RELIABLE FRONTAL CORTEX ACTIVITY FOR AN ORAL STROOP TASK USING FUNCTIONAL NEAR-INFRARED SPECTROSCOPY

By

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Abstract

RELIABLE FRONTAL CORTEX ACTIVITY FOR AN ORAL STROOP TASK

USING FUNCTIONAL NEAR-INFRARED SPECTROSCOPY

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Analysis tools such as HomER and NIRS-SPM for functional Near-Infrared systems are commercially or freely available; however, they are difficult for clinicians to use as an assessment tool. One barrier to their use is the reliability of a given functional test. Intraclass correlation coefficients (ICC) provide a measure of group and individual reliability. NIRS-SPM was extended with ICC to assess a two part modified Stroop task. The protocol was repeated once every two weeks over a period of one month. Changes in neural activity attributed to inhibition of distraction, show significant covariance to the protocol with moderate to strong reliability for the group, and moderate reliability for individuals in the medial and left frontopolar and dorsolateral cortex. In addition, as the inhibitory response increases, neural activity shows a decrease in these same areas. This methodology could be extended to aid clinicians for group and individual patient comparisons.

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Chapter 1

Introduction

Over 1.7 million United States citizens receive a traumatic brain injury every year.[1] Traumatic brain injury (TBI) and stroke combine as acquired brain injury (ABI) to be the number one cause of death and disability worldwide. TBI characteristics depend upon the specific physics of the injury such as a fall or vehicular accident and involve a coup (anterior) and contrecoup (posterior) injury. The frontal cortex is particularly vulnerable to TBI.[2] Cognitive and behavioral impairment associated with frontal injury results in poor recovery following injury. To maximize patient treatment it is imperative to quantify patient capabilities and impairment. Traditionally, neuropsychologists use structural neuroradiologic imaging combined with cognitive and behavioral assessment to determine impairments associated with frontal cerebral injury related to TBI.[3] A patient's ability to focus on therapy tasks can change the type of therapy and length of therapy needed for a specific patient. However, insurance companies in Texas are citing the lack of research on the recovery of patients undergoing therapy as a basis to limit payment for patients to six weeks. Therefore rehabilitation clinics are looking for ways to quantify the resulting improvements of therapy. The Stroop test is used as a measure in neuropsychology to determine a patient's ability to inhibit distraction, i.e. focus. This test's behavioral analysis based upon error rates undergoes habituation and may not lend itself as a sole measure for retesting during therapy. Functional Near-infrared Spectroscopy (fNIRS) allows a clinician to be able to infer the changes in neuronal activity of the brain cortex every tenth of a second. This study uses fNIRS to study healthy controls taken by clinicians at a post-acute rehabilitation clinic to determine the role of the frontal cortex to inhibit distraction and thereby determine a normal subject's ability to inhibit distraction and compare in the future to patient images to guide therapy conditions. By understanding the role of the frontal cortex in the Stroop task an extended study could be developed to help guide the length of therapy needed for patient recovery in regards to inhibiting

distraction. However, before comparisons can be to patients a measure of reliability within the healthy population is first required.

1.1 Frontal Cortex Anatomy

The frontal cortex (Fig 1.1) is comprised of the prefrontal cortex and the frontopolar cortex. The frontopolar cortex (FPC) can be broken down into a left, medial and right cortex. The prefrontal cortex is comprised in the superior region bilaterally by the dorsolateral prefrontal cortex (DLPFC), inferior bilateral regions of the prefrontal cortex are referred to as orbitofrontal cortex (OFC) and the lateral regions are the ventrolateral prefrontal cortex (VLPFC). The left lateral position of the ventrolateral and dorsolateral cortices contain Broca's area which is the cortical area used for speech generation and recognition. While not the focus of this study to probe geometry used for this study extends to into the motor and temporal cortices. Superior and posterior to Broca's area is the premotor and motor cortices associated with movement of the mouth. Posterior to Broca's area is the auditory regions which are in the temporal cortex. Parallel to these speech structures on the right side there are mirrored areas of activity which may also be associated with speech and mouth movement.

