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Editorial

The editorial team and board members are under contingencies to verbally prompt (i.e., encourage) behaviorologists, and other natural scientists of behavior, to submit manuscripts for publication in the *Journal of Behaviorology.* For a discipline to grow, it must generate and disseminate scientific products and the world is certainly in need of such products now. In order to set the occasion for verbal behavior associated with manuscript preparation and submission, consider the following.

Publication credit can generate a number of short and long term reinforcement opportunities. The growth of a discipline sets the occasion for further reinforcer availability. The *Journal of Behaviorology* is fully peer-reviewed and, being open access, enjoys a wide readership; also, authors retain copyright of their articles, which may then be disseminated in various other ways. The editorial team is standing by, ready to assist authors with topic selection and the honing of textual products and ultimately in contributing to the expansion of behaviorology and solving of some particularly troubling behavior problems, be they global in nature or relevant to individuals.

One potential impediment to writing and submission behaviors can be verbally supplemented procrastination and a lack of evoked ideas for articles. Behaviorology is in a unique phase at the moment. Those that organized the discipline are retiring, and a new generation is being encouraged to "step up to the plate," so to speak, in order to ensure that the discipline continues to thrive and expand. This new generation of behaviorologists may exhibit behaviors we might tact as reluctance or intimidation as they follow contributions from such prolific authors as Lawrence Fraley and Stephen Ledoux. One reluctance-diminishing thought is that we may, but need not necessarily, contribute essays that update and extend the same topics that previous authors addressed. One idea that is not exploited frequently, perhaps because the contingencies are not evident, is a report on what the author is currently working on as a behaviorologist—how they are applying behaviorology. Whatever you are working on involves behavior and thus behaviorology and so would likely be of interest to others. It does not need to be a report of research, but rather, may be simply an accounting of how you are applying behaviorological principles. Another idea might involve an article that explores the marketing or advancement of behaviorology in academic and/or public communities. While reports of research are always welcomed, theoretical works, review-of-topic articles, and explicative essays are welcomed as well.

Furthermore, established authors are urged to continue to generate and submit articles as a means of continuing to support behaviorology even after "retirement" and establish "inspirational" contingencies to younger behaviorologists. Retirement can make available time to engage is such behaviors that previously was made impossible by counter-contingencies.

Behaviorology is vitally important for the future of humanity. With behavior analysis remaining claimed by the incommensurable discipline of psychology, and being relegated to technologist level participation with special populations, behaviorology remains the only completely independent and comprehensive natural science discipline of behavior. The expansion of behaviorology is vital in order to help humanity resolve its ever growing problems. Humanity needs our discipline more than ever. Consider participating further and generating the reinforcers so deserving of contributing behaviorologists!

- James O'Heare, DLBC, JoB Editor

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Electrophysiological activity during stimulus class formation

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Abstract

Electrophysiological activity in normal adults was observed during baseline, training and testing of stimulus equivalence. The results indicate that the electrophysiological activity was broadly similar to that seen in research on memory and verbal recall tasks, with an increase in alpha power but a decrease in delta and theta power. Differences between stages were detected in the delta and alpha frequency power, most notably in the midline, central and right regions. No effects were detected in the theta range, where activity did not change substantially between stages. Implications for future dialogue between behaviorology and other biological sciences are discussed as well as methodological problems and future research.

Keywords: Stimulus equivalence, EEG, biological behaviorology.

In behaviorology, the subject matter is behavior; however, the definition of "behavior" is somewhat unclear even within the "behavioral sciences". Usually "behavior" refers to outwardly visible behaviors, but as Skinner made clear in his writings, private events are important behavioral events that need to be studied using the methods of behaviorology (Skinner, 1974). The applications of operant principles has also been proposed on single cell activity (Stein, Xue & Belluzzi, 1993), neural networks (Donahoe & Palmer, 2004; Donahoe, Burgos & Palmer, 1993), and group behavior (Hull, Langman & Glenn, 2001; Glenn, 2004).

Unfortunately, a chasm has emerged between behaviorology and other natural/behavioral sciences interested in human behavior (such as neuroscience and sociology for example). This chasm is characterized by a lack of communication between the two sides, misunderstanding of the techniques used, and consequently a delay in the relaying of new and emerging information. A database search with the terms "cognition" and "stimulus equivalence" yielded no significant results outside of journals published by the Association for Behavior Analysis (ABA), highlighting the lack of penetration that this important research has had outside of the behavioral field. Conversely, since the beginning of the peer review of this journal (Spring 2012) no references to modern neuroscience (either critical or complimentary) have been made. The behavior analytic journals fair better with frequent references to cognitive neuroscience, but if behaviorologists aim to place behaviorology squarely within the other biological sciences we must open a dialogue. Historically this rift was caused by the dualistic nature of explanations within psychology, neuroscience and sociology, and behaviorology's denial of these dualistic explanations and subsequent embrace of more modern monistic ontologies and scientific methods. This rift is exemplified by the discussion of behaviorological research on language and cognition (private events) in the cognitive literature. Most often behavioral explanations on language and cognition mention Skinner's Verbal Behavior (1957), and Chomsky's subsequent critique

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(1959). Rarely (or ever) are decades of research on verbal behavior mentioned, the excellent rebuttals from MacCorquodale (1970) and Palmer (2000), let alone the important contributions of Sidman (stimulus equivalence), Horne and Lowe (naming theory), and Hayes (relational frame theory). These attempts to interpret and explain complex "cognition" in behavioral terms might be one of the most important challenges for behaviorology and behavior analysis, and could be enough to at least invite doubt on the part of the most sceptic cognitive theorist about the sufficiency of behaviorological explanations of complex events such as analogical reasoning (Stewart & Barnes-Holmes, 2009) and metaphors (Stewart, Barnes-Holmes, Hayes, & Lipkens, 2001).

Within behaviorology, we rarely see the acknowledgement of the rejection of dualistic explanations in the traditional dualistic fields of psychology and neuroscience. These include the flat out rejection of the existence of memory, and instead an embrace of neural activation as a part of a longer causal chain in the behavior of remembering. This shift from the dualistic concept of memory, to the monistic neural activation caused by a physical signal should be embraced by behaviorologists as this moves psychology and neuroscience away from pre-scientific vocabulary that previously dominated these fields. Other advances, such as neurofeedback, have also been largely overlooked by behaviorologists even though the central tenet of neurofeedback is the use of operant conditioning to regulate spontaneous neural activity, which in turn has been linked with various behavioral deficits (like ADHD). It is therefore imperative that a dialogue be opened between the different fields, and we hope that this article is a step in this direction.

As previously stated, stimulus equivalence might be the most important recent contribution within behaviorology. Stimulus equivalence describes a behavioral outcome in which individuals respond to different stimuli as if they are the same, without being directly trained to do so and without any consistent physical or perceptual similarity amongst those stimuli being necessary. Stimulus equivalence is typically observed after a series of conditional discriminations (Critchfield & Fienup, 2008). In one example of such training, a participant might be taught to choose one particular 'B' arbitrary stimulus comparison from amongst an array in the presence of each of a number of arbitrary 'A' stimulus samples. Subsequently, they might be trained to choose 'C' stimulus comparisons for each of a number of 'B' stimulus samples. After this conditional discrimination training, the following untrained (or derived) responses might be observed: reflexivity (identity matching, choosing A in the presence of A), transitivity (choosing C in the presence of A), symmetry (choosing A in the presence of B or B in the presence of C) and, finally, combined symmetry and transitivity, referred to as equivalence (choosing A in the presence of C). According to Sidman, the properties of reflexivity, transitivity and symmetry constitute the defining properties of the stimulus equivalence relation (Sidman, 1994; Galizio, Stewart & Pilgrim, 2001; Wirth & Chase, 2002).

Stimulus equivalence seems similar in certain respects to human language. For example, when a child is taught to read and write, "spoken words […] are trained to visual stimuli […] and then to written symbols" (Pierce & Cheney, 2004, p. 445).

This is one possible way of understanding how words acquire meaning or the behavioral basis for complex phenomena such as categorization (Galizio, Stewart & Pilgrim, 2001). More importantly, a range of empirical results supports a link between equivalence and language. Devany, Hayes & Nelson (1986) compared three groups of children with the same mental age on a test of equivalence. The first group consisted of normally developing children, the second one of developmentally delayed children with expressive speech abilities and the last one developmentally delayed children with language deficiencies. Their results showed that the children in the first two groups displayed equivalence, but not those in the third group. This would indicate that equivalence ability could be predicted by language proficiency rather than general intelligence or cognitive ability. Hayes & Bissett (1998) also found that stimulus relations can be used as a behavioral model for semantic meaning. Participants in their experiment were trained in three 3–member equivalence classes where the stimuli used were nonsense words designed to resemble real words. Next, the participants were exposed to a priming paradigm and the stimulus pairs used were the nonsense words used in the equivalence training. Participants were shown a total of 24 pairs of equivalence class members that had previously been directly trained (8 pairs), or related via symmetry (8 pairs) or equivalence (8 pairs). For comparison, the participants were also shown 24 pairs of unrelated stimulus pairs. The results showed that the words which belonged to the same equivalence class showed a priming effect similar to those seen with semantically related words (e.g., bread-cake or tiger-cat).

The link between stimulus equivalence and language has also been indicated in a series of more recent studies that have examined physiological activity during stimulus equivalence formation. Research has shown that activity during stimulus equivalence is similar to activity observed during language tasks. This similarity is evident both in terms of location (Dickins et al., 2001; Schlund et al., 2007) and type of activity (Barnes-Holmes et al., 2004, 2005a, b).

Dickins et al. (2001) was the first published study to report patterns of brain activation during equivalence testing. Dickins et al used fMRI preparation to "shed light on possible underlying or mediating processes involved in stimulus equivalence" (p. 2). Participants were trained in 6 three-member classes of iconic (nameable) stimuli in a multi-stage error-free training procedure. The images used in each A–B–C class were semantically unrelated (i.e. A = plant, B = plane, C = dog) so that semantic relations would not facilitate training. A–B relations were trained in six blocks of training trials. In the first block the A stimulus was presented at the top of the screen and simultaneously a row of six boxes was presented at the bottom and a single correct B comparison stimulus was randomly inserted in one of those boxes (i.e. if the sample was A1 then the comparison was B1). No incorrect comparisons were presented at that time. The six sample-comparison pairs were presented in random order where the same stimulus was never presented twice in a row. More comparisons were gradually added in each block until all stimuli from the B class were presented in the sixth block. A mastery criterion of 19 correct out of 20 trials was applied in all blocks. The same methodology was then employed in establishing B–C relations.

Three days after successfully finishing training, participants were exposed to an equivalence test and a test of verbal fluency while fMRI was used to monitor brain activity. Blood-oxygen-level dependence (BOLD) during the equivalence and verbal fluency tests were compared. This activation showed important similarities and differences. During the test of verbal fluency, participants showed left-lateralized activity, especially in the dorsolateral prefrontal cortex (DLPFC) adjacent to the middle and inferior frontal gyri. These correspond to Broadmann areas 9, 44, 45, 46 and 10 as well as Broca's, areas of the brain which have been correlated with language behavior. Activity was also detected in the left posterior parietal cortex as well as lesser activity in the anterior cingulated cortex, insular and bilateral primary visual cortex, the posterior superior temporal sulcus, medial frontal cortex, left caudate nucleus and thalamus/pulvinar. During the equivalence test no activation was found at Broca's area and activation found in the DLPFC and posterior parietal cortex was more bilateral than during the task of verbal fluency. Additionally, the equivalence task activated the BA10 Broadmann area but did not activate the superior temporal sulcus which the verbal fluency task had done. Nevertheless, the authors concluded that the similarity in activity between the equivalence test and the test of verbal fluency supported the view that there is "a linguistic basis for stimulus equivalence" (p. 5).

In a more recent study, Schlund et al. (2007) exposed participants to a two-step matching to sample (MTS) equivalence procedure. In the first step, participants were trained in A–B and B–C relations and in the second step they were measured for fMRI activity while exposed to equivalence testing. The MTS task in both steps was identical, with one sample and two comparison stimuli being presented in each trial and the incorrect comparison being the cross-class equivalent of the correct comparison (e.g. when B1 is correct then B2 is incorrect). Schlund et al.'s results indicated similar activation patterns as Dickins et al. for frontal and parietal regions for trained (A–B and B–C) and derived relations (pooled symmetry, transitivity and equivalence responding). The main discrepancies between Schlund et al. and Dickins et al. were that the former failed to replicate the left lateralized effect seen by Dickins et al. Schlund et al. observed a predominantly right cerebral activation for trained, derived, transitive and equivalence relations. However, as Schlund et al. pointed out these differences might have been due to differences in methodologies and stimuli used.

Given fMRI's excellent spatial resolution, it is eminently suitable for the identification of brain areas involved in a particular task. However, this spatial resolution comes at the expense of temporal resolution. This lack of temporal resolution makes it hard to identify moment to moment changes in the brain which could possibly contribute to complex cognition. To increase temporal accuracy, researchers employ the electroencephalograph (EEG) which measures neural electrophysiological activity with a temporal resolution of one thousandth of a second. Additionally, EEG can differentiate between different types of electrical brain activity, called frequencies. These frequencies, or brain waves, have been linked with various activities such as remembering, speech, categorization and sleep (Fisch, 1999; Niedermeyer, 2005).

Behavior analysts who have studied the electrophysiology of learning have focused on the event related potentials (ERP). ERPs are created using averaged EEG activity around a particular stimulus, and are time-locked to that stimulus (Churchland & Sejnovski, 1992). Thus, the ERP identifies averaged brain activity within a few hundred milliseconds of stimulus presentation. Barnes-Holmes et al. (2004, 2005a) showed that an ERP component called the N400, which has been linked with semantic processing, is sensitive to equivalence relations. The N400 is an EEG component that consists of a negative ERP deflection that occurs approximately 400ms following stimulus presentation and is most pronounced when participants are exposed to semantically-unrelated words (e.g., Cup-Mother). Barnes-Holmes et al. found that semantically unrelated words elicited the largest N400 response, semantically unrelated but equivalent trained words elicited a smaller response and finally semantically related words which had not been connected via equivalence training elicited almost no N400 deflection. They also found that averaged activity between 350 and 550 ms after the presentation of the stimuli were greater for the left hemisphere than the right for the equivalent word pairs versus the nonequivalent word pairs.

Despite the temporal accuracy of the ERP method, it has some disadvantages. The signal detected using ERP is the product of many sources of activity in different areas of the brain. Furthermore, different electrophysiological frequencies (or waves) combine to make up the ERP signal. Some of these individual frequencies have been correlated with tasks involving language and cognition (private events). According to Klimesch (1999), three types of frequencies are foremost linked to cognitive and memory tasks; delta, theta and alpha, all of which can be detected with a spectral analysis of the EEG such as the Fast Fourier Transform (FFT). Delta waves are traditionally classified as those lower than ≈4 Hz, theta waves as those between ≈4 and ≈8 Hz and alpha waves as those between ≈8 and ≈13 Hz. By analyzing the raw EEG signal using FFT, it is possible to decompose the average brain activity at a given time point into its possible components. FFT can then be used to identify the amount of particular frequency that would give rise to the observed activity. For example, it can be observed that during a memory task, theta frequency is proportionately lower compared to baseline, than delta; hence, theta is correlated with the task being solved, while delta is not.

To date, one study has been published that employed spectral analysis of electro-physiological activity during derived relational responding (Roche, Linehan, Ward, Dymond & Rehfeldt, 2004). Roche et al. concluded that alpha activity above the frontal midline and left temporal lobe correlated positively with proficiency on the relational responding task. This coheres with the results previously reported by Dickins et al. (2001) and Schlund et al. (2005), indicating these regions as the most relevant with respect to stimulus equivalence performance. Although their pioneering work was commendable, one possible limitation to their results was that of the nineteen original participants recruited for the experiment, only three produced EEG data of high enough quality to be included in the final results.

Although delta, theta and alpha waves can be found in both human and nonhuman mammals, alpha waves are the most prominent in the human cortex while theta and delta are more prominent in other mammals (Niedermeyer, 2005; Rowan & Tolunsky, 2003). Specifically, alpha frequencies can be detected in more locations on the scalp of human than nonhuman mammals and there is greater power in the alpha frequency band in humans. There are individual differences in resting alpha power and several studies (Klimesch, Vogt & Doppelmayr, 2000; Sederberg et al, 2003) have suggested that higher resting alpha power can be used to predict performance on cognitive tasks. On the whole, relatively large alpha waves and small theta and delta waves characterize individuals that do well on cognitive tasks.

As healthy adults proceed from a resting condition (i.e., eyes closed) to a testing condition, alpha power decreases while delta and theta power increases (Keane, James & Hogan, 2007; Keane & James, 2008; Klimesch, 1999). Controlling for individual differences, power in the alpha frequency is lower during tasks that require mental effort than during baseline. During various working memory tasks, such as mental calculation (Harmony et al., 1999, 2001), letter series recall (Onton, Delorme & Makeig, 2005) and Sternberg memory task (Jensen & Teschle, 2002), theta power increases from baseline and similar changes can be seen in delta, while the opposite is observed in alpha (Basar, Basar-Eroglu, Karakas & Schürman, 1999 and 2001; Keane, James & Hogan, 2007; Keane & James, 2008).

