Phenomenological Research and Analysis

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I OBJECTIVE

The objective of this document is to provide an interim technical report on tasks 6.2, "Basic Research," 6.3, "Applied Research," and 6.4, "Research Methodology," as listed in the 1991 Statement of Work. This report covers the time period from 15 February to 30 June 1992, and includes all subtasks.*

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II INTRODUCTION

Under Statement of Work items 6.2, 6.3, and 6.4 in contract MDA908-91-C-0037, the Cognitive Sciences Laboratory of Science Applications International Corporation is tasked to conduct phenomenological research and analysis. This document details the activity accomplished under these items and constitutes the interim report covering the period from 15 February to 30 June 1992.

III PROGRESS TO DATE

This section describes the progress to date for each of the subtasks listed under items 6.2, 6.3, and 6.4 (basic research, applied research, and research methodology, respectively). The section numbering corresponds to the numbering in the Statement of Work.

6.2 Basic Research

6.2.1 Magnetoencephalography (MEG) Investigations

From 15 through 28 March 1992, the third portion of a four-part MEG investigation was carried out using receivers from a variety of populations. Details of the protocol may be found in a separate document, which has been approved by the Scientific Oversight Committee (SOC).[1*] It is beyond the scope of this report to describe the protocol in detail; however, we provide a brief overview here, followed by a summary of the analysis and the conclusions to date.

Protocol. Each of twelve receivers contributes ten blocks of data. Each block consists of ten 2-minute runs, each of which contains approximately 100 remote and 100 pseudo stimuli. Each block of data is accompanied by a control block of equal length during which the conditions are identical to the experimental block; however, no receiver is present under the MEG. The dependent variable is the average effect size of the root mean square (RMS) relative phase shift (i.e., prestimulus to poststimulus) of the dominant alpha rhythm.

In February, the statistician from the SOC visited the Cognitive Sciences Laboratory. After reviewing the statistics for the MEG project, we noticed that the t-tests that were described in the technical protocol to test difference the between various conditions were not correct because they assumed statistical independence between the variables. Measurements of brain waves that occur at 1- to 5-second intervals are likely to be correlated, especially at 10 Hz, nominally the frequency under study. Therefore, the statistics used to combine the results of all blocks from a single receiver had to be modified. We provide that modification here.

Consider N blocks of experimental data. Let n_{jr} be the number of remote stimuli (RS) for block j, and n_{jp} be the number of pseudo stimuli (PS) in block j. Similarly, define ε_{jr} and ε_{jp} as the corresponding effect sizes for block j. We define the weighted effect size for each stimulus type, k, as

$$\bar{\varepsilon}_k = \sum_{j=1}^{N} w_{jk}\varepsilon_{jk},$$

where

* References may be found at the end of this document.

$$w_{jk} = \frac{n_{jk}}{\sum_{j=1}^{N} n_{jk}} ,$$

and

$$k = r,p .$$

Tests Against the Null Hypothesis: $\bar{\varepsilon} = 0$. Since the experimental effect sizes, ε_{jk}, are derived from normally distributed data (i.e., Monte Carlo calculations of the RMS phase shift), then we know the standard error for each ε_{jk} is

$$sd(\varepsilon_{jk}) = \frac{1}{\sqrt{n_{jk}}} . \qquad (1)$$

Thus, the variance of the weighted average effect size is

$$Var(\bar{\varepsilon}_k) = \sum_{j=1}^{N} w_{jk}^2 Var(\varepsilon_{jk}) = \frac{1}{\sum_{j=1}^{N} n_{jk}} .$$

The z-score associated with $\bar{\varepsilon}$ is

$$Z_k = \frac{\bar{\varepsilon}_k}{\sqrt{Var(\bar{\varepsilon}_k)}} . \qquad (2)$$

Equation 2 is used to test the average effect sizes of the RS and PS for the experimental and control conditions against the null hypothesis of $\bar{\varepsilon} = 0$ for the experimental and control conditions.