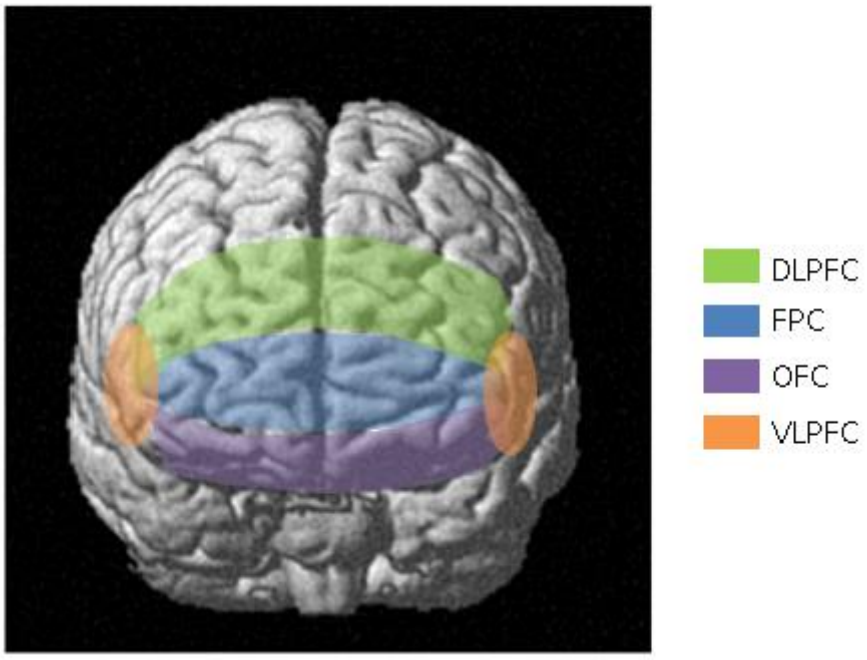


Figure 1.1 Frontal Cortex

The frontal cortex has many neural network pathways, but of specific concern to this study is the pathway of the Anterior Cingulate Cortex (ACC) to DLPFC. The ACC is located in the limbic region of the brain and associated with executive functions as well as pain. The DLPFC and FPC override the primary brain response within the ACC.

1.2 Executive Function

Executive function is one's ability to control other tasks. The areas of the brain considered to be the most influential on executive function are the DLPFC and FPC. These cortices also called Brodmann Areas 9 and 10 respectively have been determined in early lesion studies and recognized in newer functional imaging techniques to be attributed with the ability to inhibit distraction.

1.3 Stroop Test

The Stroop test is used as an assessment to determine one's ability to inhibit neuronal activity. In particular, it monitors the ability to inhibit distraction and focus on naming the color presented to them, regardless of how it is presented. The test may consist of two or many parts. It can have one or two simple tasks as comparators to a task with a distraction. The simple task is a color block and the subject says the color or selects the matching color with a finger press. A secondary simple task may be a list of words written in black which the subject reads. The distracted task may be a combination of congruent or incongruent tasks or they may be separated into different tasks. A congruent task means the color of the word matches the font color and the subject could either read the word or say the color and they would still be correct. The incongruent task is one where the text of the word and font color does not match. The subject is to say only the color. If they were instead to read the text they would have the answer incorrect. Difficulty of the task is increased by mixing congruent and incongruent presentations within the same task. While the differences in groups for each task may be compared, the differences between the distracted task and the simple task are normally compared for a given patient to a healthy population. Specifically the difference in the response delay or the success rate per task is compared against different populations.