Spectral power analyses (such as FFT) of electrophysiological activity provide ongoing data on neuronal activity that may elucidate the formation of stimulus equivalence classes (see for example Deutsch, Oross, DiFiore & McIlvane, 2000 and Roche, et al., 2004). To date, one study has been published that employed spectral analysis of electro-physiological activity during derived relational responding (Roche et al., 2004). The researchers concluded that alpha activity above the frontal midline and left temporal lobe correlated positively with proficiency on the task. This corresponds to the results previously reported by Dickins et al. (2001) and Schlund et al. (2005), pointing again to these regions as the most relevant to equivalence responding.

The current study extends and expands previous research on the biological aspects of stimulus equivalence and derived relations by using a variation of a well-established equivalence protocol used by Dickins et al. (2001). Although a linear protocol is not the preferred method of training in derived relational responding research, it has been used by authors investigating the biological correlates of derived relational responding (DRR) (Dickins et al., 2001; Schlund et al., 2007) and was therefore employed in this experiment.

In contrast to Dickins et al., who searched for anatomical locations active during equivalence, this study looked at oscillations most commonly associated with language, cognition and memory. Delta was predicted to show an overall increase in task conditions compared with baseline and temporal and posterior regions were expected to be more active during task conditions than during baseline. It was predicted that theta would show an overall decrease from baseline to task and would be most prominent in the frontal and temporal regions during task conditions. No specific hemispheric differences were expected for theta. Lastly, alpha activity was expected to decrease from baseline to both training and testing while theta and delta activity were expected to show an overall increase. During baseline, alpha activity was expected to increase more in the occipital areas than in other areas; while this difference was expected to be minimal during task conditions (Niedermeyer, 2005).

Method

Participants

13 healthy adult human (4 male) participants took part in the study. All participants were between 17 and 25 years of age, were right handed and had normal or corrected to normal eyesight; none reported taking psychotropic medication, or had previously sustained traumatic brain injury. All participants were first year students at the National University of Ireland, Galway and participated as part of their course credit. The study was approved by the NUI Galway Research Ethics Committee.

Apparatus

Training and testing involved a PC computer with Microsoft Visual Basic 6 (VB) software for stimulus presentation and recording of behavioral data. Iconic stimuli were adopted from Dickins et al. (2001) and were presented on a Compaq S716 16’ monitor using a Windows 98 operating system. Silver/silver-chloride (Ag/AgCl) recessed ring electrodes were used. All electrode cables were individually shielded (ActiShieldTM) and all channels were amplified against the average of all connected inputs. A Quick-Amp 40 EEG amplifier (Brain Products, GmbH, München, Germany) was used with BrainVision Recorder (v. 1.03.0001) and BrainVision Analyser (v. 1.05) software.

Stimuli

The stimuli were grouped together in classes as follows: A1–B1–C1, A2–B2–C2, A3–B3–C3, A4–B4–C4, A5–B5–C5 and A6–B6–C6. The alphanumeric labels refer to images used in the experiment but were not known to any of the participants (see Figure 1 for a complete list of stimuli used along with their alphanumeric labels).

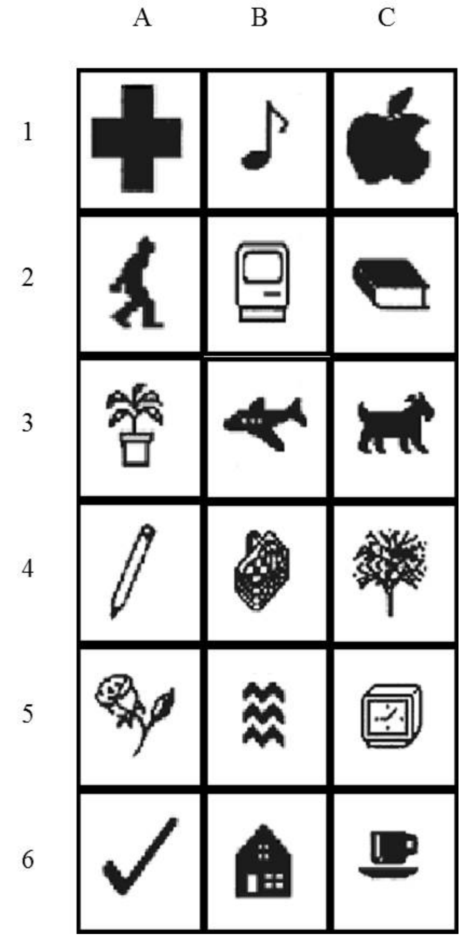


Figure 1. Stimuli used in the experiment, sorted by equivalence classes and alphanumeric denotations.

General Procedure

Participants signed up for research participation on the School of Psychology's internal website. On the website the experiment was described as a memory and categorization experiment for which participants were required to be right handed, not suffering from traumatic brain injuries or debilitating brain diseases and free of psychotropic medication. Upon arrival at the laboratory, participants signed the informed consent form and filled out a questionnaire regarding traumatic brain injury and psychotropic medication. Handedness was then assessed verbally by the experimenter. After participants had completed the demographic questionnaire and their handedness had been evaluated they were prepared for EEG. They were seated comfortably in front of the computer in the experimental cubicle and were asked to relax for 5 minutes with eyes closed and for 5 minutes with eyes open. These 10 minutes constituted the EEG baseline. The following instructions were delivered verbally to all the participants by the experimenter:

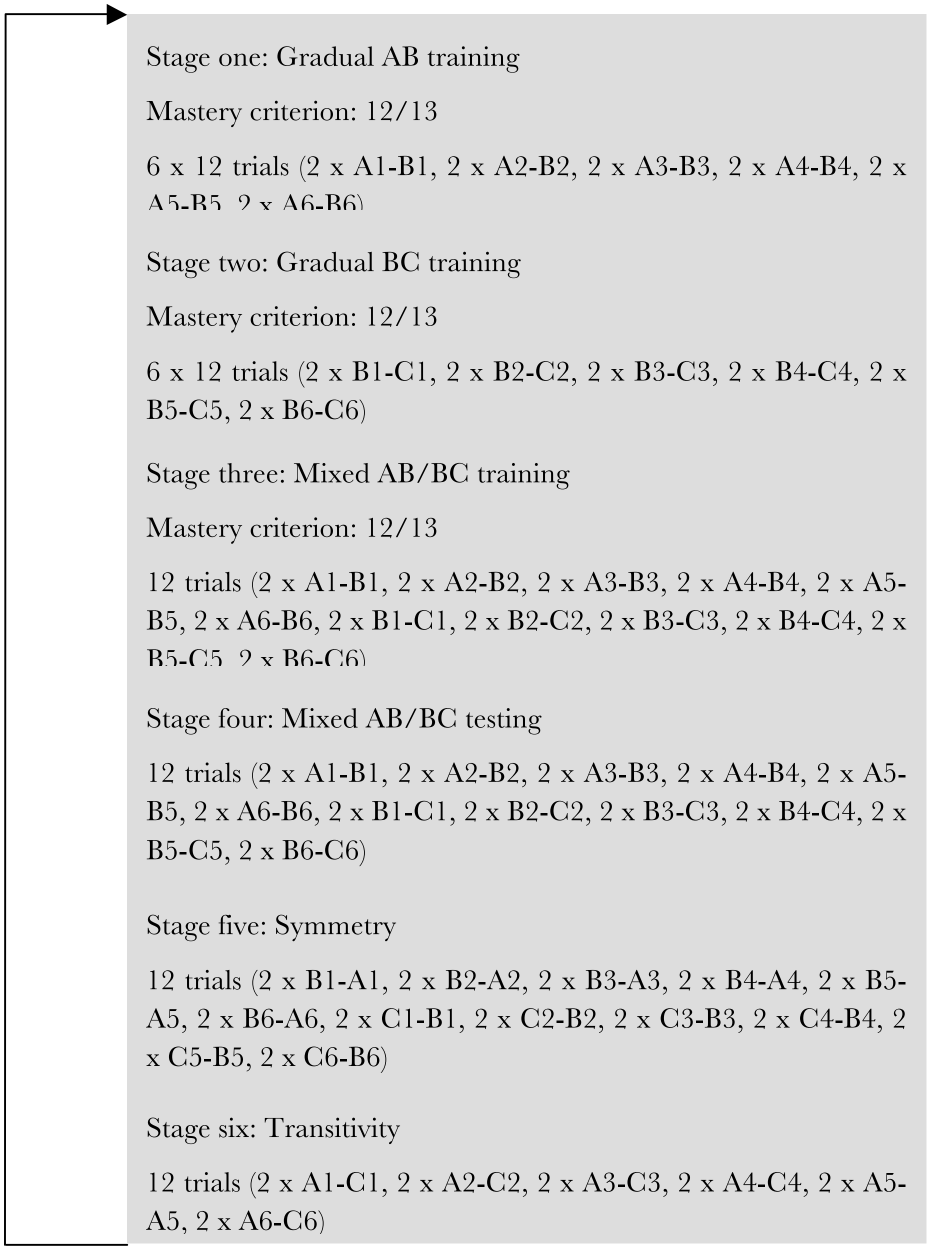
> Thank you for participating in the experiment. The experiment is a memory and categorization experiment

> in several stages during which we will monitor your brain activity. We will ask you to close your eyes for 5 minutes and relax, and then relax with your eyes open for another 5 minutes. After that the task will begin. First, you will see an image on the screen and a row of empty boxes. Shortly after that, an image will appear in one of the boxes and you can choose that image using the mouse. Gradually, all the boxes will be filled with images and you will have to remember which image in the bottom boxes corresponds, or goes with, the image you see on top of the screen. The computer will give you feedback for most of the time, but that feedback will stop at some stage. If you feel discomfort at any stage, you are free to terminate the session.

Following this the participants' baseline EEG activity was recorded and then the task began. The task was split into seven experimental stages each of which are described in detail below (see Figure 2). Stage 1 consisted of six blocks of AB training; Stage 2 consisted of six blocks of BC training; Stage 3 involved one block of mixed AB and BC training; Stage 4 involved one block of mixed AB and BC testing; Stage 5 consisted of two blocks of symmetry (BA and CB) testing; Stage 6 consisted of two blocks of transitivity (AC) testing and Stage 7 involved two blocks of equivalence (CA) testing.

EEG Data Preparation and Analysis

EEG activity was measured using a commercially available EEG cap (EASY CAP EC 40; EASYCAP GmbH, Herrsching-Breitbrunn, Germany) at the following 32 sites (which are in accordance with the international 10–20 electrode placement system): Fp1, Fp2, F3, F4, C3, C4, P3, P4, O1, O2, F7, F8, T7, T8, P7, P8, Fz, Cz, Pz, FC1, FC2, CP1, CP2, FC5, FC6, CP5, CP6, TP9, TP10, PO9, Iz and PO10. Each electrode site was prepared by abrading the skin and bridging the gap between the electrode and the scalp with a chloride-free abrasive electrolyte gel. Impedances were assessed using BrainVision Recorder (v. 1.03) software (Brain Products, GmbH, München, Germany) and were kept below 8 kΩ. Silver/silver-chloride (Ag/AgCl) recessed ring electrodes were used. All electrode cables were individually shielded (ActiShield™) and all channels were amplified against the average of all connected inputs. A QuickAmp 40 EEG amplifier (Brain Products, GmbH, München, Germany) was used in conjunction with BrainVision Recorder and BrainVision Analyser (v. 1.05.0003) software (Brain Products, GmbH, München, Germany). Sampling rate was 1000 Hz and frequencies between 0.5–12.5 Hz were used for analysis. Vertical (VEOG) and horizontal (HEOG) electrooculogram activity were also recorded to control for eye blink artefacts. Following offline ocular correction, artifact free, 2000 ms epochs of EEG data following the presentation of comparison stimuli were selected for analysis. These epochs were chosen irrespective of correct or incorrect responses.



Stage one: Gradual AB training

Mastery criterion: 12/13

6 x 12 trials (2 x A1-B1, 2 x A2-B2, 2 x A3-B3, 2 x A4-B4, 2 x A5-B5, 2 x A6-B6)

Stage two: Gradual BC training

Mastery criterion: 12/13

6 x 12 trials (2 x B1-C1, 2 x B2-C2, 2 x B3-C3, 2 x B4-C4, 2 x B5-C5, 2 x B6-C6)

Stage three: Mixed AB/BC training

Mastery criterion: 12/13

12 trials (2 x A1-B1, 2 x A2-B2, 2 x A3-B3, 2 x A4-B4, 2 x A5-B5, 2 x A6-B6, 2 x B1-C1, 2 x B2-C2, 2 x B3-C3, 2 x B4-C4, 2 x B5-C5, 2 x B6-C6)

Stage four: Mixed AB/BC testing

12 trials (2 x A1-B1, 2 x A2-B2, 2 x A3-B3, 2 x A4-B4, 2 x A5-B5, 2 x A6-B6, 2 x B1-C1, 2 x B2-C2, 2 x B3-C3, 2 x B4-C4, 2 x B5-C5, 2 x B6-C6)

Stage five: Symmetry

12 trials (2 x B1-A1, 2 x B2-A2, 2 x B3-A3, 2 x B4-A4, 2 x B5-A5, 2 x B6-A6, 2 x C1-B1, 2 x C2-B2, 2 x C3-B3, 2 x C4-B4, 2 x C5-B5, 2 x C6-B6)

Stage six: Transitivity

12 trials (2 x A1-C1, 2 x A2-C2, 2 x A3-C3, 2 x A4-C4, 2 x A5-A5, 2 x A6-C6)

If fail, then back to stage one

Figure 2. Schematic outline of the experimental procedure.

The 32 electrodes were grouped into 9 regions divided along the coronal (front to back) and sagittal (left to right) planes: Left Frontal (LF), Mid Frontal (MF), Right Frontal (RF), Left Central (LC), Mid Central (MC), Right Central (RC), Left Posterior (LP), Mid Posterior (MP) and Right Posterior (RP) (see Keane, James & Hogan, 2007; Keane & James, 2008). The electrode groupings can be seen in Figure 3.

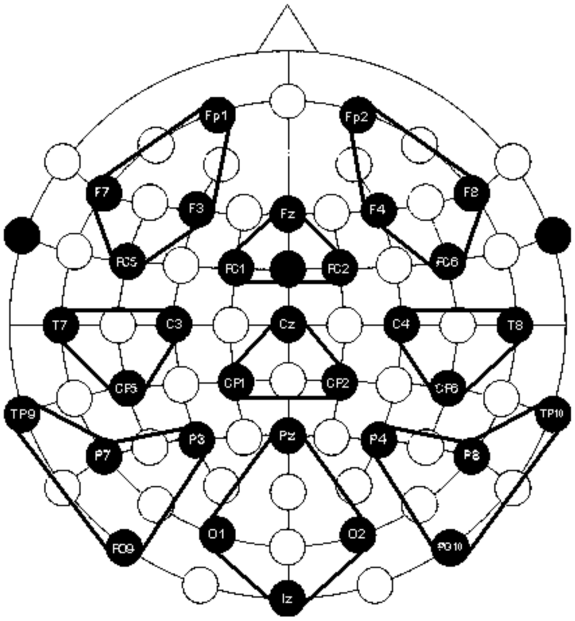


Figure 3. Electrode grouping used for EEG analysis.

Conditional Discrimination Training

Conditional discriminations, necessary for the formation of 6 three-member equivalence classes, were trained using a gradual error-free linear protocol[a]. All trials were delayed matching to sample (MTS) and were designed in the same way: A blank screen, which acted as the inter-trial interval (ITI), was presented for 500 ms. Then the sample appeared for 1000 ms at the top center of the screen before the comparison(s) were presented at the bottom of the screen. Both the sample and comparisons remained on the screen until a response was made. All stimuli were easily namable images (see Figure 1) adopted from Dickins et al. (2001). The images were presented within a black border and measured 4x4 cm. Following the response, the stimuli were removed and feedback, either 'Correct' (in green) or 'Wrong' (in red), was presented in 48 pt. Times New Roman font at the center of the screen for 1000 ms followed by the ITI. The conditional discrimination training included three stages. Stages 1 and 2 employed graduated training as follows. In Stage 1 the following conditional discrimination was trained: A1 → B1, A2 → B2, A3 → B3, A4 → B4, A5 → B5 and A6→ B6. In the first trial in the first block in Stage 1, one B stimulus was presented in the presence of the corresponding A stimulus (B1 in the presence of A1, see Figure 4, upper panel). In this block, participants chose the only available stimulus and feedback was provided. In each subsequent block of Stage 1 one further comparison was presented. Finally, in block 6, all six possible comparisons were presented (See Figure 4, lower panel). A mastery criterion of 12 cumulative correct, which allowed for one incorrect response (12 out of 13 cumulative

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[a] A linear protocol refers to a protocol where conditional discriminations are presented sequentially. In the current example A is first associated with B, and B is then associated with C. Another method is to first associate A with B, then A with C, and finally B with C. For a detailed discussion on training structure see Saunders and Green (1999).

correct was considered to have satisfied the mastery criterion), was employed in all blocks in Stage 1. Participants did not advance to the subsequent block without reaching this criterion. Stage 2 was identical to Stage 1, except that it involved B–C rather than A–B training and thus the following conditional discrimination was trained: B1 → C1, B2 → C2, B3 → C3, B4 → C4, B5 → C5 and B6 → C6.

