow the receivers to edit their internal experience. Since the dynamic targets could consist of anything, and since the receivers were blind to the static-vs-dynamic target condition, they were unable to edit their imaginations, even for the static targets. To illustrate this point, suppose that half the target pool were *ESP* cards and the other half were the ganzfeld dynamic targets, but the receivers were blind to the target condition. In any given trial, even though the target is actually the *star ESP* card, the receiver is inclined to report all internal imagery, whether it be cartoon figures, car races, and/or sex scenes from movies. This increased the incorrect information over what it would be for a simpler target pool of *ESP*-cards alone.

A strong word of caution is in order. Editing of internal experience because of sensory knowledge of the target pool cannot inflate a differential rank-order statistic. It will, however, bias any rating scale toward larger values. This is not a problem if ratings are used in correlational or comparative studies.

We define *target pool bandwidth* as the number of differentiable cognitive elements in the target pool. Forced-choice experiments usually represent small bandwidths, video clips usually represent a large bandwidth, and the *National Geographic* magazine photographs represent an intermediate bandwidth. At this time, the definition is qualitative, but we will indicate ways in which it can be made more quantitative. Nonetheless, the target pool bandwidth concept is testable.

The following hypotheses formed the basis of Lantz, Luke, and May's second study in 1993:

(1) A significant increase of *AC* will be observed for dynamic targets if the dynamic pool is designed with an intermediate target pool bandwidth that matches the static pool from the 1992 study.

(2) An increase of *AC* will be observed for static targets because the receivers will be able to edit their internal experience.

## Summary of the second Anomalous Cognition Experiment – 1993

The details of the 1993 study may also be found in Lantz, Luke, and May (1994). In that study, they included a static vs dynamic target condition to replicate the findings from the ganzfeld, but dropped the sender condition: all trials were conducted without a sender.

### Target Pools – 1993

For this experiment, Lantz, Luke, and May redesigned both the static and dynamic targets with the constraint that they all must conform to the topic, size, and affectivity homogeneity of the original static targets. Surprisingly enough, they identified a large number of videos that could be edited to produce 50 *National Geographic*-like segments: an airplane ride through Bryce Canyon in Utah or a scanning panoramic view of Yosemite Falls. Lantz, Luke, and May selected a single frame from within each dynamic target video clip, which was characteristic of the entire clip, to act as its static equivalent.

Thus, they were able to improve the target pools in two ways:

(1) The dynamic pool possessed an intermediate target pool bandwidth.
(2) The bandwidth of the dynamic and static pools were nearly identical, by design.

### Data Analysis and Results – 1993

For each response, a single analyst conducted a blind ranking of five targets—the intended one and four decoys—in the usual way. Lantz, Luke, and May computed effect sizes in the same way as in the 1992 study.

Three receivers individually participated in 10 trials for each target type and a fourth, 372, participated in 15 trials per target type. Table 3 shows the average rank, the effect size, and its associated p-value for the static target condition. We see that the combined data is significant and three of the four receivers produced independently significant results.

Table 3.

Results for Static Targets – 1993 Experiment

| Receiver | <Rank> | ES | p-value |
|---|---|---|---|
| 9 | 2.20 | 0.565 | 0.037 |
| 372 | 1.87 | 0.801 | $9.7\times10^{-4}$ |
| 389 | 3.10 | −0.071 | 0.589 |
| 518 | 1.90 | 0.778 | $7.2\times10^{-3}$ |
| Totals | 2.22 | 0.550 | $1.1\times10^{-5}$ |

Lantz, Luke, and May observed a significant increase of $AC$ for the static targets in the 1993 experiment compared to that of the 1992 experiment ($t = 1.68$, $df = 143$, $p \leq 0.047$), and three of the four receivers were independently significant, and their results improved from their 1992 effort. Thus, the second hypothesis (i.e., an increase in $AC$ for static targets) was strongly supported. Table 4 shows the same data for the dynamic targets.

Table 4.

Results for Dynamic Targets – 1993 Experiment

| Receiver | <Rank> | ES | p-value |
|---|---|---|---|
| 9 | 1.70 | 0.919 | $1.8 \times 10^{-3}$ |
| 372 | 1.93 | 0.754 | $1.8 \times 10^{-3}$ |
| 389 | 3.00 | 0.000 | 0.500 |
| 518 | 2.40 | 0.424 | 0.091 |
| Totals | 2.22 | 0.550 | $1.1 \times 10^{-5}$ |

Using the rank-order statistics above, Lantz, Luke, and May saw no difference between static and dynamic targets in their 1993 study. The first hypothesis was confirmed: they observed a significant increase of *AC* with dynamic targets in 1993 from that of 1992 ($t = 3.06$, $df = 143$, $p \leq 1.3 \times 10^{-3}$).

A detailed analysis of the static vs dynamic target issue may be found in Lantz, Luke, and May (1994) and in May, Spottiswoode, and James (1994).