Tests Against the the Null Hypothesis: $\bar{\varepsilon}(RS) - \bar{\varepsilon}(PS) = 0$. Within a given condition we cannot assume that the phase shifts from an RS are independent from those associated with a PS. Thus, hypotheses tests that do not account for potential correlations between the RS and PS are inappropriate. Because of the simplicity of the individual ε_{jk}, we can compute the exact variance for the differences as follows. Let the difference between the effect sizes for RS and PS be

$$d_j = \varepsilon_{jr} - \varepsilon_{jp} .$$

Since there usually is a different number of stimuli for RS and PS, we define a weighting factor for the d_j as

$$\Omega_j = \frac{n_j}{\sum_{j=1}^{N} n_j} ,$$

where

$$n_j = \frac{n_{jr} \times n_{jp}}{n_{jr} + n_{jp}} .$$

Then the weighted mean difference is given by

$$\bar{d} = \sum_{j=1}^{N} \Omega_j d_j .$$

The variance of $\bar{d}$ is given by

$$Var(\bar{d}) = \sum_{j=1}^{N} \Omega_j^2 Var(d_j),$$

but

$$Var(d_j) = Var(\varepsilon_{jr}) + Var(\varepsilon_{jp}) - 2\ Cov(\varepsilon_{jr}, \varepsilon_{jp}),$$

but

$$Cov(\varepsilon_{jr}, \varepsilon_{jp}) = \varrho_{rp} \sqrt{Var(\varepsilon_{jr}) \cdot Var(\varepsilon_{jp})}\ .$$

Combining these equations with the definition for the variance of the effect size, gives the $Var(\bar{d})$ as

$$Var(\bar{d}) = \sum_{j=1}^{N} \Omega_j^2 \left[\frac{1}{n_{jr}} + \frac{1}{n_{jp}} - 2\ \varrho_{rp} \sqrt{Var(\varepsilon_{jr}) \cdot Var(\varepsilon_{jp})}\right],$$

and

$$Z = \frac{\bar{d}}{\sqrt{Var(\bar{d})}}\ . \qquad (3)$$

Tests Against the Null Hypothesis: $\bar{\varepsilon}$(Experiment)$-\bar{\varepsilon}$(Control) = 0. To compare each stimulus type in the experiment and control conditions, we assume that the data are independent. Thus, the z-score for the difference is given by

$$Z_k(Experiment - Control) = \frac{\bar{\varepsilon}_k(Ex) - \bar{\varepsilon}_k(Cl)}{\sqrt{Var(\bar{\varepsilon}_k(Ex)) + Var(\bar{\varepsilon}_k(Cl))}}$$

$$= \frac{\bar{\varepsilon}_k(Ex) - \bar{\varepsilon}_k(Cl)}{\sqrt{\dfrac{1}{\sum_{j=1}^{N} n_{jk(Ex)}} + \dfrac{1}{\sum_{j=1}^{N} n_{jk(Cl)}}}}\ . \qquad (4)$$

Equation 4 is used to test the difference between experimental blocks and their corresponding control blocks.

Conclusions. All data from the MEG investigation have been analyzed. Using the above tests, we have not observed significant deviations from chance expectations for any of the conditions. The specifics and tables of individual performance will be presented in the final report.

In this investigation, however, we did learn that the well-known Crammer-Rao limitation[2] on the expected variance for a phase measurement in low signal-to-noise environments was a limiting factor. In fact, if there is a phase shift due to the RS, then the mathematical technique that was used in this study would not be sensitive enough to detect it.

For basic neuroscience arguments, we expect that a phase shift should exist. A phase shift of primary alpha rhythm is one indication that the central nervous system (CNS) has been aroused by some stimulation.

Given that anomalous cognition (AC) has been well established in the laboratory and in practical applications, it would be likely that an AC stimulus would arouse the CNS in a similar way.

We have collected nearly 1,000 megabytes of data in this study. Proposed modifications to the analysis of the data should determine if a phase shift is present. The details of the proposed analysis will be described in detail in the final report.