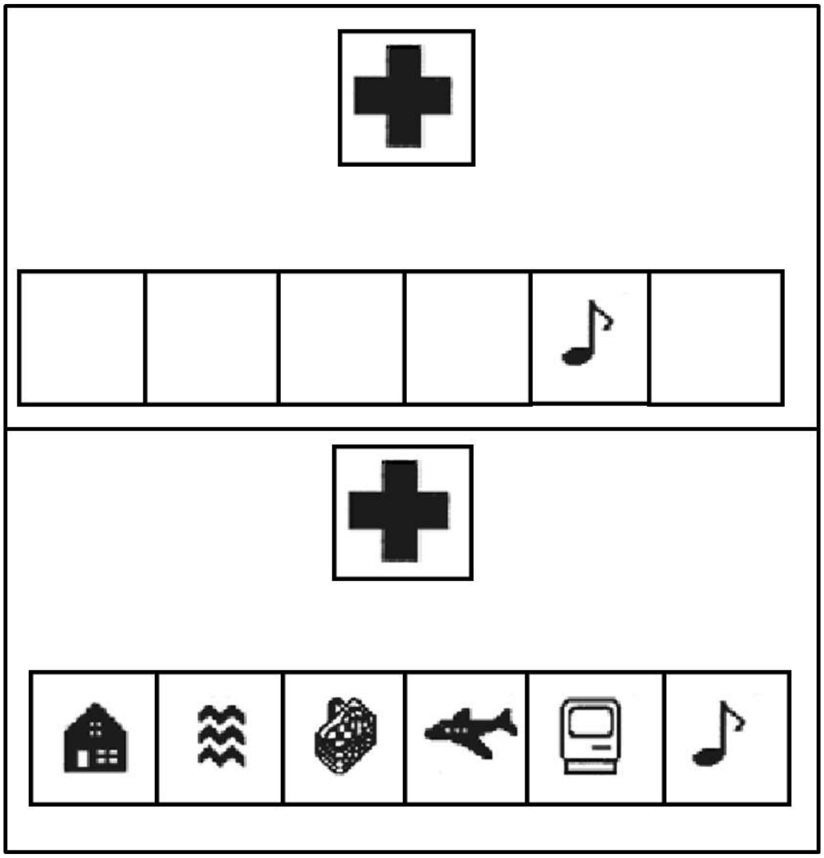

Figure 4. Screen shots from A–B training in Block 1 in Stage 1 (Upper Panel) and Block 6 in Stage 1 (Lower Panel).

Stage 3 was a single mixed training block that trained all A–B and B–C conditional discriminations in the final block format of stages 1 and 2 (i.e., in which participants were required to choose the one correct stimulus out of 6 possible comparisons). The following two conditional discriminations were trained: A1 → B1, A2 → B2, A3 → B3, A4 → B4, A5 → B5, A6→ B6 (AB conditional discrimination), B1 → C1, B2 → C2, B3 → C3, B4 → C4, B5 → C5 and B → C6 (BC conditional discrimination). As in previous stages, a mastery criterion of 12 cumulative correct, which allowed for one incorrect response, was employed.

After reaching the mastery criterion in each block, a message appeared on the screen reminding participants to take a short break. A similar message appeared after participants finished all training stages. The minimum number of trials required to complete stages 1 and 2 was 72 (6 blocks of 12 trials), and the minimum number of trials required in Stage 3 was 12 trials. If participants did not reach the testing stage within 80 minutes of initiating training the experimental session was terminated.

Testing Baseline and Derived Relations

Stage 4 was a single mixed testing block, consisting of 12 trials, which tested all A–B and B–C conditional discriminations from Stage 3. The following conditional discriminations were tested: A1 → B1, A2 → B2, A3 → B3, A4 → B4, A5 → B5, A6→ B6, B1 → C1, B2 → C2, B3 → C3, B4 → C4, B5 → C5 and B6 → C6. All trials were delayed MTS which started with a blank screen, which acted as the ITI, presented for 500 ms. The sample then appeared for 1000 ms at the top center of the screen before the comparisons were presented at the bottom of the screen. Both the sample and comparisons remained on the screen until a response was made. Following the response, the stimuli were removed and the ITI blank screen was presented for 500 ms. A mastery criterion was employed in the testing stages whereby participants had to respond correctly to 11 out of 12 trials in each testing stage in order for their performance to be labelled as "Pass". However, participants were allowed to advance through all test stages regardless of performance. Only if they did not reach the criterion in Stage 7 (equivalence testing), they were re-exposed to the training from Stage one.

Stage 5 was a single mixed testing block, consisting of 12 trials, which tested all symmetrical relations (B1→ C1, B2 → C2, B3 → C3, B4 → C4, B5 → C5 and B6 → C6). Stage 6 was a single mixed testing block, consisting of 12 trials, which tested all transitive relations (A1 → C1, A2 → C2, A3 → C3, A4 → C4, A5 → C5 and A6 → C6). Stage 7 was a single mixed testing block, consisting of 12 trials which tested all equivalence relations (C1 → A1, C2 → A2, C3 → A3, C4 → A4, C5 → A5 and C6 → A6). Sample and comparison locations, ITI and mastery criterion in Stages 5 to 7 were identical to those in Stage 4. If participants did not demonstrate equivalence in Stage 7, they were re-exposed to the procedure beginning from Stage 1. A schematic representation of the experimental procedure can be seen in Figure 3.

Results

Thirteen participants were recruited for the experiment; one participant dropped out after failing equivalence on the first exposure. This person's data are not included in the final analysis. Results for equivalence training and testing for the remaining 12 participants can be seen in Table 1 below.

Table 1. Total number of trials during training stages and number of correct responses during testing stages

	Training				Testing			
Ptp No	A-B	B-C	AB-BC	Total	AB-BC	Symmetry	Transitivity	Equivalence
1	72	72	12	156	12/12	12/12	11/12	12/12
2	74	73	12	159	12/12	12/12	11/12	12/12
3	72	73	12	157	11/12	12/12	12/12	12/12
4	141	94	12	247	12/12	12/12	4/12	5/12
	72	72	12	156	12/12	12/12	1/12	3/12
	72	73	12	157	12/12	12/12	2/12	2/12
5[1]	829	----	----	829	----	----	----	----
6	85	74	12	171	12/12	12/12	10/12	12/12
7	72	74	12	158	12/12	12/12	12/12	12/12
8	74	73	12	159	12/12	12/12	9/12	12/12
9	132	75	12	219	12/12	11/12	11/12	11/12
10	73	74	12	159	11/12	12/12	8/12	12/12
11	74	72	12	158	12/12	12/12	1/12	0/12
	74	72	12	158	12/12	12/12	2/12	0/12
	72	72	12	156	12/12	12/12	2/12	1/12
12	72	72	12	156	12/12	12/12	11/12	12/12

[1] Training terminated after 80 minutes

Behavioral Results

Nine of the 12 participants showed rapid learning, needing 85 trials or less to reach mastery criterion in all 6 blocks of Stage 1 in the first exposure. Participants 4 and 9 needed 141 and 132 trials respectively to advance to Stage 2 in the first exposure. Participant 4 was exposed three times to the protocol and showed rapid learning in the second and third exposure. Participant 9 displayed equivalence on the first exposure, and thus did not repeat the A–B training. Participant 5 did not proceed past Block 3 in Stage 1 and thus the experiment was terminated for him after 80 minutes. Ten of the 11 participants exposed to B–C training displayed rapid learning, needing only 72 – 75 trials to advance to Stage 3. In his first exposure, Participant 4 needed 94 trials in Stage 2, but in subsequent exposures needed only 72 and 73 trials respectively. In the final training stage, all participants satisfied the mastery criterion (12 correct) in the first exposure.

During Stage 4 (AB–BC mixed testing) and Stage 5 (Symmetry), all participants performed to mastery criterion which was set to 11 correct responses out of 12 trials. Only 6 (50%) of the 12 participants displayed transitivity after one exposure. However, 9 (75 %) of the 12 participants displayed equivalence after one exposure. Participants 6, P 8 and P 10 failed to display transitivity, but displayed equivalence. These participants were not re-exposed to training. Three participants did not display equivalence. Of those, two (Participants 4 and 11) were exposed three times to the protocol. As mentioned above, Participant 5 did not advance past Block 3 in Stage 1.

EEG Results

EEG data from Participant 8 was not saved due to computer error and the data from that participant was therefore not included in the final analysis. EEG data was analyzed for the 8 remaining participants that displayed equivalence. All those participants displayed equivalence on their first exposure to Stage 7. The following stages were chosen for analysis: Baseline, Stage 3 (AB–BC mixed training or Training) and Stage 7 (C–A equivalence or Testing) as little behavioral variability was found between participants in these stages. Frequency bands are presented in ascending order, from the slowest (delta) to the fastest (alpha).

Delta (.05–3.5 Hz). A one-way repeated measure ANOVA, performed on the grand average delta power to assess the effect of the different stages on delta power, found a significant effect of Stage on delta power ($F_{2,14}$ = 10.28, p = .002). This overall effect can be attributed to delta being significantly lower during Baseline (43.66 μV^2) than during either Training (57.45 μV^2, p<.001) or Testing (55.20 μV^2, p = .019) (see Figure 5) as was predicted.

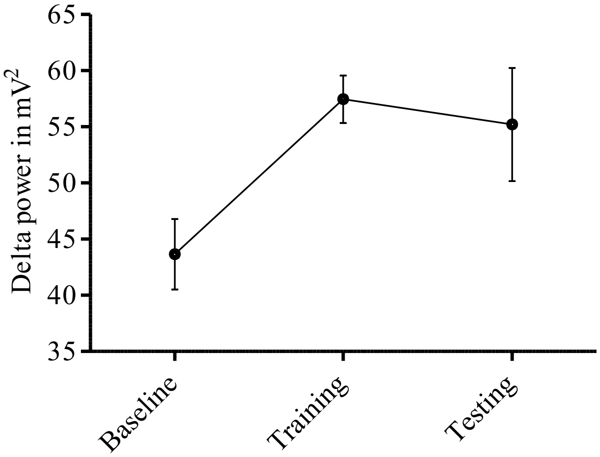

Figure 5. Grand average delta power in μV^2 in all 9 regions during Baseline, Training and Testing.

Mean delta power values and standard errors in all 9 regions can be seen in Figure 6 below. As can be seen, delta power was lower during Baseline, in the Mid Central and Right Central regions, than during either Training or Testing.

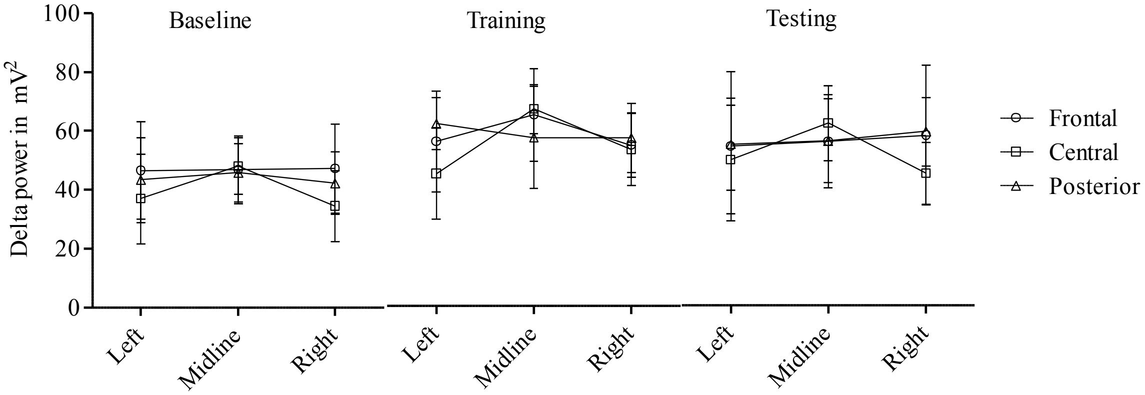

Figure 6. Mean delta power values and standard error in all 9 regions used for analysis during Baseline, Training and Testing.

A one-way repeated measure ANOVA was performed at each of the nine regions to assess any changes in EEG power during the three experimental stages. The F and *p* values and degrees of freedom are summarized in Table 2.

Table 2. Summary of F and p values and degrees of freedom for one-way repeated-measures ANOVA on the effect of Stage at each of the brain regions for the delta frequency

Delta (0.5–3.5 Hz)

Brain region	F	p	df
LF	.794	.471	2
MF	2.99	.083	2
RF	1.42	.275	2
LC	1.63	.232	2
MC	6.35	.011*	2
RC	5.17	.021*	2
LP	3.72	.051	2
MP	2.95	.085	2
RP	7.03	.008*	2

LF = left-frontal, MF = mid-frontal, RF = right-frontal, LC = left-central, MC = mid-central, RC = right-central, LP = left-posterior, MP = mid-posterior, RP = right-posterior.

*Significant effects

There was a significant effect of Stage on delta power at the Mid Central and Right Central brain regions. The greatest increase in delta power was at posterior regions and the smallest increase was at frontal regions. Although the Mid Central region showing the strongest effect of all nine regions, these effects cannot be attributed to differences between Training and Testing. The region which showed a Stage effect (Right-Central) showed a significant difference only between Baseline and Training but not between Baseline and Testing. In the other region (Mid-Central) Baseline was significantly higher than both Training and Testing respectively.

Theta (3.5–7.5 Hz). No significant changes were observed in overall mean theta power between the three stages (see Figure 7 below). Therefore, no further analysis was conducted on the theta frequency.

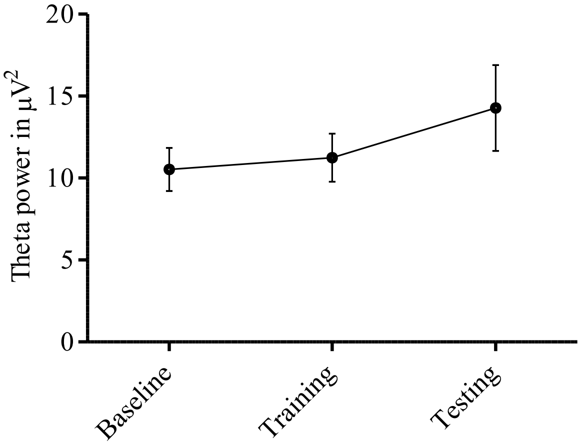

Figure 7. Grand average theta power in μV² in all 9 regions during Baseline, Training and Testing.

Alpha (7.5–12 Hz). As predicted, alpha power was lower during both Training and Testing than during Baseline (see Figure 8 below). A one-way repeated measure ANOVA, performed on the grand average alpha power to assess the effect of the different stages on alpha power, found a significant effect of Stage on alpha power ($F_{2,\ 14} = 5.73$, $p = .026$). During Baseline average alpha power was 13.00 μV², then decreased to 6.90 μV² during Training and increased slightly to 7.74 μV² during Testing. However, Baseline alpha power was not significantly higher than during either Training ($p = .073$) or Testing ($p = .198$).

As can be seen in Figure 9 below, the largest changes in alpha power were observed in the midline regions. Additionally, alpha power during Training is more equally distributed throughout the nine regions than during Baseline or Testing which might indicate less regional specificity during that part of the task.

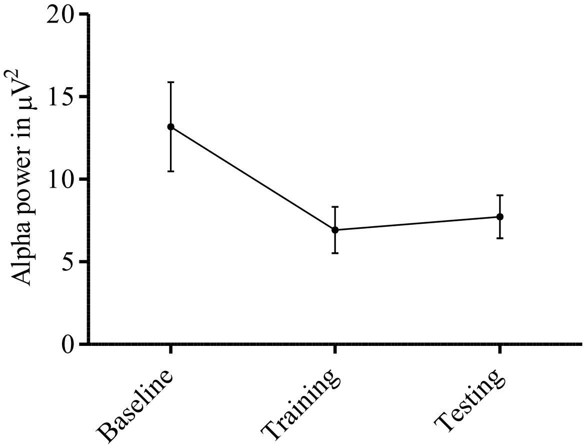

Figure 8. Grand average alpha power in μV² in all 9 regions during Baseline, Training and Testing.

To assess if the Stage effect could be traced to any particular locations, a one-way repeated measure ANOVA was performed on all nine regions. Stage had a significant effect on alpha power at four brain regions (see Table 3), although Mauchly's test of sphericity was violated for all but the left-central region.

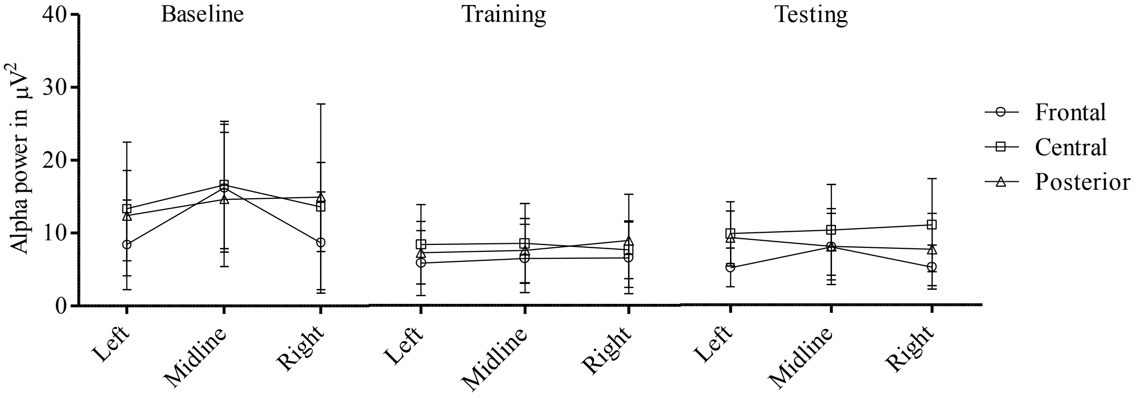

Figure 9. Mean alpha power values and standard error in all 9 regions used for analysis during Baseline, Training and Testing.