## General Discussion and Conclusions

One possible interpretation of the results from Lantz, Luke, and May's two experiments is that the noise was sharply reduced by narrowing the target pool bandwidth. They observed a significant increase of *AC* with the dynamic targets and a large increase with the static ones. Caution is advised in that this analysis is *post hoc*, and there were a number of potential contributing factors. For example, in the first experiment, receivers were not monitored and were at distances ranging from a few 100s to 1000s of km from the targets. In addition, feedback was delayed for a few days due to the delivery time of the U.S. postal service. In the second experiment, the receivers were monitored, given immediate feedback, and the targets were meters away.

To our knowledge, studies of *AC* performance have not yielded any signficant effects with regard to target-receiver separation (Dunne, Dobyns, and Intner, 1989; Puthoff and Targ, 1976); therefore, the enhancement we see is not likely because of "local" targets produced better results than do "distant" ones.

Perhaps, a more meaningful contribution to the enhancement arises because the receivers were monitored in the second study and not in the first. Although we have not studied the effects of monitoring on performance systematically, our laboratory experience suggests that monitoring sessions appears to enhance results, at least with novices. This enhancement, however, is sharply reduced in case of experienced receivers such as were in these studies.

May (1988) demonstrated that the quality of *AC* responses did not depend upon feedback considerations, at least in the weak presentation domain. Targ and Targ (1986) also showed that feedback was not a necessary ingredient for successful *AC*. Based on these findings and on our knowledge of our experienced receivers, we believe that little of the observed AC-enhancement was because of the more immediate feedback during the second study.

We find the bandwidth analysis more compelling because of its "common sense" appeal. Since the properties attributed to target pool bandwidth may be subjected to experimental scrutiny, we urge that such studies be carried out. For example, is there a parabolic-like functional relationship between the target pool bandwidth and the $AC$ effect size?

To conduct such experiments, we need to develop a quantitative definition of target pool bandwidth. This implies a quantitative definition of cognitive content, and we have been applying our fuzzy set analysis (May, Utts, Humphrey, Luke, Frivold, and Trask, 1990) toward this end. We are also looking at other measures that might be used. Nonetheless, it seems clear that a quantitative definition of bandwidth is within reach. Once realized, and if the target pool bandwidth idea can be verified, we all may benefit from a specific protocol that will reduce the noise in free-response $AC$ experiments.

## References

Bem, D. J. and Honorton, C. (1994). Does psi exist? Replicable evidence for an anomalous process of information transfer. *Psychological Bulletin.* **115**, No. 1, 4-18.

Dunne, B. J., Dobyns, Y. H., and Intner, S. M. (1989). Precognitive Remote Perception III: Complete binary database with analytical Refinements. *PEAR Technical Note.* PEAR 89002, pp. 34.

Honorton, C. and Harper, S. (1974). Psi-mediated imagery and ideation in an experimental procedure for regulating perceptual input. *The Journal of the American Society for Psychical Research.* **68,** 156-168.

Honorton, C. (1975). Error Some Place! *Journal of Communication*, 103-116.

Honorton, C. and Ferrari, D. C. (1989). "Future Telling:" A meta-analysis of forced-choice precognition experiments, 1935-1987. *Journal of Parapsychology,* **53**, 281-308.

Honorton, C., Berger, R. E., Varvoglis, M. P., Quant, M., Derr, P., Schechter, E. I., and Ferrari, D. C. (1990) Psi Communication in the ganzfeld. *Journal of Parapsychology,* **54**, 99-139.

Lantz, N. D. and Luke, W. L. W., and May, E. C. (1994). Target and sender dependencies in anomalous cognition experiments. Submitted for publication in the *Journal of Parapsychology.*

May, E. C., Utts, J. M., Humphrey, B. S., Luke, W. L. W., Frivold, T. J., and Trask, V. V. (1990). Advances in remote-viewing analysis. *Journal of Parapsychology,* 54, 193-228.

May, E. C., Spottiswoode, S. J., and James, C. L. (1994b). Shannon entropy as an intrinsic target property: Toward a reductionist model of anomalous cognition.. Submitted for publication in the *Journal of Parapsychology.*

Puthoff, H. E. and Targ. R. (1976). A perceptual channel for information transfer over kilometer distances: Historical perspective and recent research. *Proceedings of the IEEE*, **64**, 3, 329-354.

Rosenthal, R. and Rubin, D. B. (1989). Effect size estimation for one-sample multiple-choice-type data: Design, analysis, and meta-analysis. *Psychological Bulletin*, **106**, 332-337.

Rosenthal, R. (1991). *Meta-analytic procedures for social research* (Rev. ed). Newbury Park, Ca: Sage.

Schlitz, M. J. and Honorton, C. (1992). Ganzfeld psi performance within an artistically gifted population. *The Journal of the American Society for Psychical Research,* **86**, No. 2, 83-98.