1.4 Principles of Functional Near-Infrared Spectroscopy

Functional Near-Infrared Spectroscopy is primarily used to determine the changes in concentrations of Oxygenated Hemoglobin (HbO) and Deoxygenated Hemoglobin (Hb). These two

concentrations when added together determine the Total Hemoglobin (HbT) concentration change for a given area over a specific period of time. To determine the concentrations, two wavelengths of light within the range of 700-900 nm of what is called the near-infrared range are used to calculate the change in optical density. This range is within the optical window (700-1000) of biological tissue meaning most tissue is transparent to light of these wavelengths. However HbO and Hb absorb light within this range with different absorption coefficients allowing for a ratio of the changing light intensity as it passes through blood to be proportional to the change in concentration of hemoglobin known as the modified Beer-Lambert Law. As light is predominately scattered through brain tissue it is possible to place a photo detector one to three centimeters away from a light source both perpendicular and incident to the skull. The path that the light photons travel between the detectors due to scattering is a banana shaped path and is referred to as a channel.

HbO changes are a result of changed glucose metabolism requirements within a channel. Neural activity within an area requires glucose to function and it is supplied either through aerobic (requiring oxygen) or anaerobic (without oxygen) metabolism. Ninety percent of brain glucose metabolism is aerobic met by cerebral blood vessels. Increasing requirements of HbO triggers local increases of blood flow and blood volume. This neurovascular coupling process normally continues for a few seconds until the region is above the metabolic rate of oxygen consumption ($CRMO_2$.) The normal hemodynamic function response (HFR) then continues at a plateau for the approximate length of the stimulus and then HbO may drop down briefly below the baseline concentration before returning to the baseline concentration.

1.5 Stroop Test and Functional Imaging

Recently, functional neuroimaging has been used to correlate specific areas of cerebral activation to cognitive skills.[4] One advantage of functional neuroimaging is that it is possible to obtain a series of patterns of cerebral activation approaching real-time. This measure can be correlated to the task or test given to compare to treatment and eventual outcome. This correlation may allow for evaluation of treatments and guide more efficient timing of treatments.

Soeda and Nakashemi used Functional magnetic resonance imaging (fMRI) to correlate specific areas of cortical activity with working memory and inhibitory ability for individuals with TBI.[5] These

individuals however were greater than one year post injury and although they produced more errors on the Stroop task, the number of errors was not significantly different than those committed by the control group. Imaging results yielded similar patterns of activation for both controls and patients, which included frontal, parietal and occipital areas. However, the TBI patients demonstrated less activation in the anterior Cingular gyrus as well as decreased right side activation. The result being that left hemisphere cortical activation is the primary activation area for TBI patients one year post injury. Other authors have discovered increased frontal activity in response to executive tasks, possibly due to recruitment of other neural circuitry.[7]

Hiroyuki used fNIRS to study cerebral organization following stroke.[8] He compared the motor function of healthy versus chronic stroke survivors. HbO for the unaffected arm were similar for both groups, while the affected arm demonstrated increased ipsilateral activation of the somatosensory cortex for patients. Following TBI authors theorize that mechanisms as restitution, substitution or compensation can be studied using functional neuroimaging techniques.[9] Breier et al. demonstrated significant increases in brain activation patterns using MEG following constraint language treatment in an aphasic client in brain regions homotopic to the left hemisphere which continued to increase in activation with three months of treatment.[10] Longitudinal motor function studies using fMRI show reduced activation for controls called habituation with increased activation for patients which may be due to rehabilitation.

Near infrared spectroscopy has recently been used to study brain activation associated with cognitive abilities/impairment. This approach has several advantages over traditional measures of cerebral activation such as MEG and fMRI. For instance, with measures at $1/10^{th}$s fNIRS has better temporal resolution than fMRI. FNIRS is also less restrictive so that the patient can move more freely during studies as compared to MRI or MEG. Cost is significantly reduced for fNIRS than other neuroradiologic imaging approaches. There are several limitations for fNIRS, however, including lack of commercially available whole head coverage and limited spatial resolution that is restricted to the outer cortices. However fNIRS is well suited for repeated measurements that would allow for assessment of any change in brain activation patterns associated with recovery/treatment during rehabilitation. Increased freedom of movement and

relatively low-cost also makes fNIRS an ideal measurement technique to assess relevant changes in brain activation patterns associated with rehabilitation.