The alpha frequency Stage effect can be attributed to differences between Baseline and Task conditions, but little or no difference between the two Task conditions. Baseline alpha power was significantly higher than both Training and Testing at the Mid Frontal, Mid Central, Right Central and Mid Posterior regions.

Table 3. Summary of F and p values and degrees of freedom for one-way repeated-measures ANOVA on the effect of Stage at each of the brain regions for the alpha frequency.

	Alpha (7.5–12 Hz)		
Brain region	F	p	df
LF	2.52	.116	2
MF	5.99	.013*	2
RF	1.85	.194	2
LC	3.70	.051	2
MC	5.02	.023*	2
RC	9.85	.002*	2
LP	3.14	.075	1.173^{+}
MP	7.48	.006*	2
RP	4.49	.062	1.184^{+}

LF = left-frontal, MF = mid-frontal, RF = right-frontal, LC = left-central, MC = mid-central, RC = right-central, LP = left-posterior, MP = mid-posterior, RP = right-posterior.

*Significant effects

$^{+}$ Greenhouse-Geisser correction

Discussion

Overall the results confirmed the validity of the experimental protocol as a measure of stimulus equivalence as 9 out of 12 participants displayed equivalence on the first exposure to the protocol. The EEG activity of participants that displayed equivalence was analyzed, comparing baseline EEG activity to activity during mixed A–B/B–C training and C–A equivalence testing. Analysis was focused on three frequency bands, the alpha, theta and delta, all of which have shown high correlation with activity both during verbal and memory (recall) tasks (see Klimesch, 1999) as well as during derived relational responding (see Roche et al., 2004). The overall pattern of EEG activity was in line with that seen in previous EEG studies; namely, a drop in alpha activity from baseline to task conditions, but an increase in both delta and theta from baseline to task (Klimesch, 1996, 1997, 1999; Keane, James & Hogan, 2007; Keane & James, 2008).

As expected, alpha power decreased from baseline to task, which is in line with previous research both on derived relations (Roche et al., 2004) and memory and cognition (Klimesch, 1996, 1997, 1999; Fisch, 1999, Sederberg et al., 2003). However, it is interesting to note that alpha power becomes more evenly distributed throughout the scalp during Training as compared with Baseline and Testing. Power in frontal areas decreased during both task conditions as compared to Baseline. No difference was found in frontal alpha power between Training and Testing, which indicates that alpha activity in those regions is not a central component of equivalence class formation.

Theta was expected to rise from Baseline to task conditions, but this pattern was not observed. Slight increases were found in theta from Baseline to Training; however, they did not reach significance. Power during Testing showed a visible, albeit non-significant, increase as compared to both Baseline and Training.

It is worth noting that during Testing, midline theta showed an increase in power greater than that seen in the left and right sides of the scalp. Theta activity in the mid region is correlated with short term memory tasks in particular (Jensen & Tesche, 2002; Mitchell et al., 2008; Onton, Delorme & Makeig, 2005). It therefore seems that some aspects of short term memory could be involved in equivalence tasks. Mitchell and associates postulate that in some instances the frontal midline theta can be functionally connected with the hippocampal theta which has been connected with relational memory (context dependent memory, see Cohen & Eichenbaum, 1993). If brain activity during equivalence is more akin to that observed during more complex relational learning, then that would suggest that we look to frequency bands also associated with those types of task, such as gamma (30–100 Hz), to better understand the neural activity during equivalence.

Overall, the lack of a significant difference in theta power between the stages could be due to the low number of trials involved or the fact that theta is generally not considered to be time-locked to the initiation of a task. With regard to the latter point, theta has been described as "a phasic, task-related modulation of the background EEG" (Mitchell et al., 2008, p. 159). In our analysis we focused on activity 2000 ms following the presentation of comparison stimuli which might have been too restrictive. Also, our protocol only involved 12 trials which might only have been enough to capture the most prominent changes between the stages. Given more trials it is conceivable that an effect would be found in the frontal-midline theta.

Delta showed an increase in power during both Training and Testing from Baseline in Mid and Right Central regions. Previous research has indicated that relational information tasks correlate with activity in the midline regions (see for example Basar et al., 1999 and Bonfiglio et al. 2005). However, no noticeable changes were detected in the Front and Posterior Central regions. Activity during Testing then seems to even out throughout the scalp, which could indicate the activation of a distributed delta network correlated with signal detection and decision making (Basar et al., 2001). However, these results must be interpreted with caution due to the limited number of trials used in this protocol. Of particular interest in the current study was the change in distribution from baseline to task. During baseline the power of delta was fairly equal overall. But during training, the midline regions showed a (non-significant) increase in power as compared with the left and right sides of the scalp. This difference was also apparent during testing but was not as striking as it was during training. The increased power during training could point to increased activity in the corpus callosum, the bundle of nerves that connects the left and right hemispheres.

The widespread activity of alpha which correlates with task activity could be interpreted by referring to distributed neural networks. As McIntosh (2000) pointed out: "Cognitive function may…be determined by how the properties of different regions are combined, or *aggregated,* through interregional interactions rather than by the involvement of any specific region." (p. 863). The more widespread activity during task conditions could support that view. That is, though alpha might indeed be important for equivalence, the exact location of activity might not be. Rather, the increased activity throughout the scalp could be taken as evidence that alpha might play an important role in equivalence.

The experimental protocol used in this study was similar to those used in previous experiments in stimulus equivalence (see for example Dickins et al, 2001) which validates the results to some extent. Participants were given sufficient time to master the task, feedback was given during the training stages and participants only progressed to the next stage after reaching a mastery criterion. Despite this, the protocol did have some limitations. Frequency in the gamma (30–100 Hz) range was not included in the final analysis due to the long experimental protocol despite the fact that this frequency is thought to contribute to categorization and complex learning (Miltner et al., 1999; Basar et al. 1999 and 2001, Tallon-Baudry, 2009). High frequency oscillations are more susceptible to interference from muscle movements and muscle movement can sometimes be mistaken for gamma activity. Long experimental sessions make it harder for participants to sit still which would increase the likelihood of interference and variation in gamma power. With such a small number of trials, this increased variation would render the results useless. For this reason, it was not considered for analysis at this time. In order to include gamma, the time that participants spend in the experiment needs to be decreased. Additional changes might include a protocol that would produce behavioral patterns that are more uniform across participants, regardless of performance. For example, participants might be exposed to a set number of trials regardless of performance. This way, all EEG datasets would include the same number of trials and the amount of fatigue could be decreased or kept constant between participants, given that the set number of trials is kept reasonably low.

Many participants gave unsolicited descriptions as to the strategies used in the task, some citing some sort of mnemonic strategy. These strategies could involve arranging the stimuli together in some logical fashion (e.g. man writing on a computer, use computer to write a book, a man writing a book on a computer are stimuli A2, B2 and C2) or participants "seeing the stimuli in a line". These and similar strategies have been reported in other publications (see for example Schlund et al., 2007), and successful usage of these mnemonics might facilitate learning. It is hard to ascertain if the usage of mnemonic strategies by participants would have any bearing on EEG activity. Possible effects might be activity in verbal areas, such as Broca's, if participants verbalize rules during the task, although none were reported by Dickins et al. (2001). Regardless, the possible effects of these mnemonics can be reduced, for example by using hard to identify or abstract stimuli. The use of iconic stimuli might also facilitate learning where participants can more easily name categories, or stimuli in each category than if the stimuli were abstract images or nonsense syllables. Currently these shortcomings are being addressed in our laboratory with a shorter protocol using button pressing responses rather than mouse responses and comparing abstract and iconic stimuli.

The protocol had other shortcomings that might have introduced increased variability into the results. First, during training and testing, only 12 trials were used to calculate the average brain activity. Ideally, more trials should be used. Second, there is a possibility of great variability within groups in this protocol. For example, some participants only showed equivalence after 2 or 3 exposures to the protocol taking up to two hours in total. This long exposure time might well have induced fatigue which would of course have influenced the EEG. Other participants displayed equivalence in the first exposure. The question would then arise whether the two groups are compatible. Third, we could not compare EEG activity in participants that displayed equivalence with those that did not as most of our sample successfully mastered the task. All of these shortcomings can be addressed with a different experimental protocol, preferably one that has a fixed number of trials in all stages, which would allow a detailed comparison of participants, based on performance, in all stages. Also, using different types of stimuli (such as abstract stimuli or nonsense syllables) might raise the equivalence failure rate and thereby make a systematic comparison between passes and fails more feasible.

Overall, effects were found in both alpha and delta as baseline power in both frequencies was lower than task frequencies as was expected. Contrary to predictions, no significant differences were found in theta power between stages. The lack of effects in theta might be attributed to the small number of trials used to calculate the EEG power

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Part III: Comparing the implications of the new internal perspective with those of the traditional perspective

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Abstract

The study of reality typically involves analytical contributions from both behaviorology and neural physiology. This work offers a cursory examination of the kinds of contributions that each of those two fields is prepared respectively to provide. To the extent that human beings are natural entities (entirely so, according to natural science), humans differ from other natural entities according to structural intricacy and complexity, being somewhat toward the extreme of intricate complication on a continuous scale of structure that, among other things, includes, toward its simplistic extreme, the driveway gravels upon which we trod. With increasing complexity and intricacy of structure comes greater reactivity, meaning a greater diversity and complexity of the processes that can be exhibited by such increasingly complex and intricate structures. Thus, putatively, given respectively equal energy inputs to a human being and to a rock of equal mass, both entities get warmer, but the human, being of a more complex and intricate structure, also exhibits a further range of reactivity comprising such processes as behavior, nutrition, reproduction, et cetera. The behavioral processes occur in two principal varieties according to the kinds of structures that mediate them: muscular and neural (the latter historically called *verbal*). In the mode of neural behavioral process, the human being behaves the environment in which it purports to exist, a neural behavioral product that then conceptually projects to externality. This work explores certain implications of environments cast as such conceptual projections.

Cooperative Natural Sciences

Behaviorology and Neural Physiology: Adjacent Scientific Neighbors

The work of behaviorologists and neural physiologists can proceed with respective independence, each at the level of analysis afforded by the discipline that informs the work of its practitioners. However, progress in one such adjacent natural science may usefully steer some of the work in the other one. For example, a cross-disciplinarily informed practitioner might avoid a critical but inappropriately emboldened foray into an adjacent scientific domain. Or, results from an adjacent field that pertain to issues under examination in another field may usefully suggest to its practitioners some new line of inquiry that may prove fruitful.

To examine this issue at (a) a practical level and (b) in terms of the new reality developed in Parts I and II of this book, let us consider an example with familiar elements, first by reviewing some simple "realities"[1]: For a human–type unit of matter to *behold a new car* is simply for that material unit to behave one neurally, presumably with rapid chaining to the identification of that neural behavior as a seeing-type of process. The environmental status of the entity that is called "the car" then inferentially chains (more neural behavior) from the initial neural seeing event. Material entities thus derive via neural behavioral process, and they manifest abstractly in the mode of more neural behavioral process. Thus "substantive" material entities enjoy a kind of virtual establishment quite different from that implicit in the assumptions of the traditional perspective.

To offer an explication of these relations in a way that remains heavily reliant on the traditional perspective: If closed eyes are

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behaved muscularly, a concurrent manifestation of a neurally behaved car is attributed[2] to imaginative visualization that is occurring via chaining neural behavior with no immediate links to an external environment. On the other hand, if concurrently, open and focusing eyes are behaved along with the visual sensational neural behavior, which may chain quickly to an assumption of incoming external light (more neural behavior), the neural manifestation of "seeing a new car" is attributed, as a result of prior conditioning, to an electromagnetic energy input from without. That neurally behaved energy surge, now classed as "incoming light" and presumed to have stimulated that neural behavioral manifestation of a new car, is then, in turn, *attributed* to an environmentally located car (further neural behavior) thus endowing that neurally behaved car with the external status of environmental "reality." Thus, nerves, as structurally arranged in brains, behave subsequent "accounts" for their own behavioral activity in the mode of additionally chaining neural behavior that, as a result of previous conditioning, manifests interpretively as a functionally causal past comprising interactions with a remote "environment."

However, the initial burst of neural activity that occurs on an occasion of basic awareness or sensation (the intrinsic details of which are to be explicated by the neural physiologists) would supposedly occur as a neural behavioral mediation by an individually unique, microstructural, neural entanglement and hence emerge in the form of an intrinsically unique burst of neural behavioral activity. Furthermore, importantly, that initial basic awareness sensation would be devoid of any recognizable car-ness via the neural behavior of any *other* biological observer were another such observer somehow able to behave such an "observation" of the neural activity of another individual.[3] As traditionally may be asked: Why should our respective neural entanglements that behave the private basic sensations that we call "responses to the same thing" be any more identical than the respective ridge-patterns on the faces of our fingertips? It seems reasonable to expect (from the misinterpreted and impossible traditional perspective) that those masses of complex nerve entanglements exhibit micro-level structural differences from person to person, and therefore the neural behavioral activity in which those different structures respectively engage would differ among persons even if whatever might stimulate those respective neural behaviors were somehow to be held constant (as we assume, from the traditional perspective, when various people supposedly are "looking at" the same feature of what they presume to be their single commonly shared environment).

Although, from the intrinsic perspective of a behaviorally immured individual, there is no way to invest the concept of "public" with an external reality, to resort nevertheless to that traditional invalid perspective: Theoretically, when people "publicly react in common" to what is regarded as a fixed environmental event the access to which they are sharing among themselves, each person's sequence of neural behavioral reactions theoretically must begin with an individually unique burst of neural activity (called a "sensation"). A subject's rapid "recognition" (construed as a jump to commonality) of his or her particular kind of neural awareness-burst as, for example, a "particular new automobile" would then have to follow as a product of prior conditioning (a previously discussed neural micro-restructuring kind of event that, again, the neural physiologists will explain in detail). Without that conditioning an observing individual's unique basic awareness could not chain to such a putatively *common* recognition response. That is, from the traditional perspective, only with appropriate conditioning can a visually behaved cluster of raw sensations become "a particular new automobile." According to this theory, the microstructural neural changes produced by conditioning processes would have to be occurring to links in the chaining that lie beyond the initial "raw" and unique sensational activity.[4]

However, a conditioned recognition response of "new car," if chaining from that particular kind of initial neural surge (the basic visual sensation), interpretively amounts to the conceptual projection of that particular kind of neural burst into the imagined environmental realm insofar as subsequent behaving so implies. That is, the new car may be deemed both to be "out there" and "real." But the *out-realm* and its *reality* are both arising as neural behavioral manifestations that happen to, and within, a particular kind of evolutionarily organized organic material unit (a.k.a. an "individual" or a "person."). Or in this case, as traditionally would be noted with respect to the more recently posited "internal" perspective, it is happening within "an" individual (with respect to which the traditional reality of other individuals cannot be established).

Considering such situations from the perspective of isolation that characterizes mere units of matter, recall that an appreciation, presumably *of* all or part of one's external environment, imposes on an "environment" (which, in the first place, can inhere only in the intrinsic neural behavioral activity of an organized unit of organic matter) the requirement of its impossible establishment in an external reality. Thus the environment, rather than stimulating behavior with projected energy streams *from* an external realm that is established in reality, emerges instead as an internally mediated conceptual construct. That conceived environment *includes* the behavior-stimulating energy projections needed to complete the conceptual reversals that characterize such traditional accounts. Environments and their stimulative behavioral functions actually emerge in the mode of certain neural behavioral processes that complex structural intricacy can and does enable *within* certain evolutionarily organized samples of organic matter. (Note, of course, that such "organized samples of organic matter" are themselves merely behaved endovironments.)

Natural scientists, as aspects of the traditionally construed common environment and operating from its fallacious perspective, have long implied, and often insisted, that "life forms" are not supernatural or unfathomable mystical entities. Yet members of the natural science community have been slow, as have others, to abandon the implications of their own presumed mystical omnipotence as they endow themselves and others with the fictitious capacity to receive communications putatively from a "real external environment" that actually occurs exclusively in the mode of each individual's own neural behavior. That is, the environment upon which each natural scientist traditionally has relied as a basis for reality is merely projected conceptually to externality in the mode of more of that individual's own internal neural behavior. According to this theoretical formulation, an organic unit of matter must behaviorally project the environment with which it purportedly is interacting, a feat that manifests in the form of further neural behavior that chains from the initial kind called "sensations." Thus, the essence of environmental substance exists only in the form of neural behavioral process, and that occurs internally to units of organic matter that are possessed of the organizational complexity and intricacy to exhibit such processes. Such reliance on the presumed reality of an external environment by what is traditionally construed to be a chunk of appropriately micro-structured matter[5] has traditionally been regarded as a manifestation of its sentience and is but one kind of activity that shares in denoting the over-taxed "state of life"—a condition that, traditionally, in most cases, has been misinterpreted to have mystical properties and yet to represent reality.