6.2.2 Data Patterns/Correlations

6.2.2.1 AC/Target Feature Correlations

We have reviewed our standard static target pool of 100 *National Geographic* magazine photographs and a set of 30 clips of video movies and documentaries, and have analyzed them with regard to the total change of Shannon entropy (ΔS). The complete details of that analysis can be found in the technical protocol, which has been approved by the SOC,[3] and the results of this analysis can be found in a previous interim report.[4]

6.2.2.2 Experiments Testing AC/Target Feature Correlations

All AC trials were conducted without monitors, and the data were faxed to the principal investigator. Five receivers completed 40 trials each. Significant effects were seen for two of the five receivers for static targets ($p \leq 0.02$), and a significant effect was observed for the combined data ($p \leq 0.01$). Analysis of variance (ANOVA) showed no overall difference between sender and no-sender conditions. That is, the quality of AC did not depend upon a sender. Significant AC was not observed for the dynamic targets regardless of the sender condition. We found a significant correlation between the quality of AC and the Shannon entropy of the targets. The details of this correlation and of the ANOVA results will be provided in the final report.

6.2.2.3 AC/Geomagnetic Activity Correlations

We may discover more about the impact of geomagnetic field fluctuations (GMF) on AC performance by research on possible medical effects that are modulated by very low frequency magnetic fields. Some literature suggests a connection between idopathic and epileptic seizures and GMF fluctuations. Currently, we are assembling a database of approximately 4,000 seizures and seizure-related mortalities. Preliminary analysis of a subset of this database suggests that both seizures and mortalities associated with seizures are weakly correlated with elevated GMF noise levels. GMF noise might be depressing the melatonin level, resulting in an increased probability of seizure. We have examined the database with respect to recordings of precise power levels in the ULF/ELF spectrum and found that the correlations persist.

6.2.2.4 Literature Search for AC Correlations

Mr. Charles Honorton of the Psychophysical Research Laboratories (PRL) has been subcontracted to conduct a detailed key-word parapsychology literature search for potential correlations between AC performance and external variables (e.g., personality, IQ), and to perform meta-analyses where appropriate. The meta-analyses portion of this task is complete: Clairvoyance and telepathy were examined with regard to Ganzfeld studies, the results were inconclusive because of insufficient data. The details of this meta-analysis will be provided in the final report.

6.2.3 Theoretical Issues

6.2.3.1 Assessment of Theoretical Constructs

Currently, one senior research physicist has been identified who is anxious to explore thermodynamic and general relativistic models to formulate hypotheses for the mechanism of AC. We have identified a systematic approach for the theoretical modeling.

6.2.3.2 Targeting

As part of its subcontract, the PRL is nearing completion of a detailed design to explore the potential of a beacon as a targeting mechanism. In addition, the experiment, which is described in Section 6.2.2.2 above, explores the role of a sender in AC experiments. Mr. Honorton has designed an appropriate investigation to address the sender/no-sender condition in the Ganzfeld.

6.2.3.3 Communication

We have designed a computer-based binary AC experiment that uses sequential analysis to enhance AC effects. The details of the experimental design can be found in our technical protocol, which is under review by the SOC.[5] Sequential analysis will improve a sample hit rate from a raw hit rate of 60% to an observed hit rate of 85%. We show in the technical protocol that this enhancement is 21% better than a one-in-three majority vote procedure. The experiment is nearly complete, and preliminary results indicate that some receivers are able to realize the predicted hit rate.

6.2.4 Altered States

6.2.4.1 Lucid Dreaming

The Lucidity Institute has been subcontracted to conduct a pilot experiment to study AC in lucid dreams. The details of the experimental design can be found in our technical protocol, which is under review by the SOC.[6] Experienced receivers and lucid dreamers will individually be given carefully double-wrapped and sealed targets drawn randomly from our standard set of *National Geographic* magazine photographs. With the aid of a DreamLight, a device to help induce a lucid dream, the experimental task is to

- become lucid in a dream
- open the sealed envelope (i.e., while still dreaming)
- study its content
- wake up and record the dream impressions

Analysis of the responses will follow the standard protocol for rank order judging.