TBI patients, one year post injury, undergoing Stroop studies with functional Magnetic Resonance Imaging (fMRI) show increased activation of left dorsolateral prefrontal (DLPFC) and left posterior parietal cortices.[13] Also functional Near-Infrared Spectroscopy (fNIRS) of healthy subjects after exercise in comparison to control groups for interference tasks shows significant left DLPFC activity.[14-16] Leon-Carrion et al employed fNIRS and found that oxyhemoglobin concentration in the superior dorsolateral prefrontal cortex was associated with shorter reaction times on a modified Stroop task in a group of healthy volunteers.[11] Ciftici found significant increases in oxyhemoglobin in the left lateral prefrontal cortex during the interference portion of the Stroop using fNIRS.[12] These latter authors compared the classical versus Bayesian methods for data analysis, and concluded that Bayesian models were the preferred model. This latter finding brings up the issue of a lack of a standard analysis paradigm for use with fNIRS, which continues to be problematic for generalizing and comparing results across studies using fNIRS technology. Cutini et al saw there might be a shift in right to left dorsolateral prefrontal cortex activity for the Stroop effect with age.[17] Goldberg suggests that novel information is learned on the right cortex and shifts to the left cortex as it is modularized.[18] This shift may also be present in recovery with patients.

Chapter 2

Stroop Test Reliability

2.1 Aims

No longitudinal study of healthy subjects for the Stroop study has been published as of the time of this writing for fNIRS or even fMRI. A local neuropsychological rehabilitation clinic purchased a commercial fNIRS system and performed three years of data collection of Stroop, Speech and Line Orientation protocols to ascertain patient brain function in comparison to control data. However, available software for analysis did not provide an adequate method to ascertain their results. This study examined fNIRS data used to assess patterns of cerebral activation and changes in frontal activity associated with a modified Stroop test in healthy individuals. Differential response rates are the difference between the success rates of two tasks. Differential activity is the difference in maximum HbO values between the two tasks for a subject. The aims of this study are:

1. Determine the pattern of neural activity for a group of healthy subjects during inhibition of distraction.
2. Determine if those patterns are consistently reliable for repeated sessions.
3. Determine if there is a correlation between inhibition of distraction and HbO concentration.

2.2 Materials

2.2.1 Subjects

The healthy subjects numbered fourteen of which two subjects missed one session. They had an average age of 39.3 years (range 29-61 years), were 50% female and 86% right-handed. Informed consent forms, as part of an approved Investigation Review Board through the University of Texas Southwestern Medical Center, are kept at the rehabilitation clinic and all information used for analysis was deidentified. Analysis in NIRS-SPM was performed blind of knowledge of any individual other than an identifier code.

2.2.2 Instruments

2.2.2.1 Hitachi ETG-4000

A Hitachi Medical Systems ETG-4000 was used to acquire ten images per second at 695 and 830 nm wavelengths with Class 1M laser diodes to determine oxygenated and deoxygenated blood concentrations.[19] The standard Hitachi 3x11 optical array measuring 52 channels was placed across the forehead, providing bilateral frontal, temporal and mid to inferior parietal coverage. The array was attached through a black cloth swim cap to ease placement and limit noise.

2.2.2.2 Optode and channel geometry

Placement of the optode array centered directly on the center of the forehead with the bottom optode positioned 2cm above the nasion. The sides of the cap were positioned 3cm above the Targus of each ear. The channel separation is 2 cm. The coregistration of the images was confirmed using an integrated Polhemus Patriot digitizer. Figure 2.1 shows the channels corresponding to the coregistered optodes. Appendix A contains the full Brodmann anatomical references and percentage of overlap.