Starting from the traditionally considered view of an internal perspective: The neural activity of brains, insofar as the origins of such activity can be identified, begins with bursts of inwardly directed sensational activity that then chain interactively. The logically necessary endovironmental body parts for such sequences of activity inhere as aspects of a bodily material matrix, which previously having been behaved into its virtual existence, "rationalizes" such neural behavioral events, meaning that the inward chaining sensational activity comes to be further mediated by particular preconditioned microstructures that organize those chaining sensations into what are called "logical" patterns. Within one's pre-behaved body the initial bursts of sensational neural activity transmit toward the brain from various kinds of "receptors." Some relatively familiar examples of such receptors include photoreceptors (light), chemoreceptors (flavors and odors), mechanorecepetors (physical contacts), thermoreceptors (heat), and nociceptors (tissue damage/distortions). The characteristics of initial sensation behaviors thus rely partly on the microstructural configurations of the "receptors" that, from the traditional perspective, generate those raw neural reactions and launch their transmissions brainward. Importantly, again cast from the traditional perspective, among various individuals the respective neural configurations of a given kind of receptor exhibit a structural diversity imparted via their genetically determined individual origins.[6]

Therefore, given the neurally behaved logical constructs of different "individuals" and their respective sets of "functioning body parts" as considered from the traditional perspective, among various individuals inwardly transmitted neural activity must at least reflect in some orderly way a diversity that derives from the individualized, genetically governed, constructions of their relevant sensory receptors and other involved body parts. That is, that inherent structural diversity among their sensory receptors of any given kind and the nervous transmission lines leading away from them would, in turn, be reflected in the bursts of neural activity that are mediated by, and chain away from, those sensorial microstructures. It follows, therefore, from the traditional external perspective, that among different individuals the respective sensations of a "shared environmental experience" would differ accordingly—a presumption that taxes the notion of "sharing" any given experience. That is, given a traditional assumption that two people are confronting "the same apple hanging from a limb on an apple tree," the bursts of neural activity moving inward from their respective photoreceptors cannot be identical if the microstructures that presumably mediated and transmit them are not identical. Thus, according to this theory, in the posited situation an apple-in-common cannot be established merely by way of the relevant visual sensations of different people.[7]

Nevertheless, in spite of such structurally induced differences in the early and private sensational activity, we have long noted from the traditional perspective that the "meaning," for any given individual, of a particular burst of its neural sensational activity inheres in that behaving organism's subsequent external (i.e., public) behavior to which that burst of neural behavior subsequently chains. The "sociality" of a behavioral event refers to its direct and indirect implications for the control of the subsequent behavior of any and all parties—implications that derive as products of what behaviorologists call "the behaving individual's particular conditioning history."

For example, consider basic *visual* awareness described from the traditional perspective. Suppose that an instance of such raw awareness occurs to a person. It may consist of meaningless patterns of neurally behaved colors of varying intensities and hues, which may then, as a result of prior conditioning, chain almost instantly to what that individual subsequently describes as "a computer screen showing a document appearing on a scenic background picture bordered on two sides by tool bars," …et cetera. All of the sensation and recognition behavior will have occurred exclusively in the medium of neural behavior within that organized unit of organic matter (i.e., in this example, a "person"). Suppose that that neural behavior then further chains to a public vocal expression such as, "Wow, this screen display is really interesting"—a remark that alludes to a vast history of conditioning, both of speaker and listener, pertaining in part to computer use and, in general, to the English language. Speaking from the traditional perspective, were the listener to be a second individual unit who "sees" the computer screen over the shoulder of the speaker, the respective genetically different visual receptors, transmission nerves, and involved brain parts of those two individuals presumably would generate differing bursts of private neural activity, while prior conditioning and shaping processes would have led to the similar public reactions to which those differing bursts respectively chain—public reactions characterized by a kind of compatibility that is said to reflect the "mutual understanding" of those two organic units. However, from the internal perspective, given that for an individual the entirety of the external (or "environmental") realm remains a private and personal neural behavioral construct of which all things social are but parts, the traditional accounts, built on the flawed assumption of a real and absolutely-established remote environment that is shared in common, must be recast as aspects of a new reality that comprises only internalized private neural behaviors.

Speaking traditionally: As has been true of all humans in general, we behavioral scientists, having likewise anchored our concepts of reality in what generally we have regarded as a "real external environment that we share in common," may tend to find the conceptual reversal explicated in this book a difficult idea to sustain. That difficulty is perhaps exacerbated insofar as this particular explication may seem labored and perhaps annoyingly incomplete—seemingly inevitable problems that ensue when challenging the fundamental reality of everything. The assumed reality of our traditionally familiar external realm, regardless of how logical the counter-arguments against it, tends conceptually to snap back into place like the abrupt relaxation of a stretched rubber band.

To help clarify the points previously discussed suppose that we pursue a familiar kind of example: From the traditional perspective, consider a situation involving several people none of whom have any prior acquaintance with a particular kind of entity—in this case, with the kind of material entity known as a "troimoc." That is, each of them is without preliminary conditioning history of any kind with respect to that particular kind of thing. Suppose that those people then respectively confront a particular troimoc for the first time, so that each of those persons neurally behaves an awareness response, presumably (again from the traditional perspective) to an incoming energy stream reflecting from that troimoc.

As previously speculated, we cannot anticipate that those respective initial surges of neural activity will be identical in those persons, because (a) those persons' receiving postures differ and (b) the respective neural microstructures that behave those sensational surges, being of genetically determined construction, are unlikely to be structurally identical. Suppose that those people next undergo similar episodes of both general social conditioning and specific direct conditioning featuring the effective consequation of their reactions to that and perhaps other troimocs (i.e., each of those individuals is "getting to know" troimocs). Through those selective processes of conditioning those individual's respective frequencies of common overt behaviors toward any given troimoc will tend to increase—a kind of overt behavioral change toward sameness that is commonly deemed to be their respective "increasing familiarity with troimocs."

From the traditional perspective, note, again, that behavioral events, all of which exist in process mode, derive characteristics from the respective structures that mediate them. That is, behavioral process being mediated by structure, which occurs with energy transfer to or from that structure, exhibits some characteristics that follow from the particulars of whatever structure is mediating that behavioral process. Recall, for example, that the structural particulars of a radio act upon the electromagnetic energy input impinging upon its antenna to yield a very different kind of structure-determined output—one that is rich in sonic characteristics. (Note that what is called "nourishment" for the necessary amplification comes via a separate electrical energy input.) The formal properties of the audible output differ vastly from those of the electromagnetic input, which we humans cannot directly detect, although order is putatively preserved across the process of mediation between the incoming electromagnetic stream and the outgoing sound. Typically, however, a radio, on the basis of the environmental effectiveness of its previous sonic output, unlike human organisms, cannot typically undergo feedback induced changes to its own internal structure to produce a more effective sonic output. That is, radios ordinarily cannot undergo conditioning processes by which they become able (i.e., "learn") to play more effectively—a shortcoming attributable merely to some fundamental structural inadequacies in typical radios.[8]

Turning away from non-behavioral entities such as radios, let us now consider material units of sufficiently intricate and particular structure to exhibit behavioral processes. Speaking traditionally and in general, we must attribute any event, including a *behavioral* kind, to a "real" "cause," which always involves energy transfer. As they say objectively, there is always a "reason" for the occurrence of a materially-mediated event, and the term "reason" alludes to a change in the energetic status of that material. An assertion to the contrary can be regarded as a recourse to mysticism thus breaching scientific objectivity. Reliably, energy impinging on, or departing from, matter alters either the state or the relativity of that matter (in general, we refer to that effect as an "event"). Such an event may involve a whole set of material components being shifted in position, and/or one or more components being restructured intrinsically. Accordingly, as a logical deduction from elementary physics, we insist that a transfer of energy to or from such a material structure precedes or accompanies every process-type event, of whatever kind, that such a structure exhibits, and that must include behavioral events.

Thus, in behavior-capable organisms the reinforcement, punishment, and extinction processes that are followed by changes in the frequency of certain kinds of overt responses presumably would have to be resulting in micro-structural changes, seemingly to the respective nerve masses that share in the behaving of those responses. According to that theory, an orderly series of changes in behavioral responding to an unchanging environmental stimulus would seem to mean that those changes in behavior are the mediations of changing bodily structures probably of the micro-neural variety. Thus, generally and from the traditional perspective, in accordance with the requirements imposed by this theory, different people, when subjected to common selective conditioning processes, have certain of their individually unique neural microstructures progressively re-crafted presumably via some micro-re-structuring. Due to the selectivity in those conditioning procedures, such microstructural changes tend to facilitate increasingly common changes in the frequencies of the relevant overt behaviors being mediated by the affected bodily components, this despite the initial disparities among the respective initial sensorial reactions of the involved individuals. Detailed explications of such hypothesized microstructural alterations remain tasks for the neural physiologists. Theoretically, such micro-neural re-crafting *can lead to increasingly similar overt*[9] *responding* by different individuals (to be explored as follows).

According to this theory, as cast from the traditional perspective, the structurally differing masses of nerve cells in respective individuals would necessarily behave disparate basic or raw awareness responses that, as a result of subsequently imposed conditioning processes, then chain, typically with great rapidity, to the control of *similar overt responses* by different individuals on a given kind of occasion.[10] Thus the respective nounal "meanings" of *troimoc* to those people would inhere in their overt or public responses to troimocs (as behaviorologists have long insisted). However, according to this theoretical speculation, such common overt responding, constructed directly or indirectly via conditioning processes, would, in each individual, be under at least partial control of neural activity that chains or emerges from fundamental awareness responses that remain individually unique due to the uniqueness of the structures that mediate them. Nevertheless, regardless of such speculation, the "similarity" of overt responding has been measured traditionally merely by matching overt behavioral manifestations without recourse to any supposed internal micro-neural similarities or differences in the respective sensorial systems.

In any case, if two people react overtly in very similar ways on a given occasion, as they often may do, then according to general theory we probably cannot expect to search fruitfully through the neurons of their respective sensory systems, nor probably not through their brains in general, for pockets of identical microstructure—certainly not as imagined by adherents to robotistic notions such as "identical mental configurations" in different people representing their respective "storages of the same idea." Instead, the respectively complex neural sensorial structures of each individual, being not only initially unique, but also intricately complex, may be expected to react respectively to common inputs of energy with an initially unique neural-behavioral variation.

Seemingly, one of two theoretical possibilities may then ensue: First, given the respectively differing, neural, sensational, behavioral activity, conditioning processes may then result in selections (perhaps via processes that passively eradicate the rejected behavioral capacities, all occurring in ways to be explicated by our neuroscience colleagues). The subtractions via such culling would thus leave a residual of micro-neural structures that respectively mediate behavior that is sufficiently similar to that of other individuals to be regarded as "common." Or second, instead of sorting for selective retention, conditioning could be *constructive*, constructing and installing neural configurations that mediate precisely the behavior that facilitates reinforcement ("proves more effective," as we note). However, in general, selection is a more natural mechanism than creation, although a theoretical approximation of creation could result from mere rearrangement of neural microstructure. Note that creation might seem to involve progress via what has been called "intelligent design," an unnatural approach whether by a remote deity or a putative self-agent. Nevertheless, regardless of which kind of theoretical process best accounts for what occurs, traditionally the mystically agential "individual" has been credited with thereby initiatively rendering itself more discriminative (i.e., with proactively "learning" more about certain things).[11]

In recent years occasional televised science programming has proclaimed to the general public that "mind reading" experiments were being conducted in neuroscience laboratories. The involved neuroscientists typically began with recordings of the unique electrical activity of an individual's brain while its neural behavior was being controlled by verifiable stimulation. For example, consider a blindfolded subject who previously has engendered confidence among the research team members that he or she could reliably see and recognize an elephant were it to be standing sideways in front of that non-blindfolded individual. Suppose that in the current experimental setting the subject's blindfold is removed to reveal an elephant standing sideways before that subject. Whatever the resulting burst of neural electrical activity then detected and measured in the brain of that subject, the experimenters assume that it represents, in that subject's environmental construct, a visualized elephant in side view. The establishment of that stimulus–to–neural-response relation is purely correlative insofar as the experimenters "know" the stimulus and then merely record whatever intracranial neural activity follows in the brain of the subject. Subsequent confirmation would consist of intruding electrically into the brain of that person, somehow to incite *directly*, in the absence of any other stimulus, a similar burst of neural electrical activity, and inquiring of that person what he or she is then visualizing. A response of "elephant, standing sideways," thus procedurally rendered credible, would complete the confirmation.

We could then attempt, in the environmental absence of an elephant, to introduce a burst of visual neural electrical activity, similar to that from the first subject, into the brain of a second subject and condition that second subject to "interpret" that initially meaningless burst as the visualization of an elephant. While the second subject, if presented with an actual elephant, probably would produce a differently patterned burst of neural electrical activity, that subject nevertheless also has been conditioned to "see" privately an elephant when stimulated by a burst of neural-electrical activity similar to that of the first subject's elephant-seeing burst. It could then be said in common parlance that the second subject has "learned to read the mind" of the first subject (to a limited extent) or perhaps to "think like the first person." Or metaphorically, it might be said that the second subject has "learned one unit" of the first subject's otherwise private neural "language."

Furthermore, referring back to our two subjects, again from the traditional perspective, the first subject can be conditioned to further respond to his or her own initial sequence of neural electrical brain activity (i.e., the neural behavior of an elephant) by writing the word elephant on a piece of paper. That outcome involves some chaining neural behavior that culminates in a sequence of muscular writing responses). A second subject, previously unconditioned with respect to the written word *elephant*, upon exposure to that written word, could then be conditioned to visualize an elephant (confirmed perhaps by pointing to the picture of an elephant among an array of assorted pictures), although that second subject's corresponding initial sequence of private neural electrical activity would probably differ substantially from what had occurred initially in the brain of the first subject. After all, their initial, sensorial, activities would differ: "big live animal" versus scrawl on paper (as the experimenters from their traditional perspective might describe their respective stimulations). Thus the second subject's overt behaviors pertinent to an elephant could then ensue via an overtly implied commonality that nevertheless remained based on private neural behavioral differences.

Traditionally, we have referred to the second individual's role in this process as that individual "learning to read." It results, through conditioning processes, in the attainment of overt commonality among individuals each of whom remains otherwise trapped within itself insofar as the neural electrical activity of each isolated individual remains unique and, prior to the appropriate conditioning of "overt responding," incomprehensible to anyone else, or so the traditionally cast theory goes. In this analysis, the respective private neural behavioral activity of individuals, while affected by conditioning processes, remains unique to each individual even as it chains to the muscular variations from which conditioning processes selectively fashion the overt commonality upon which all things social are based.

However, under more careful scrutiny from the internal perspective of an isolated individual, "conditioning processes" are but one aspect of an individual's behaved environmental construct. Those putative "conditioning" processes rationalize changes that are occurring in certain ongoing aspects of such a private internal construct.

Note too that "thoughts," although traditionally regarded as private, become overt to a computer that is equipped sufficiently with appropriate sensors for detecting such neural electrical activity. However, from a traditional interpretation, that electrical data always comes as if individually encrypted, and the key to the encryption inheres in the unique neural micro-structuring of the involved individuals along with the respective conditioning history of the overt behaving that, wholly or in part, chains from that neural activity—this in both an individual who generates those data and others who would interpret them. The traditionally construed commonality that characterizes any particular culture derives from a shared conditioning history among its individual members each of whom is defined by unique neural activity while relying on conditioning processes for the overt commonality (i.e., sociality) of which their culture is comprised. Two levels of consideration are implicit: From the internal perspective, one level of consideration pertains to the individual as a unit of matter, the unique definitive processes of which, along with their environmental context, must remain internal to itself. The other level of consideration, from the invalid traditional perspective, is with respect to an abstract cultural construct that via conditioning processes integrates the overt behaviors of various individual units of matter into a society that putatively exists independent of any given individual that may not yet have become a part of it.

An individual's (a) initial private and unique awareness (i.e., sensorial) activity, manifesting in neural behavioral mode, and (b) any subsequent, related, conditioned, public, overt responses to which the awareness behavior chains often occur in such rapid succession that that sequence may seem instantaneous. Thus in the previous example about troimocs it might be said of the various subjects that ultimately "each of them could *instantly* recognize a troimoc." (In common parlance, rapidity often gains an increase in emphasis through such a conceptual leap to instantaneity.)

Occasionally, again from the traditional perspective, a conditioned overt reaction is delayed sufficiently for a time-gap between awareness and recognition to be noted socially. In such cases the subject might explain the publicly noticeable delay by saying something agential such as this: "For a brief interval I was aware of something in front of me before I realized that it was a troimoc." To account for this phenomenon (described from the traditional perspective), with respect to the private neural behavior of concern, such instances may suggest an initial insufficiency in an impinging, behavior–stimulating, stream of energy that subsequently becomes enhanced to sufficiency, as when an early morning sunrise eventually provides enough light to discern a person's face peering from the nearby foliage (a recognition-type response described in agential terms). Cast as a general question: To what extent is the difference between (a) basic or raw awareness and (b) recognition merely a matter of the intensity of the incoming energy stream? Implicitly, we are left to ask of our neural physiological counterparts how best to describe the relevant events. Does the initial delay of the effective reaction follow merely from an insufficient energy input that, while sufficient to yield a raw sensation, is, for a time, insufficient to initiate its chaining to a recognition response? And does such a question refer to the successive involvement of two distinct parts of the brain or merely to the degree to which a single part is stimulated?[12]

In any case, this sectional discussion amounts only to a casual and inquisitive poke of a behaviorological nose over the physiological neighbors' field fence as those natural science colleagues pursue a level of analysis different from our own. Perhaps the neural physiologists will find among speculative and possibly naive formulations such as these an occasional lead for their scientific probes just as we peer over their shoulders to glean insights that, in turn, may help us better frame some of our behaviorological inquiries.