As an introduction to lucid dreaming, the Lucidity Institute conducted a 3-day workshop in January for the participants in the experiment and a follow-up 1-day work shop in March. Trials began in late March.

We have experienced some difficulty in this experiment because the frequency of lucid dreams has been lower than expected. We will, however, provide the analysis of the complete trials in the final report.

6.2.5 Energetics

6.2.5.1 Anomalous Perturbation Protocol

At the sponsor's request, SAIC provided two receivers to participate in an exploratory anomalous perturbation (AP) experiment. The results of that exploration indicated that addition sessions must be conducted with similar AP target systems.

6.3 Applied Research

6.3.1 MEG Developments

6.3.1.1 Identification

There has been no additional activity for this item beyond that reported earlier.[4]

6.3.2 Correlations/Pattern Analysis

6.3.2.1 Correlations

We have used the fuzzy set database for the static targets that were used in the experiment, which is outlined in Section 6.2.2.2. We are currently examining the results of that experiment with regard to various levels in the target fuzzy sets.[7]

6.3.2.2 Beacon Conditions

PRL has been subcontracted to conduct a test of the sender/no sender condition in Ganzfeld experiments. A protocol is currently being prepared for review by the SOC, and the laboratory is now completed for the experiment. Mr. Honorton has designed protocols to test the role of the sender in the Ganzfeld environment. The protocols consider the results of the meta-analysis (see Section 6.2.2.4).

6.3.3 Training

6.3.3.1 Empirical Training Analysis

An analysis of one in-use training procedure, which uses a stimulus-response protocol has been completed. The results of that analysis will be provided in the final report.

6.3.3.2 Potential New Methods

We have designed a potential new training methodology that is based upon subliminal perception.

Background. Preconscious processing of sensory information may be responsible for much of the perceptual information that reaches conscious awareness. A trivial example is the processing of the left and right two-dimensional retinal images into a single three-dimensional cyclopean percept. Because the eyes view the world from different viewpoints, the two retinal images are not superimposable, and frequently contain different information about the external environment. In those abnormal instances where both retinal images reach conscious awareness, the viewer perceives diplopic images of the external environment, that is, he has double vision. The observations that the cyclopean image is not retinotopic for either eye and that the cyclopean image is created without conscious effort are strong support for preconscious processing of sensory information.

A more significant example is provided by the Poetzl effect,[8] in which an unperceived stimulus is capable of evoking subsequent memories of having perceived the stimulus. Very often, the memories are distorted, but contain spatial, chromatic, textural, temporal, and contextual elements of the previously unperceived stimulus. This effect provides evidence of preconscious processing of not only the unperceived stimulus, but of its primitives in several domains, such as color.

The most compelling evidence for preconscious processing is provided by a body of research commonly known as blindsight.[9] Blindsight can occur when anatomical brain structures that are crucial to visual perception, such as the striatal cortex, have been destroyed, but the remainder of the visual system is intact. Under these conditions, any visual stimulus that falls on an area of the retina that projects to the destroyed area of the striate cortex cannot reach perceptual awareness. A person with this condition is blind in this area of the visual field. A large body of evidence, however, demonstrates that persons with this condition can respond to visual stimuli, even though they cannot see them. Furthermore, persons with blindsight can make visual discriminations, for example of form and color, without perceiving the form or color of the stimuli. Blindsight, then, is a compelling example of preconscious, or perhaps extraconscious processing.

Other evidence of preconscious processing can be found by comparing the sensory and perceptual thresholds. The sensory threshold can be determined physiologically by measuring the amplitude of a stimulus that elicits an identifiable signal in a receptor system, for example, a change in the firing rate of a sensory neuron. The perceptual threshold can be defined as that amplitude of the same stimulus that elicits a response indicating that the stimulus has been detected. It is a well-known phenomenon that the sensory and perceptual threshold can differ markedly.[10,11] Thus, between the sensory and perceptual thresholds, the receiver is processing information that is below the perceptual threshold, that is, preconscious processing.