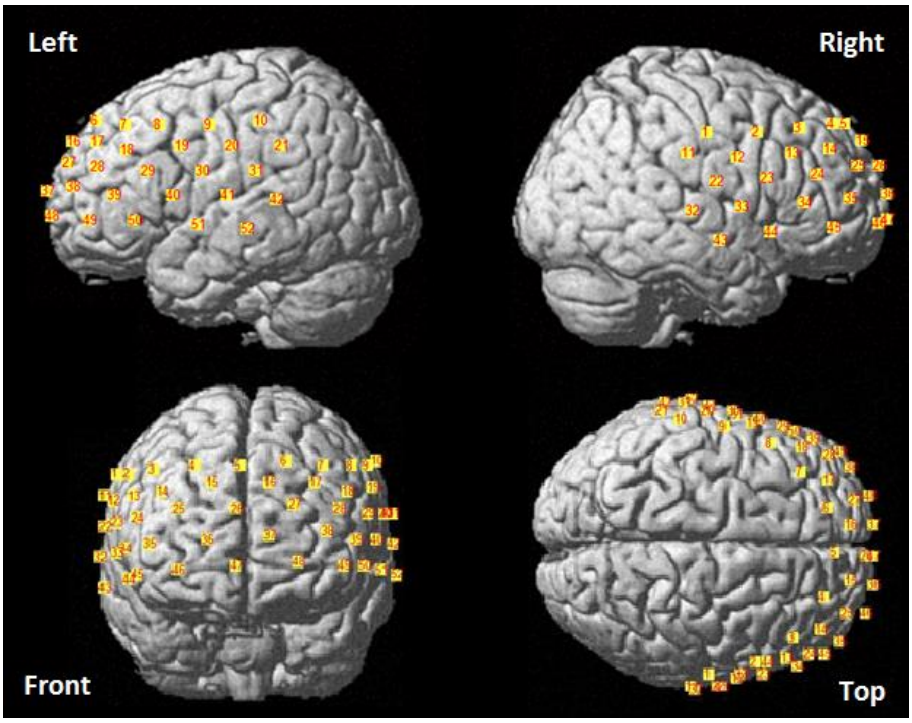


Figure 2.1 Channels

2.3 Methods

To determine where significant activation occurs with reliability several steps are required as seen in Figure 2.2 Analysis Methods. First the behavioral data is analyzed to determine if there is consistency in the response for the task itself by the subjects. Then the task stimuli must be compared to the changes in cortical activation which is done by combining in NIRS-SPM the protocol design and the raw data from the fNIRS instrument. Then the mean change in HbO can be compared across sessions to determine if that positive or negative change is reliably repeatable using intraclass correlation analysis. Finally, the individual changes in neural activity (HbO) can be correlated to the behavioral task and compared with those channels which are reliable. This correlation can be used to determine which areas show changes in neural response in comparison to task success and which areas of cortex consistently show inhibitory response activation.