Starting Inquiries with Better Fundamental Assumptions

One fundamental issue being addressed in this work is implicit in the question of how a rock on the ground can know anything about the adjacent rocks. The question, of course, is nonsensical. A rock cannot "know" of its environment. But the essence of its failure in that regard inheres essentially in the intrinsic uniformity of a rock's structure, a structure that derives from a rock's kind of formational processes. A rock emerges from its formational processes with a somewhat uniform structure that affords relatively little capacity for diverse reactivity—far too little to exhibit the complex processes that comprise "life," including neural-behavioral processes such as "knowing."

Let us readdress this issue by starting with a material composite of a different kind. Instead of a substance composed uniformly of mineral grains cemented together by precipitations from ground water and thus mostly formed with structural sameness, as for example is sandstone, or perhaps solidified from a molten state, as is basalt, let us instead consider the kind of matter with structure that develops through biological processes. As general biology textbooks typically note, on this planet the organic examples of matter are almost exclusively carbon-based and feature a molecular structure that also relies variously on hydrogen, oxygen, nitrogen, phosphorus, and sulfur. As considered from the traditional perspective, that kind of formation can yield intricate structural variations, each supporting its own variety of physical and chemical reactions to putative energy inputs. Elementary physics proclaims that processes (as opposed to material entities) occur to various material structures when those structures undergo energy changes, and the number and complexity of the processes that those structures exhibit increases with their increasing structural complexity and intricacy. Thus, structural variation may become sufficiently elaborate, especially in biologically formed material, to sustain naturally both behavioral and reproductive processes. Note that the latter class of reactive processes indirectly render organic individuals susceptible to evolution via a general culling process. Importantly, such complex mega-processes, each with its respective assortment of constituent processes, require an intricate structural complexity far exceeding that of ordinary rocks—an elaborate complexity that is generally characteristic of organic entities.

Note, however, that people and rocks thus respectively occupy far separated positions along a single scale of mere structural intricacy, a much simpler difference than human culture has tended to acknowledge.

Life per se consists of an aggregate of manifesting processes, and the structural simplicity of a rock is simply devoid of the capacity to support enough of those interrelated processes for a state of "life" to manifest. But in contrast to the more uniform structure of ordinary rocks, an organic construction can result in a much more intricately elaborate structural complexity, although organic entities are still just material entities as are the sedimentary, metamorphic, or igneous rocks that are evoked for this comparison.

To summarize, still from the traditional perspective: In organic kinds of material entities an increasingly intricate structural complexity invests various parts of those organic matter samples with the capacity to react to energy inputs by engaging in correspondingly elaborate processes, which, if behavioral, are typically designated as "mediations." That is, bodies, as material entities, mediate the behavioral processes that they exhibit in the same sense that radios mediate sonic outputs. In addition, the increasingly complicated, structure-enabled, reactionary processes of organic bodies may also result not only in structural duplication (i.e., in "reproduction") but also in selection-based structural drift across successive generations (i.e., in "evolution").

Also, if we consider elaborately organized units of organic matter—kinds that can display a more extensive and diverse reactivity, then, perhaps exclusively in the case of animals, those complex structures can also come to support a variety of additional reactionary processes in the class called *"neural behavioral activity,"* which sequentially begin with energy-induced sensations. Furthermore, with progressive evolution, such sensation-reactions increasingly gain in capacity to stimulate, intrinsically, further kinds of neural behavioral reactions of the kind known, in general, as *thought*. Typically, some of that covert neural behavioral chaining comes to share in the control of muscular activity, which, being *overt*, may stimulate, via a "feedback loop," further sensorial reactions. The organism may thus, as we say from the traditional perspective, become more interactive with its environment. From the traditional perspective, the individual is then regarded as "becoming more aware of, and sensitive to, its environment" (i.e., it becomes more "sentient"). However, from the internal perspective, an organic matter unit, which is projected conceptually to environmental reality along with all else that is said to be "out there," remains isolated unto itself in process mode, with some kinds of its behavioral processes merely interacting with other kinds of its behavioral processes.[13]

Following a given behavioral event (putatively a "response"), some of the subsequently inferred energy arrivals at the initially behaving individual, traditionally presumed to be "feedback" from the environmental implications of that earlier response, theoretically could change the neural microstructures with which that initial response had been mediated. Logically, such altered micro-structures must, in turn, then mediate altered frequencies and forms of similar behaviors on future occasions of similar stimulation. This alludes to the broadly construed "conditioning" and "shaping" processes that, perhaps but not necessarily in combination, are also informally called "learning." The neural microstructural capacity to produce some elaborate, neural behavioral constructs (in neural behavioral process mode), also known as "knowledge" (in allusion to the effectiveness of the behavior that it shares in stimulating), can thus increase accumulatively. Such accumulations of modified neural microstructures and their accordingly modified capacities to mediate behavioral process (sometimes misleadingly called "stored knowledge"), upon the impingement of subsequent appropriate energy streams, simply engage more or less readily in the re-mediation, perhaps with drift in form and frequency (an allusion to shaping and conditioning), of a special cluster of previously behaved responses.[14] (Note that frequently encountered references to "stored knowledge" typically rely on a confounding of structure and process.)

Consider a "live" organic entity. At one level of consideration all that exists is a delicate and elaborate unit of naturally organized matter that is endowed with the neural microstructural alterations presumably of a lifetime of energy inputs (a.k.a. a lifetime of "experiences"). Note too, again from the traditional perspective, that biological kinds of matter, being of a delicate and nutrition-supported structure, are maintained through complex nutritional processes that remain subject to various kinds of failure followed by a rapid deterioration of the intricate structures that have been relying for supportive maintenance upon those degraded processes. Organic entities, with their intricate micro-structures, are particularly subject to quick disorganization (i.e., rapid biological dying and the subsequent loss of structural integrity known as decomposition).

However, in more detailed considerations cast from the traditional perspective, slow "dying" can be regarded as a multi-phased process across the first two phases of which ("social death" and "person death") organic units may lose progressively the capacity and/or the opportunities to mediate certain classes of behavioral processes. That is, in cases of slow dying, an individual's respective behavioral processes may, for different kinds of reasons, sequentially stop happening thus giving rise in succession to "social death," "person death," and finally, "biological death."[15] The middle stage, person death, apart from diminishing opportunities, can involve the progressive failure of structural capacities to mediate the behavioral processes that define or characterize the identity of a given "person." In that phase of dying the individual is thus said to lose its "personal identity." Nevertheless, the dying of a person, as a natural entity, can be compared with that of its much more enduring but structurally less complicated rock-style "cousins" as they are left mainly to the sameness of a long slow and typically less interesting erosive kind of deterioration.

The traditional "reality" of our environments inheres in private accumulated microstructural configurations that can mediate certain internal neural behavioral processes, the particularities of which putatively chain to the *conceptual projections* that serve as our respective "environments." And all of this occurs naturally in process mode. (The adverb "naturally" alludes to the fact that, as mere units of matter, we do not agentially "do" our own behaving. Given all contributing factors, purely neural behavior, as well as any muscular activity that it may or may not share in producing, occurs with theoretical inevitability).[16] As with all other natural events, from the traditional perspective the behavior that we exhibit is exclusively reactionary (that is why we refer to specific instances of behavior as "responses").

Considered from the internal perspective, we passively behave our invalidly construed environments as something that occurs reactively to and within us without our ever having to "get out of ourselves to go exploring in those remote environments" (which is fortunate insofar as that agential step would be impossible from the more realistic internal perspective). For a person to go out into an "environment" that is being internally behaved and only conceptually projected to externality would represent an ethereal transcendence that is logically precluded for what, from the traditional perspective, may be construed as a mere "material entity" regardless of its organizational complexity. To otherwise explicate that prohibition: Neurally behaving an environment does not then allow an individual, acting independent of that environment-creating behavior, to enter into that environment and "do things" within it insofar as the existence of that realm has manifested only in the mode of private internal neural-behavioral process. Although one may further behave oneself acting that way, an external environmental reality independent of the neural behavioral construct in which such an environment arises cannot be established.

From the internal perspective, one's environmental reality is thus rendered ethereal and is uniquely produced as a contextual aspect of that person's own self-defining mega-process, while the traditional view casts the environment as a material out-realm in which the self-agent maintains its independent operational existence. But, as noted earlier, from both the traditional and internal perspectives the redundant self-agent vanishes for lack of anything to do. Gone too is the externality of "environmental reality." Note that an "environmental reality," when shifted inside as a neural behavioral aspect putatively of each individual's unique conceptual environmental construct, loses the absolute fixation that would be necessary for affording various individuals a single and shared common environment.[17]

Thus, a pregnant question is again revived: Given the isolation of each individual unit of biological matter within the confines of its own internal neural behavioral processes, how are we as individuals (if more than one of us even exists), each putatively dwelling in its own virtual reality, to account for the commonality that putatively characterizes social interaction, community, and culture? When individual reality is a behavioral construct manifesting in process mode putatively within the isolation of each self, what is occurring when such isolated units of organic matter are said, from the traditional perspective, to communicate mutually with respect to a putatively shared environment? Given as many unique "environments" as there would be individuals to behave them, what, of the traditional notion of "common" and its many derivative variations,[18] can survive?

Emergent Commonality amidst Individual Isolation

The Mystery of Social Behavior

To make the arguments in this section easier to track the discussion will continue to invoke, as respectively appropriate, either (a) a "real," single, remote environment that putatively is being shared in common as considered from the *traditional* perspective or (b) the hypothetically multiple, internally-behaved, environmental versions examined in this three-part work. Either of those two perspectives (the "traditional" or the "internal") respectively may be deemed helpful in support of an immediate point. Note, however, that any seemingly valid behavior-related account that has been cast from the traditional environmental perspective remains subject to re-expression from the isolation of the internal perspective. However, such a translated product may seem meaningless or incoherent if that switch from the traditional perspective strips away fundamental assumptions and perhaps aspects of the familiar logic that lend coherence to the traditional account. After all, a traditionally conceived remote brick with an absolute existence established in a single independently enduring environment seems quite different from a brick that is established only in neural behavior mode and only conceptually projected to eternality as part of an individually unique environmental construct. The compensatory elaboration, thus seemingly essential to such a translation from the traditional to the internal perspective, could disruptively carry the point at hand somewhat afield if, indeed, any of it would survive such a translation.

An individual's environmental construct, mediated behaviorally by the body, casts that individual's world entirely in the mode of private internal neural-behavioral process. An individual thus neurally behaves the world in which it purports to be living and also behaves itself into insubstantial existence as an aspect of that virtual world. An assumed transcendence to materialistic reality of such a process-defined self is a meaningless notion. As considered from the internal perspective, we, as exclusively behavioral manifestations, cannot "get out" of our process-confined selves. That is, consisting of mere process ourselves, we cannot move away from ourselves to enjoy a more comprehensive perspective on our own "activity." Such a departure would have one moving about within a putatively "real" remote environment when neither that individual nor such an environment can be established in material reality.

Note that the evolved language available to us to explicate the perhaps unfamiliar internal perspective and its implications has emerged in compatibility with the fictional traditional perspective that has tended to prevail during the developmental history of our species. If instead, our predominant construct of reality had developed according to, and from within, the internal perspective, a different form of language could be anticipated that would be more suited to talk about that version of reality and to pursue its implications.

The commonality of a neurally behaved world, which from the traditional perspective we presume to share, cannot be expected to inhere unchanged in an individual, private, neural-behavioral, construct of reality. Such a construct consists of privately behaved manifestations that, according to logic, are produced in the isolation of an individual's particular and unique neural microstructuring and hence must differ among individuals (were "other" individuals really to be "out there"). Therefore, the essence of commonality, which traditionally is said to inhere in the respective conditioning "of each individual's *overt* behaviors," would have to be something that occurs within the isolated individual's neural behavior, an isolation that obviates the traditional notion of commonality per se.

Note that the traditional notion of an environment shared in common and in which various individuals can exert their respective overt behaviors has long imposed a heavy demand on the processes of conditioning. Nevertheless, traditional behavioral conditioning comprises a cluster of operations that have proven sufficiently robust seemingly to meet that traditionally cast challenge. But how do such traditionally cast accounts change if reexamined from the alternative perspective afforded by the individual isolation described in this work?

Within an individual's private environmental construct that individual presumably exhibits overt (i.e., "public") behaviors, behaviors that would be mediated and hence partly determined by what is construed to be that individual's unique neural structures. According to privately behaved logic, such "overt" behaviors presumably manifest with a public exposure where they may stimulate the behavior of presumed others, or so goes the inherent logical interpretation of what remains a private environmental construct. And because either (a) implicitly-related simultaneous behaviors or (b) coordinated and closely sequential responses between or among neurally behaved "individuals" logically imply commonality in the presumed environmental controls on those respective patterns of behavior, if within a single unit of organic matter two behaviorally created "people" in coordinated proximity seem publicly to behave simultaneously or sequentially with the exhibition of a common order, they are logically presumed, from the traditional perspective, to be "reacting to the same environmental things." Furthermore, in the logic of the traditional perspective, the behavior of each is presumed to function as stimuli for other individuals during social conditioning and shaping operations. And all such "social" activity implies the commonality of a single shared environment.

However, that commonality, if considered as a private neural-behavioral event occurring as a private individual appreciation, cannot be established and remains but a logical self-behaved interpretation merely of certain aspects of one individual's private environmental construct. Public sociality thus remains within, and a part of, the private environmental construct being behaved by one individual—an individual that then assumptively posits in a seemingly natural way that others are "out there" perhaps behaving similarly. Accordingly, that individual is behaving those other individuals as features of its own privately behaved environmental construct thus endowing its virtual "environment" with a virtual sociality. Thus, the "world" (i.e., the environment) in which traditionally the individual purports to exist and with which it purportedly may be interacting remains a virtual abstraction that inheres in that isolated organic unit's internal, neural–behavioral, environmental construct. Nevertheless, that self-made behavioral abstraction is the virtual world in which traditionally an organic unit purports to "live" and in which such an isolated organic unit engages in an imagined sociality.[19]

Sociality, like all other environmental phenomena, exists only in the mode of private neural behavior as one feature of an individual's privately projected environmental construct. From the traditional perspective, we can say with objectively based logic and literal meaning that the individual lives in a world of its own—a kind of solitary isolation in which the individual's confinement cell is a "whole world" that exists in the mode of its own neural behavior, a world that also includes that material individual per se among its vast assortment of behaved and hence immaterial "entities." That is, the individual behaves a world that includes its "material" self and then behaviorally casts itself as operating in that world. The private behaving of the concept of sociality and its various expressions reduces dissonance in an individual's private environmental construct, a naturally occurring manifestation of the kind of process called "logic."[20] But, beyond its own internally behaved logical suppositions, no individual can otherwise establish a remote reality for any aspect of its total "environment," which is constructed, in process mode, of its own neural behavior. That exclusion of the establishment of reality includes both a remote reality for "other individuals" as well as a more intimate material reality for one's self-entity. While we are more structurally complicated than the gravels on our driveways and hence exhibit a wider range of reactivity, substantively we do not differ from them with respect to individual isolation but only with respect to the complex intricacy of what is isolated.

To better illustrate the fallacy of "social," let us imagine, from the traditional perspective, two people, perhaps companions, walking side by side, engaged in conversation. Now, let us began to rely on adaptations from the internal perspective: The environmental construct being behaved by the first organic entity posits itself walking beside its companion. Additionally, that same entity may also behave a question: Does its companion likewise behave a similar environmental construct that includes that first entity strolling close by? But note that the companion to whom that question pertains is merely a behaved feature of the first entity's environmental construct. Note too that each such entity would be isolated in its own behaved environmental construct. A companion's world would be another universe, and the first organic entity cannot "get there" from its own behaved "here-and-now."

In review of the first sentence of the previous paragraph, which was cast from the fallacious traditional perspective, while one entity can behave itself existing in a social context, it has no means, from within its own behavioral isolation, to establish an independent reality for any other material entities that may seem needed to complete that social episode in a traditional account. "Other individuals" along with their putative social activity merely complete the logic of an individual's intrinsic environmental construct and thus remain behavioral manifestations of and within that isolated individual. In expansion of this conclusion: An organic entity, having internally and privately behaved its environmental construct, has no way to establish an external or remote reality for that construct as a whole nor for any aspect of it including any other individuals. And recourse to the traditional fallacy of mutually sentient individuals occupying a common, independently real, externality, which requires treating aspects one's neural behavioral process as independent material substances, cannot validly pierce that prohibition.[21]

A traditional social interaction among individuals, including its ongoing processes of conditioning and shaping,[22] must be reconsidered, because traditional social relations cannot be established from the private internally behaved perspective of an individual. Analytically, in recent years we have moved a small step toward such a reconsideration by noting, from the traditional perspective, that presumed social conditioning would pertain to each individual's *overt* reactions to presumably shared environmental stimuli rather than to their respective and probably differing, individual, private, neural, behavioral activities that are putatively occurring in reaction to those stimuli. Thus, from the traditional perspective, through conditioning and shaping processes that have pertained to *publicly* displayed behaviors, we have been saying that two individuals will come to react *overtly* in a similar way to what is being regarded by each as a common stimulus even though their respective private micro-structurally differing neural apparatuses would have to be behaving *unique* versions of the environmental stimuli of which each purports to be sharing a public appreciation with others. Through the conditioning of the overt reactions to which the individually unique private neural behavior chains in each individual the *traditionally* construed socialization could emerge amidst the extreme private isolation that characterizes the respective unique private neural activity of the involved individuals.