The question of interest here is whether the perceptual threshold can be reduced so that it is closer to the physiological threshold. Several studies suggest conditions under which the perceptual threshold can be lowered to more closely approximate the sensory threshold. For example, changing the emotional content of the stimuli or the emotional state of the viewer has been shown to affect the perceptual threshold for subliminal stimuli.[12,13] Essentially, reducing the emotional state of the subject or elevating the emotional content of the stimulus reduces the perceptual threshold.

The question can now be refined further to ask whether the perceptual threshold can be reduced through training. Couched in terms of signal detection theory, the question can be posed: Can the subject's threshold be changed through training so that the subject can detect a signal at a lower signal-to-noise ratio?

Here, again, the answer is yes. Detection thresholds have been found to respond to training protocols that use feedback on repeated trials to elevate sensitivity to previously unperceived visual cues.[14,15,16] We propose to change the detection threshold through a program of repeated feedback.

Purpose. This study has a two-fold purpose. The first is to assess the effects of training protocols on the detection thresholds for subliminal visual stimuli. The second is to examine whether those subjects whose thresholds were lowered by training perform better on remote viewing tasks than subjects who have not been through the training. By using threshold-lowering training protocols, we will attempt to increase the sensitivity of human subjects to subliminal visual stimuli so that following training, stimuli that had been subliminal will be supraliminal. We will then determine whether there is a parallel increase in sensitivity to AC stimuli.

Methods. Subjects will first be randomly assigned to a subliminal-training group and a sham-training group. No subject will be informed of his status until both the training and remote-viewing portions of the study have been completed.

Each subject in either group will be shown a series of target images that are presented tachistoscopically for approximately 10 milliseconds, alternating with a 5-second presentation of a masking stimulus. All target images will be below the subject's detection threshold, that is, they will be subliminal. Interspersed randomly among the subliminal stimuli will be an equal number of blank trials in which no target image is presented during the 10-millisecond presentation.

Immediately following each presentation of either the blank or target stimulus, the subject will respond by pressing a button indicating either that he was aware that a target was presented or that he was unaware. Essentially, the subject's task will be to report whether a target was presented. After each response, the subject will receive feedback about whether his response was correct or incorrect. The experimental paradigm is shown in Figure 1.

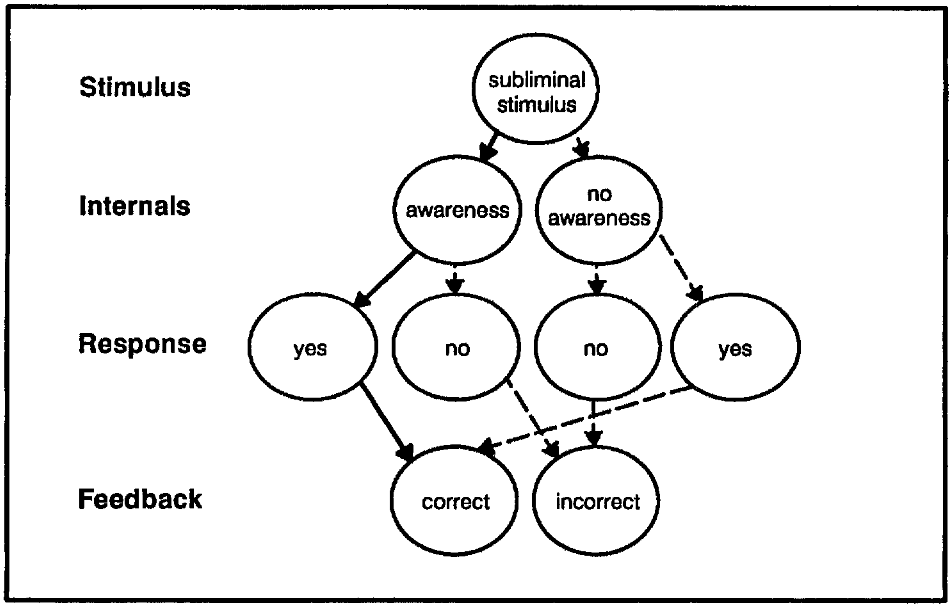

Figure 1. Experimental Paradigm for Training.