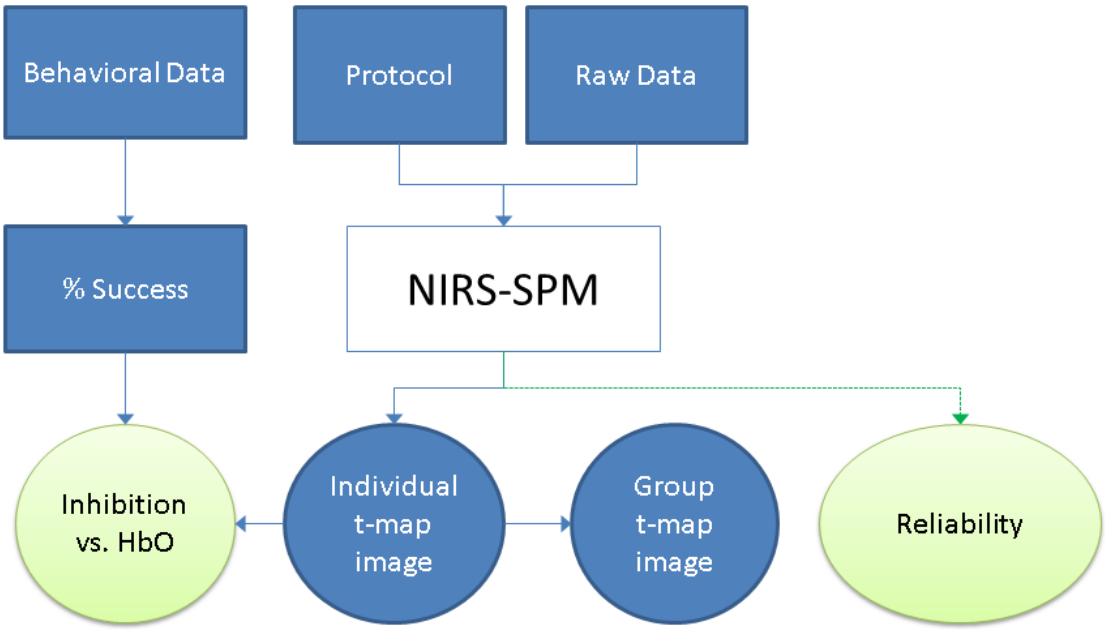


Figure 2.2 Analysis Methods Overview

2.3.1 Experimental Design

The experimental design was by neuropsychologist Patrick Plenger, PhD. Each subject read and signed an informed consent form before proceeding. Then they were centered two feet away from a 42”

monitor placed directly in front of them. The placement probes were confirmed and registered using a Polhemus Patriot Digitizer for direct storage by the Hitachi ETG-4000 system and later coregistration with NIRS-SPM. Sufficient channel signal was confirmed before running each protocol by the proctor viewing a green indicator in the ETG-4000 system for each channel. Each subject was given the instruction to say the color of each object or word presented to them and not the word shown. A black dot was used in the rest periods. The protocol used was repeated once after two weeks and then again four weeks after the initial session giving a total of three presentations to each subject.