However, this traditionally cast notion has a problem: It is cast from the perspective of an independent observer of the ongoing social activity, but no individual, trapped in its own private behavioral isolation, could be privy to such an independent view of what others might be doing in an "out there" that inheres entirely in that would-be observer's own neural behavior. Such a putative observer does not "have a view of …", but rather would have to be behaving a private environmental construct of its own, which, while it might include a relevant scene, could not be representing "a view of some ongoing remote social activity among others." The proposition of one's having such a "view" into an alien universe is illogical, insofar as the reality of the internally behaved target universe cannot be established in the first place. Because such an "observer's view" would consist exclusively of that "viewer's" own internal neural behavior, no part of that behavior could be established, beyond mere presumption, as a "view" of anything external. That is, such a presumption, existing in the mode of private internal neural behavior, cannot, in the traditional sense, endow that which is presumed with an externally remote reality. The presumption that such a view into a remote externality is occurring is, in fact, merely part of the internally behaved logic by which the various aspects of an individual's internal behaving become rationalized. The internally behaved "external realm" to which reality traditionally has been attributed cannot be established. It is as if the traditionally construed external realm represents an alternative universe with which no means of contact exists and thus can afford no basis for its posit in the first place.

Environmental Reality

The independent reality of what traditionally we have called the "environment" is a fallacy. In a perhaps somewhat more realistic conceptualization that nevertheless draws implausibly on both the traditional and internal perspectives, the "external environment" exists presumably in the plural, …that is, multiplicatively as the respective, private, neural-behavioral constructs of individually isolated organic matter units, if indeed, from the perspective of one individual, "other individuals" actually could be "out there" undergoing a similar existence. Typically, each traditionally construed individual has been presuming that its own private environmental construct represents a remote and commonly shared environment that is endowed with an absolute reality. But such a traditional environmental matrix, seemingly remote and with an existence that would be independent of the individuals presumed to occupy it, can exist only as a virtual abstraction that is being behaved by a single individual. That is, the traditional "environment" manifests in neural behavioral mode that presumably is being mediated respectively by each isolated individual if, indeed, such "others" even exist. Such an individual, mistaking such personal internal process for a remote mega-entity called "the common external environment," must nevertheless contemplate that "environment" from the perspective of its own isolation. But instead of looking outside of itself at an independently real and remote environment in which it purportedly operates (as traditionally presumed), the individual is actually confronting an aspect of its own *internal* neural behavior. Thus, logically, there would be as many "environments" as there were individuals to behave them. However, no isolated individual can transcend the internal world that it creates in a neural behavioral mode. Thus, the individual isolation of those previously discussed limestone driveway pebbles is an isolation that is shared with units of organized organic matter. It is just that the organic matter units, because of their more elaborate and complex structures, enjoy a more "re"-actively elaborate isolation than do their limestone pebble cousins.

Traditionally presumed interactions between putatively remote environments and individual organisms must actually occur among parts of an organism's own neurally behaved environmental construct. Thus, notions of cause-and-effect, specifically of environmental-stimuli–and–behavioral-responses, between the putatively remote environment and some behavior of a given individual presumably pertain to logically behaved accounts for certain of the behavioral patterns of an individual. Note that, generically, this involves behaviors affecting other behaviors of a single individual. Importantly, all such events must involve internalities exclusively. Neurally behaved accounts of behaviors, which traditionally have been cast in terms of remote environmental stimuli and an individual's responses to them, actually pertain to further relations (called "logic") among aspects of the individual's own environmental construct, but the entirety of such constructs, including behaved events and the behaved accounts for those events, occur only in the private mode of internal neural behavioral process. However, lest we forget, the organic body per se that represents the behaving individual, as well as all behavioral process occurring to that body, inhere only as aspects of a behaved endovironmental construct. "One" does not enjoy an independent existence as some kind of remote observer of one's "self" in action. As we search traditionally for what "we really are" (as they say) plus the presumably "real" remote environment in which we have purported to exist, eventually we discover that there is nothing left of what was not there in the first place.

Note that from the logic of the traditional perspective we can acknowledge in the abstract the personal isolation of each neurally behaving individual while exempting ourselves from the disconcerting limitations of such immurement. We note that others would have to be trapped within the confinement of their own neural behavior. Yet few of us, as we indulge in that perspective, seem to notice that what we are observing about others in that regard would have to consist of but aspects of our own projected environmental constructs complete with the limitations inherent in such a perspective. As we often posit when beginning the presentation of an interpersonal interaction for analysis: "Given two individuals…." Yet neither of those individuals, nor a remote observer of both, can establish its own involvement in such a remote and independent reality, because each of them is "trapped" within, or confined to, the realm of its own behavior. For units of matter that lack the structural intricacy and complexity required for behavior to be included among their exhibited processes (e.g., the pieces of gravel scattered on a driveway), no environments can get behaved, so issues about isolation relative to posited environmental aspects do not arise with respect to gravels. However, the organic "gravels" that live in the houses to which those driveways lead do meet the necessary conditions. So how, then, amidst their individual isolations do *they* exhibit a sociality?

To review critical elements of the traditional explanation: The principal explanation from the traditional perspective has relied on the routinely behaved, complex, intricacy of individual "neural structures" (parts of behaved endovironments)—microstructures that remain subject to continual change produced by energy inputs. Those readily modifiable structures mediate the neural behavior of concern. Certain processes (featuring respective energy inputs called reinforcers and punishers) may then modify certain of those behavior-mediating neural structures, resulting in the repetition of certain of their neural behavioral manifestations and the suppression of others, while leaving the ineffective remainder to extinction. For a given individual, the initial, overt, behavioral assortment upon which those selective processes putatively have their effects tends to be of such diversity and rich variation that selections from that extensive microstructurally mediated repertoire can progressively come to approximate the overt behavioral commonality that eventually emerges among respective individuals. This behavioral drift may occur slowly or rapidly (to which people commonly refer as slow and fast learning). In this traditional account, those acceptably common overt behavioral mediations presumably emerge as reinforced selections from an array of options afforded by what are disparate neural configurations within respective individuals.[23] Again from the traditional perspective, when those overt approximations of behavioral commonality by different individuals, attained via conditioning-and-shaping processes, reach effective similarity, we tend to say agentially that those parties are behaviorally reacting "in agreement about …," or "in common to …," specific aspects of a single, commonly shared, environment.

However, the internal perspective precludes a view that putatively surveys, as if it is really out there, a remote environment—an environment that can exist independent of the individuals that are said to occupy it—a discrete environmental matrix that could incorporate multiple individuals each of whom occupies, shares, and privately appreciates that single, putatively "real," but remote externality. Given that an "environment" exists only in behavior mode as the conceptual projection of an individual that is said to be "occupying it," no perspective exists that affords the previously described traditional view. For an isolated individual there can be no establishment of a real remote community of agents "out there" among whom "agreements are being reached." Instead, the structure-enabled reactivity of a single material entity has merely come naturally to a logical and hence private internal resolution in neural behavioral mode—a resolution that features the neural-behavioral construct of a conceptually projected "external" environment—one that can include other seemingly independent occupants. However, the behaved "individuals" that putatively occupy such a construct remain endowed with the immaterial status of pure process (the neural-behavioral process occurring to a single isolated individual). That intangibility of "others" along with their confinement to the conceptual projections of a single individual precludes the "real" existence and participation of other individuals as "real entities" in a traditionally assumed communal environment. Such an "environment" as well as the individuals said to share the occupancy of it, manifesting only in the behavioral process mode of an individual, cannot be established objectively in independent concrete reality. Instead, the alternative logical establishment must occur exclusively in the form of further behavioral process by that single and thus isolated "individual."

The isolation of the process to which "we" refer as a neural behavioral "individual" being mediated by an organic "entity," is a complete isolation. The elements of sociality, and hence culture, occur merely as logical resolutions per se (as the internal neural behaviors of an "entity" that actually manifests only in the process mode of some different neural behavior). Also, the "body" that putatively does that neural behaving remains a part of the conceptually projected environment (in this case, the endovironment) and, manifesting only in behavioral process mode, is therefore as virtual as all else in that environment. The entire external realm is but an aspect of an internality manifesting entirely in the neural behavioral mode of a neural system the existence of which also manifests with similar intangibility. Thus, the existence of an external audience to which "I now write" cannot be established from within the realm of isolated process that is my being (and neither can "I"). Said in more general terms, the physical reality of an entire external environment, including all that it putatively comprises, cannot be established as such from within its own putative, internal, behavioral manifestation.

What more closely approximates "establishment" in that internal manner is the logically behaved integrity of the internal behavioral construct that is then merely regarded (in further neural behavioral process mode) as a "real" externality. External reality is thus but a name for a kind of special perspective that, chaining automatically in neural behavioral mode, modifies an individual's "energy induced" neural behavioral construct into a perceptively remote world (previously described as the "conceptual projection" to externality of an internal, neural, behavioral construct)—an externality in which that individual then purports to exist. This creation of a seemingly "real" remoteness occurs internally in the manner of an automatic kind of behavioral sequence of least resistance called a "logical resolution." Thus, the regarding (a chaining process) of a maturing neural behavioral construct as "external reality" "makes sense" of, or "logically interrelates," a particular ongoing cluster of occurring "neural behaviors." That is, in general, one set of processes merely so relates to another.

The available language by which to discuss and resolve these matters seems to compel reliance on a natural, neural, aspect of the endovironment (i.e., on a nervous system), the reality of which, like the entire ectovironment, is eroded by the arguments being developed herein. That is, also remaining unestablished would be the putative nerves that seem essential for behaving the remote environment into its insubstantial existence. And, as earlier noted, anything that resolves to pure neural behavioral process, including an organic unit of matter said to be mediating that process, forfeits its status in reality. Accordingly, with such a pierce of our bubble of pretentiousness, we vanish into a nothingness from which we were never actually removed.

Note that natural scientists have long been insisting that we "human beings" are naturally occurring entities of an organic kind, but that relatively easy conclusion also supports among its implications the perhaps more troublesome conclusions developed via the reasoning in this work. The preceding paragraphs of this section thus represent an arguably thin account of how an abstractly organized cluster of hydrogen, oxygen, nitrogen, phosphorus, and sulfur atoms creates the absurd perspective from which the events analyzed in these paragraphs can have been regarded traditionally as *"the environmental 'reality' amidst which our lives come to pass."* However, with a total environment, which (a) includes the individual that is behaving it and (b) being circularly confined to the neural behavior processes of that putative individual, the "individual" loses its material status as such, and the isolation of the "individual" is in a sense complete and absolute. Concepts such as "social," "community," and "culture," so traditionally familiar, must now be recast for conformance to that new "reality."

Resolution of the Traditional and Internal Perspectives

Beginning with the traditional perspective, a review of its resolution with certain realities of the internal domain might proceed as follows: Consider a particular red rose that is construed to be an established aspect of a remote and independently existing environment—a traditional proposition that has been challenged in this work. Nevertheless, continuing from the traditional perspective, while two individuals' respective *private* neural behaviors of a particular red rose will necessarily differ (because the biological microstructures that mediate those respective private neural events differ), the respective conditioned *public* reactions of those two individuals to that rose then serve as part of the stimuli for each other's subsequent public behaviors of reaction to that rose and to each other. Thus, as traditionally explained, the relevant public behaviors of those two individuals can evolve, by way of conditioning and shaping processes, leading each of those individuals to their respective conclusions of stimulus commonality.

Note, in this traditional consideration, that the relevant commonalities in the subsequent overt rose-related behaviors of the involved individuals—commonalities that an individual, in its isolation, would have to behave independently—would come to occur without the traditionally construed respective individuals ever having had to confront each other's *private* neurally behaved renditions of that flower. However, their presumably shared environment, which to each seems so convincingly to be "out there" as if "shared in common," remains, from the internal perspective, an automatically occurring assumption of one individual in its private isolation. That individual's conceptually projected environmental construct simply includes any relevant "others" as well as the presumably common environmental features that seemingly they are all sharing. However, no two independent "individuals" nor their respective behavioral processes can be compared, because no independent perspective can be established from which such a comparison could occur. An "individual" is trapped in the universe that it behaves into being, and that universe has no window through which to search for any other such universes that may or may not be "out there."

Traditional assumptions of environmental commonality by individuals would always involve less than completely justified conceptual leaps, first because any so-called "leap to an assumption" of commonality by an individual would necessarily be overshooting the limits of personal, currently available, sensational data and second, as has been explored in this work, would be based on a misinterpretation of the nature of the data upon which that conceptual leap relied. Therefore, despite the putatively ongoing conditioning and shaping, which presumably builds a degree of behavioral commonality sufficient to support traditionally construed social and cultural operations, the individually based constructs of environmental reality will, when misconstrued from the fallacious traditional perspective, inevitably lead to some individually behaved "public" discrepancies. But given what is presumed to be a common reliance on the *assumed* reality of a single, shared, real environment, such differences tend often, from within the traditional framework, to be resolved accusatively with agential declarations that "those other people" seem to be mistaken about what is "really out there." However, if "others" were to be "out there," their respective environments would consist of their private conceptual constructs. While the behaved environments "of different individuals" would be incomparable, were they somehow to be so, one such environment would never exactly match any other.

The traditional perspective, by which a common environment is construed to be appreciated by all parties, remains an unavailable view from an inaccessible vantage point. "People," insofar as they manifest exclusively in the mode of behavioral processes, logically cannot stand apart from the bodies in which they are occurring "to take a look" at anything, including look-backs at themselves. Being processes (rather than entities) "they" and "others" (were others to exist in their own separate universes) could occur only to the structures that mediate them and thus would be confined to certain kinds of process that those structures are undergoing. Logically, a hypothetical "group of observers" of a "common environment" (the traditional notion) could exist only in the behavioral process mode of a single individual. Such a traditionally construed group of observers must occur collectively within the isolation of that singular "organized unit of matter," which, from the internal perspective, is behaving all such "other" hypothesized observers. That is, each of those "others," occurring exclusively in the behavioral process mode of a single individual, must be mediated by, and inseparable from, that single "material entity" by which they are being originated.

Even as we thus rely upon a body to mediate an environment in which that body is purportedly operating we note once again that such a material body is but an endovironment existing in behavioral mode. All matter resolves to pure process insofar as it is behaved into "existence." Thus, "environments" inhere in neural behavioral process mode as behavioral constructs—one such construct[24] for each behaving material entity (if hypothetically any other such entities exit). A commonly shared, single, and independently existing environment remains a myth that, as traditional logic dictates, has been respected by nearly everyone, even as each such hypothetical "individual" would represent a deviation from that notion.[25]

This work has merely reconsidered the traditional view of reality and reinterpreted it to eliminate some of its illogic. However, with such a recasting of some long held notions comes perhaps unanticipated and disconcerting implications. This three-part work may seem to a reader to rather blatantly ignore or gloss over some of those important attendant issues. While I may prefer to describe such neglect as my "declining to become sidetracked by those branching issues," perhaps "failure to resolve them in a timely fashion" comes closer to the truth. In any case, this work leaves ample room for others to join in the scientific adjustment and expansion of this sketchy initial discussion

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[1] As Part III gets underway, a reader will notice an increasing reliance on quotation marks around familiar words and phrases denoting concepts that, although well understood from the traditional perspective, have been challenged by the arguments set forth earlier in this work. That is, while such familiar words and phrases may be evoked to enhance or ease a reader's comprehension of the immediate point, those terms and phrases would not withstand an analysis from the new perspective to which the reader has earlier been introduced. Alternatively, a translation of those familiar words and phrases, recasting them from the new internal perspective so as to render them compatible with the new way of looking at such matters, could require language so convoluted that the point at hand would become obscured. A resolution of that compositional dilemma has been attempted herein by occasional recourse to the traditional language (for easier comprehension of the immediate point) with quotation marks to remind the reader that such seemingly easy comprehension comes at the price of knowing better than at least some of what the traditional meaning of those words and phrases may be implying.

[2] Note that from the traditional perspective an attribution tends to imply an inner agent that performs it. That is, from the traditional perspective a "self-agent" is required to distinguish (a) a privately occurring visualization from (b) a view, through a sensory window, of an "external" environmental entity. The traditional fictional relations that comprise the contrasts defining such a distinction, when recast from the internal perspective being sketched herein, imply a radically nontraditional concept of reality.

[3] From the traditional perspective on reality a direct observation by one individual of the neural behavior of another is theoretically possible. However, from the intrinsic perspective of an internally isolated individual a direct observation of "real" environmental events is a meaningless concept, because that environment is being behaved and virtually projected to externality by that individual. It is meaningless to suggest that one can look, in some independent way, to see what is "out there" in an environmental construct that one is creatively behaving in the first place, and that preclusion would include the private neural behavior of another individual that is being behaved as a feature of that environment.

[4] To a behaviorologist this speculative sequencing of neural events may represent a logical deduction, but the neural physiologists will confirm or replace such speculations on the basis of more direct evidence.

[5] For readers who are asking: Would not such a "chunk of appropriately micro-structured matter" merely be yet another feature of a conceptually projected environment? The answer is "yes," and such illogical reliance on the independent material existence of such a body will shortly be subjected to correction.

[6] While everyone may have a nose, no two noses are identical—true also of other body parts such as "receptors," a conclusion that carries vast implications when such a receptor must impart the "raw material" for subsequent interpretations that confer environmental reality. Note that while microstructural similarity puts corresponding neural entities in the same general category, individual differences, superimposed on any sameness of those microstructures, render unique each individual's neural behavioral expression within the relevant behavioral category. When, as in such cases, this pertains to the microstructures that mediate neural behavior, it is the processes of "conditioning" that are relied upon for a microstructural drift toward the mediation of behavioral commonness.