Subjects in the subliminal-training group will receive truthful feedback about their performance, whereas subjects in the sham-training group will receive random feedback. Because all stimuli will be subliminal, sham-training subjects should not be able to detect that the feedback is uncorrelated with the stimuli.

Feedback to the subliminal-training subjects is expected to reinforce the pathways identified by bold arrows in Figure 1. The proportion of "yes" responses under blank-trials conditions (i.e., sham-training) will be used to estimate the guessing rate.

Several hundred trials will be run, and cumulative performance measures, in terms of percentage of correct responses, will be calculated for each of the sham-trained and subliminally-trained subjects. Subjects from both groups will participate in a blind study of remote-viewing performance.

6.3.4 Applications

6.3.4.1 New Approaches

There was no activity for this item during the reporting period.

6.3.4.2 Communications

We developed a technical protocol, which is currently under review by the SOC, that applies standard Bose-Chaudhuri-Hocquenghem (BCH) codes to AC analysis.[17] The BCH code that was selected includes two message bits and three check bits and will correct for all single errors and some double errors.[4] Six receivers completed this experiment. The rank-order analysis did not demonstrate statistically significant evidence for AC; therefore, the BCH analysis was not successful at enhancing evidence for AC. This experiment, however, did indicate unforeseen difficulties with the particular protocol. Even though we attempted to prevent receivers from guessing the answers to the analysis questions, they reported that after the first trial, they were unable to function in their "normal" AC mode. In addition, we gained insight into the nature of successful target pool construction. The details of this experiment will be provided in the final report.

6.3.4.3 Enhancement

In analyzing the results of all the experiments, we have gained valuable insight into the nature of what constitutes an AC target system. A general picture is emerging that suggests a target selection method that is sensitive to a possible fundamental limitation to the amount of information that may be gained by AC and is optimized with regard to specific intrinsic properties. Details will be provided in the final report.

6.3.4.4 Analysis

We have developed an adaptive fuzzy set procedure that may be applied to both laboratory and field applications. In this procedure, the analysis of a current AC session is modified to include the statistical past "successes" of the specific receiver. The details of the technique will be provided in the final report.

6.4 Research Methodology

6.4.1 Scientific Oversight Committee

The SOC was not involved during this reporting period. One member, however, did visit the laboratory and provided valuable addition to the MEG statistical analysis.

6.4.2 Institutional Review Board

The Institutional Review Board did not meet during the reporting period.

IV GLOSSARY

Not all the terms defined below are germane to this report, but they are included here for completeness. In a typical anomalous mental phenomena (AMP) task, we define:

- Anomalous Cognition—A form of information transfer in which all known sensorial stimuli are absent. That is, some individuals are able to gain access, by as yet an unknown process, to information that is not available to the known sensorial channels.
- Receiver—An individual who attempts to perceive and report information about a target.
- Agent—An individual who attempts to influence a target system.
- Target—An item that is the focus of an AMP task (e.g., person, place, thing, event).
- Target Designation—A method by which a specific target, against the backdrop of all other possible targets, is identified to the receiver (e.g., geographical coordinates).
- Sender/Beacon—An individual who, while receiving direct sensorial stimuli from an intended target, acts as a putative transmitter to the receiver.
- Monitor—An individual who monitors an AC session to facilitate data collection.
- Session—A time period during which AC data are collected.
- Protocol—A template for conducting a structured data collection session.
- Response—Material that is produced during an AC session in response to the intended target.
- Feedback—After a response has been secured, information about the intended target is displayed to the receiver.
- Analyst—An individual who provides a quantitative measure of AC.
- Speciality—A given receiver's ability to be particularly successful with a given class of targets (e.g., people as opposed to buildings).

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