[7] Note that this represents a kind of structure-based prohibition on commonality among the unmatchable environmental constructs of different individuals.

Furthermore, the fact that an "environment" represents a logical projection of neural behavior per se precludes the establishment in external reality of any individual's "environment." Thus, from the traditional perspective, various individuals may approach, but cannot achieve, environmental commonality, because the individually different neural structures by which respectively they would behave those environmental constructs into existence would insure the respective uniqueness of such constructs; and as explored in earlier parts of this work, from the internal perspective, the reality of an "environment" cannot be established in the first place insofar as an environment consists of a logical projection to "externality" merely of some "internal" neural behavior.

[8] Scientists, perhaps roboticists, working in their laboratories presumably could add to radios the additional structures necessary to improve their sonic outputs on the basis of feedback from their audience members. Such radios, in response to feedback from their listeners, would thus structurally self-adjust to better control the attention behaviors of their respective audience members.

[9] The term "overt" in this context refers to externally obvious muscular behaviors that are at least partly controlled by the neural behavioral activity under consideration.

[10] The particulars of the here-theorized, neural, micro-structural events await a more detailed explication by the neural physiology community from which eventually we will receive factual descriptions with which to replace what for non-physiologists remain but speculations. However, in the meantime it may prove worthwhile to note that, with respect to theoretically posited events, (a) objectively based speculation and (b) factual description represent what are called "different levels of analysis." The practitioners at each level have to "make their cases "with the kind, or level, of logical objectivity that is capacitated by their respective disciplines. However, in general and expressed from the traditional perspective, all scientists work to shift from speculation to factual description. In this case, to the extent that the behaviorological speculations in this work have merit, such a shift in kind of establishment may be facilitated by scientists in one field (neural physiology) relating their work to corresponding aspects in an adjacent field (behaviorology).

[11] Such a fallacious proposition is bolstered by the fundamental error of mistaking a process for a material entity. More specifically, when a "person" or an "individual" is construed to be a vaguely defined entity that inhabits a body rather than a mere process being mediated by that body, then logic dictates that a whole mythology be created to account for that putative entity and to describe its activities. For example, a huge facet of modern human culture is devoted to creating seeming niches for, and putative operations of, such fallaciously conjured agential self-entities, including (a) the secular "self" to which pronouns refer and (b) the putative "soul" that classifies generally under the rubric of "religion."

[12] The neural physiologists probably already have answers to many such questions. These questions are posed here merely to exemplify the utility of interdisciplinary cooperation when work in one field stimulates questions best answered by practitioners in another field. While the answers to such questions may be irrelevant to a behaviorologist's direct intra-field concerns, they can be satisfying to a scientifically "well rounded" practitioner. Furthermore, insights acquired from another field may result in better-framed inquiries and better interpretations when those imported insights are taken into account with respect to matters in one's own field.

[13] To speak traditionally of the internal perspective: An "environment," being an internally behaved and projected neural behavioral construct of an individual, can manifest as but neural behavioral process occurring *within* that organized unit of organic matter. Any additional behavioral processes that purport to reflect that individual's interactions with such a "remote" environment, consist merely of additional behavioral processes that actually are interacting only with that internal environmental construct. Furthermore, it *all* occurs in the mode of internal *process* thus preserving the absolute isolation of the "individual"—a plight that, in spite of its expanded capacity for reactivity, the traditionally construed organic matter-unit shares with its driveway-gravel cousins. Note, however, from the *internal* perspective, that the "organic individual," confined to the isolation of its own behavioral process, must behave into a process-type of existence, as one aspect of its "environment," those driveway gravels upon which we traditionalists now rely for this comparison. And the same can be said of that "organic individual" per se. When the agential mini-deity ("self"), acting as a miraculous body manager, is stripped conceptually from its interior post, the organic individual is reduced to a collection of naturally occurring processes that according to further neural behavioral logic (a further kind of

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process) are "attributed to the intricacy of its structure."

[14] The traditional notion of "mentally stored knowledge" is misleading. Behavior of any kind consists exclusively of process and hence cannot be stored for iteration (in the same sense that knee bends cannot be stored for later occurrence). Thus, all responses represent *new* behavior in the sense of each response being newly mediated. The essence of what are known as behavioral "repetitions" inheres in the neural microstructure that mediates the responses in question. Such a microstructure presumably is alterable by what we regard as "feedback" from each specific occasion of behavioral mediation by that structure. Such microstructural alterations may re-capacitate that neural microstructure so that it can mediate more or less readily similar but perhaps trending behavioral manifestations on future occasions of similar stimulation. Creating the particular environmental arrangements through which such feedback is contrived constitute a major part of the engineering aspect of behaviorology, while delineation of the detailed internal workings of such neural activity falls within the purview of neural physiology.

[15] For detailed explanations and discussions of these various stages of "dying," see Fraley, L. E. (2012). *Dignified Dying—A Behaviorological Thanatology*. Canton, NY: ABCs.

[16] Leaping inductively beyond the available data, natural scientists insist that the total control over any kind of occurring event, including the behavioral kind, renders that event inevitable. That "total control" comprises various controlling factors. However, in the case of a specific behavioral event, because as a matter of practicality we cannot account with scientific objectivity for all contributing factors, we predict the occurrence of such an event in terms of its "probability." Thus, the effects of our behavior-engineering interventions among the contributing variables for which we *can* account are described in terms of shifts in the "probability" of the behavioral outcome. Our speaking in terms of "behavioral probabilities" allows both insignificant and also unrecognized factors to exert their contributions to the totality of the control over a behavioral event of concern, while as scientists, we work to reduce to insignificance the combined effects of such neglected controlling factors. As with other kinds of engineering, behavior engineering, as a matter of practically, involves gaining control of significant "causal" factors while ignoring lesser ones, some of which presumably remain unidentified.

[17] At this point a reader might find worthwhile a review of Chapter XVIII, entitled The Self , in Skinner, B. F., 1953, *Science And Human Behavior.* New York: The Free Press (The Macmillan Company). Skinner cast his analysis, at times implicitly or assumptively, from the traditional perspective, which features reality anchored in a remote environment the existence of which was independent of any organism that might be occupying it. Absent such an organism, that environment would still be there, its enduring reality unaffected by any organisms that may or may not be occupying it. To pierce such a compelling traditional reality for "the environment," it may help to abandon the traditional logical approach to "environment" via one's seemingly compelling need for a place to be and instead approach "environment" from an entirely different perspective, namely, by considering how, or if, a naturally occurring organic unit of matter (if there is such a thing) could, via its behavioral process mode, come to realize an ambient environment. Considering "environment" from this "back door" approach may lead more easily to a very different notion of environmental reality than does the mere assumption of a real and absolute remote environment as has been traditional**.**

[18] In a typical large English dictionary, definitions of "common" and of its derivative forms and phrases total close to one hundred.

[19] We behave what we regard respectively as the ectovironment and the endovironment. That is, with respect to the endovironment, we behave into the ethereal existence of pure behavioral process our own material body, and we behave that body behaving interrelatedly with an ectovironment.

[20] Note that the phrase "reduces dissonance" constitutes an appeal to negative reinforcement. Implicit among the implications of this fact is a biological question pertaining to the sequential development of complex organisms (viz., is the capacity for negative reinforcement more, or less, biologically primitive than the capacity for positive reinforcement?). Evolutionary biologists typically can address questions such as this in much more elaborate biological detail than can behaviorologists.

[21] An author may accordingly ask in traditional terms: To whom then do I write, and what is the point of my bothering to do so? …Such questions imply some of the necessary reformulation as our species steps gingerly from its traditional and more primitive perspective toward a new reality, which its evolving intellect and expanding analytical capacity

enable its members gradually to appreciate. In general, all behavior including writing would tend to restore imbalances among other behavioral internalities, so in one sense writing would always occur as an internally restorative activity. Thus, the mythical agential author would, in the traditional sense, always be writing to itself.

[22] *Conditioning* pertains to changes in the frequency of what traditionally is regarded as a particular kind of behavioral response, while *shaping* pertains to changes in its form.

[23] Note that from the traditional perspective on reality we have had little difficulty in recognizing that the neural microstructures in the brains of various individuals would have to differ, as reassured by the neural physiologists. It follows that when each individual is initially confronted by "the same environmental stimulus" any neural-behavioral processes that are mediated by those individually differing structures would have to differ among individuals on such occasions. Nevertheless, with some conditioning of their respective overt responses, which occur under partial control of those differing bursts of neural activity, all of the involved individuals may soon agree overtly that the stimulus is "a dark green pickup truck." Even from the traditional perspective we have gotten that far (differing neural microstructures; common overt reactions). But accounting for such commonality from the internal perspective of isolated units of organic matter can be more challenging.

[24] A conceptual construct manifests as a particular pattern of behaving. However, in the traditional view that particular pattern of behavior is mediated by particular neural microstructural configurations putatively in a brain. As traditionally described, those structural mediators of neural behavior are created genetically and thereafter modified during subsequent episodes of conditioning and shaping. From the traditional perspective, the professional definitive and interpretive responsibilities with respect to conditioning and shaping are divided as follows: (A) for requisite environmental configurations and events plus the environmental implications of the resulting behavioral events, the professional responsibility rests with behaviorology; (B) for how conditioning and shaping processes affect brains and the intrinsic nature of the resulting neural behavioral activity, the professional responsibility rests with neural physiology.

[25] A work such as this presents a substantial writing challenge insofar as both author and readers have long operated comfortably from the traditional perspective of reality that this work calls into question. Among the many common, traditional, conceptual constructs (a.k.a. notions) being challenged by the thematic content of this work are some pertaining to familiar features of communication. The exposition featured in this work has thus, of seeming necessity, frequently switched between that common to the familiar traditional perspective on reality and an exposition more characteristic of the new and perhaps more alien perspective to which I have referred tentatively as the "internal perspective." I have relied on the former both as a platform from which to launch textual forays into the latter and to serve frequently as a haven of literary retreat, as most readers will have noticed—some perhaps annoyed by such alternations of perspective. I too was so affected in spite of the seeming necessity for such oscillations. As I labored over the prose of this work I could not help thinking that Miss Foley, my indomitable tenth grade English teacher, were she again to have peered over my shoulder, might have indicated numerous instances of overlooked editing that would both simplify and thus enhance the ongoing exposition.

Submission Guidelines

Journal of Behaviorology (previously known as *Behaviorology Today*) is the fully peer-reviewed Journal of The International Behaviorology Institute (TIBI) and is published in the spring and fall of each year.

To submit a manuscript, contact the Editor:
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All accepted pieces must contribute to the behaviorology discipline (e.g., by relating to or clarifying or expanding some part of the discipline such as the philosophical, conceptual, theoretical, experimental, applied, or interdisciplinary aspects). Accepted pieces must also be crafted in ways that convey as much consistency as possible with the principles, concepts, practices, philosophy, and terminology of the discipline.

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Behaviorology is an independently organized discipline featuring the natural science of behavior. Behaviorologists study the functional relations between behavior and its independent variables in the behavior-determining environment. Behaviorological accounts are based on the behavioral capacity of the species, the personal history of the behaving organism, and the current physical and social environment in which behavior occurs. Behaviorologists discover the natural laws governing behavior. They then develop beneficial behaviorological-engineering technologies applicable to behavior-related concerns in all fields including child rearing, education, employment, entertainment, government, law, marketing, medicine, and self-management.

Behaviorology features strictly natural accounts for behavioral events. In this way behaviorology differs from disciplines that entertain fundamentally superstitious assumptions about humans and their behavior. Behaviorology excludes the mystical notion of a rather spontaneous origination of behavior by the willful action of ethereal, body-dwelling agents connoted by such terms as *mind, psyche, self, muse,* or even pronouns like *I, me,* and *you.*

As part of the organizational structure of the independent natural science of behavior, *The International Behaviorology Institute* (TIBI), a non-profit organization, exists (a) to arrange professional activities for behaviorologists and supportive others, and (b) to focus behaviorological philosophy and science on a broad range of cultural concerns. And *Journal of Behaviorology* is the refereed journal of the Institute. Journal authors write on the full range of disciplinary topics including history, philosophy, concepts, principles, and experimental and applied research. Join us and support bringing the benefits of behaviorology to humanity. (Contributions to TIBI or TIBIA—the professional organization arm of TIBI—are tax deductible.)

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Volume 7, Number 2 (Fall 2004): BEHG 101: Introduction to Behaviorology I.*
Volume 7, Number 2 (Fall 2004): BEHG 102: Introduction to Behaviorology II.*
Volume 7, Number 2 (Fall 2004): BEHG 201: Non–Coercive Child Rearing Principles and Practices.*
Volume 7, Number 2 (Fall 2004): BEHG 355: Verbal Behavior I.*
Volume 8, Number 1 (Spring 2005): BEHG 400: Behaviorological Rehabilitation.
Volume 8, Number 1 (Spring 2005): BEHG 415: Basic Autism Intervention Methods.*
Volume 8, Number 1 (Spring 2005): BEHG 420: Performance Management and Preventing Workplace Violence.*
Volume 8, Number 1 (Spring 2005): BEHG 425: Non–Coercive Classroom Management and Preventing School Violence.*
Volume 8, Number 1 (Spring 2005): BEHG 475: Verbal Behavior II.*
Volume 8, Number 2 (Fall 2005): BEHG 410: Behaviorological Thanatology and Dignified Dying.
Volume 9, Number 1 (Spring 2006): BEHG 365: Advanced Behaviorology I.
Volume 9, Number 2 (Fall 2006): BEHG 470: Advanced Behaviorology II.
Volume 10, Number 1 (Spring 2007): BEHG 120: Non–Coercive Companion Animal Behavior Training.

Current Syllabi by Course Number

BEHG 101: Introduction to Behaviorology I:
Volume 7, Number 2 (Fall 2004).*
BEHG 102: Introduction to Behaviorology II:
Volume 7, Number 2 (Fall 2004).*
BEHG 120: Non–Coercive Companion Animal Behavior Training:
Volume 10, Number 1 (Spring 2007).
BEHG 201: Non–Coercive Child Rearing Principles and Practices:
Volume 7, Number 2 (Fall 2004).*
BEHG 355: Verbal Behavior I:
Volume 7, Number 2 (Fall 2004).*
BEHG 365: Advanced Behaviorology I:
Volume 9, Number 1 (Spring 2006).
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BEHG 415: Basic Autism Intervention Methods:
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BEHG 420: Performance Management and Preventing Workplace Violence:
Volume 8, Number 1 (Spring 2005).*
BEHG 425: Non–Coercive Classroom Management and Preventing School Violence:
Volume 8, Number 1 (Spring 2005).*
BEHG 470: Advanced Behaviorology II:
Volume 9, Number 2 (Fall 2006).
BEHG 475: Verbal Behavior II:
Volume 8, Number 1 (Spring 2005).*

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*An older version appeared in an earlier issue.

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TIBI, as a non-profit educational corporation, is dedicated to many concerns. TIBI is dedicated to expanding and disseminating the behaviorological literature at least through the fully peer-reviewed *Journal of Behaviorology* (previously called *Behaviorology Today*) and the behaviorology.org web site; TIBI is also dedicated to teaching behaviorology, especially to those who do not have university behaviorology departments or programs available to them; TIBI is also a professional organization dedicated to organizing behaviorological scientists and practitioners into an association (*The International Behaviorology Institute Association*—TIBIA) so that they can engage in a range of coordinated activities that carry out their shared purposes. These activities include (a) holding conventions and conferences and so on; (b) enabling TIBI faculty to arrange or provide training for behaviorology students; and (c) providing TIBI certificates to students who successfully complete specified behaviorology curriculum requirements. And TIBI is a professional organization also dedicated to representing and developing the philosophical, conceptual, analytical, experimental, and technological components of the separate, independent discipline of behaviorology, the comprehensive natural–science discipline of the functional relations between behavior and independent variables including determinants from the environment, both sociocultural and physical, as well as determinants from the biological history of the species. Therefore, recognizing that behaviorology's principles and contributions are generally relevant to all cultures and species, the purposes of TIBI are:

a) to foster the development of the philosophy of science known as radical behaviorism;
b) to nurture experimental and applied research analyzing the effects of physical, biological, behavioral, and cultural variables on the behavior of organisms, with selection by consequences being an important causal mode relating these variables at the different levels of organization in the life sciences;
c) to extend technological application of behaviorological research results to areas of human concern;
d) to interpret, consistent with scientific foundations, complex behavioral relations;
e) to support methodologies relevant to the scientific analysis, interpretation, and change of both behavior and its relations with other events;
f) to sustain scientific study in diverse specialized areas of behaviorological phenomena;
g) to integrate the concepts, data, and technologies of the discipline's various sub–fields;
h) to develop a verbal community of behaviorologists;
i) to assist programs and departments of behaviorology to teach the philosophical foundations, scientific analyses and methodologies, and technological extensions of the discipline;
j) to promote a scientific "Behavior Literacy" graduation requirement of appropriate content and depth at all levels of educational institutions from kindergarten through university;
k) to encourage the full use of behaviorology as an essential scientific foundation for behavior related work within all fields of human affairs;
l) to cooperate on mutually important concerns with other humanistic and scientific disciplines and technological fields where their members pursue interests overlapping those of behaviorologists; and
m) to communicate to the general public the importance of the behaviorological perspective for the development, well–being, and survival of humankind.

*This statement of the TIBI/TIBIA purposes was adapted from the TIBI By–Laws.—Ed.

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