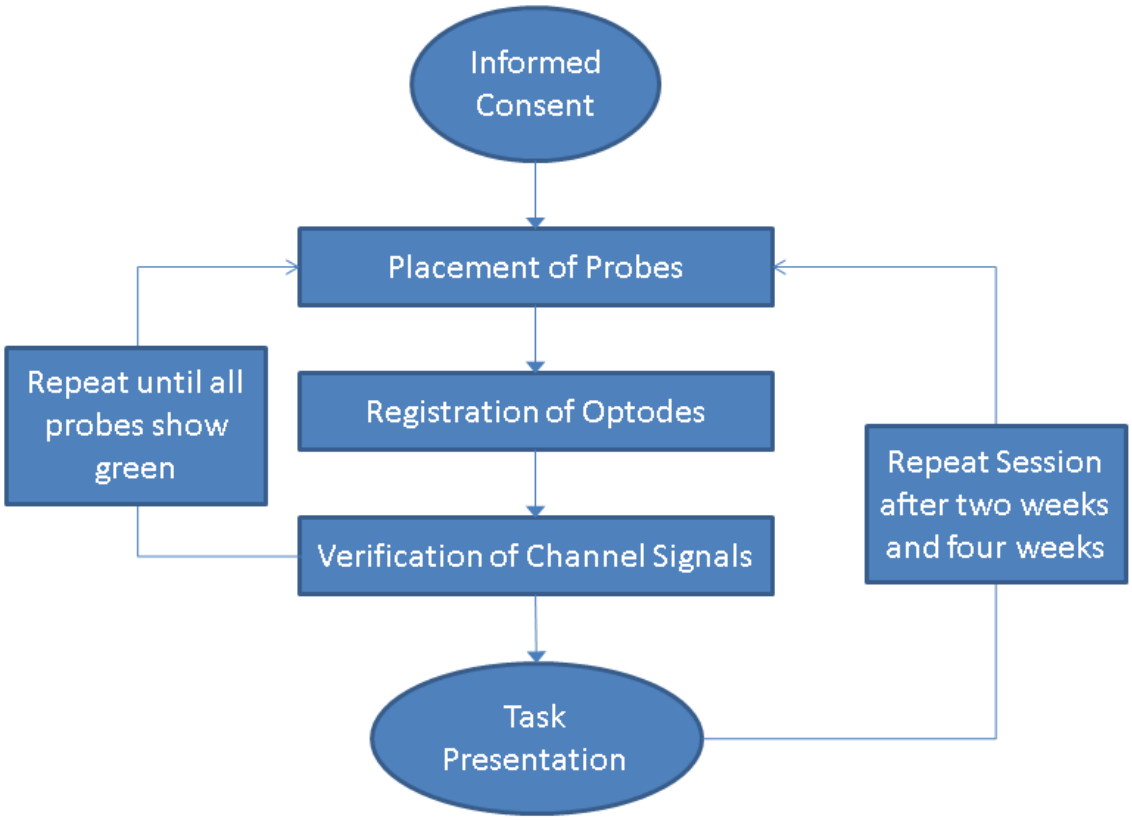


Figure 2.3 Experimental Design

2.3.2 Experimental Protocol

Two tasks were used for the protocol. During the simple task stimulation (Task A) the subjects were instructed to say the color (red, green, blue, or yellow) of a dot presented on the screen. During the interference stimulation block (Task B) the subject said the font color when shown different color name text. For Task B the written color of the word was incongruent with the font color in 78% of the

presentations. Each dot or word changed color every 1 second in the stimulation block period. Each block of stimuli presented was 24s long. Each session consisted of a 10s prescan and 40s baseline with a stimulus block followed by 40s rest in an ABBABA pattern (Figure 2.4.) One exception is the rest after the third block was 39s. During the rest periods the subject looked at a black dot in the middle of the screen. Three total sessions were performed by each subject with each session being given two weeks after the previous over the period of one month total. All subject sessions were proctored by a neuropsychologist or clinical psychologist and recorded with audio and video.

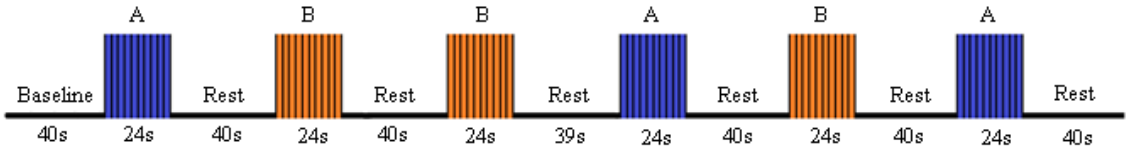


Figure 2.4 Protocol

2.3.3 Behavioral Data

Behavioral data is calculated by the number of successfully named colors for the task for the session divided by the number of stimuli. Each task has 72 total stimuli for each session. Tasks are looked at individually but also the difference between distracted task and the simple task is compared as Task B-A. This difference is due to inhibition of distraction. In addition to success rates, the subject response time is normally calculated for this task, but the design of this task with the interstimulus interval of one second and poor quality of audio equipment does not allow for accurate response time measures for the oral task. Previous studies on the Stroop task use a finger press for response which could more easily allow for response time calculation, however future study groups of patients with brain injuries may not be able to respond quickly with a finger but may make an oral response.

2.3.4 Task vs. Oxygenated Hemoglobin Covariance (NIRS-SPM)

To determine the covariance of HbO values to that of the behavioral tasks NIRS-SPM version 4 on Windows XP Professional with SPM 8 and Matlab 2011a.[20] Using NIRS-SPM for each subject, each channel is registered to a template taken with a Polhemus Patriot Digitizer and compared using MNI to a Taliarch MRI image. Each subject's session data is then filtered according to the suggested method by Tak

to use wavelet transformation of time and frequency and minimal descriptor length analysis to determine which frequency components should be used. Then the prewhitening method is used to limit bias in the temporal correlation. No serial correlation was assumed in the estimation as blocks were pseudo-randomized (Figure 2.5.)

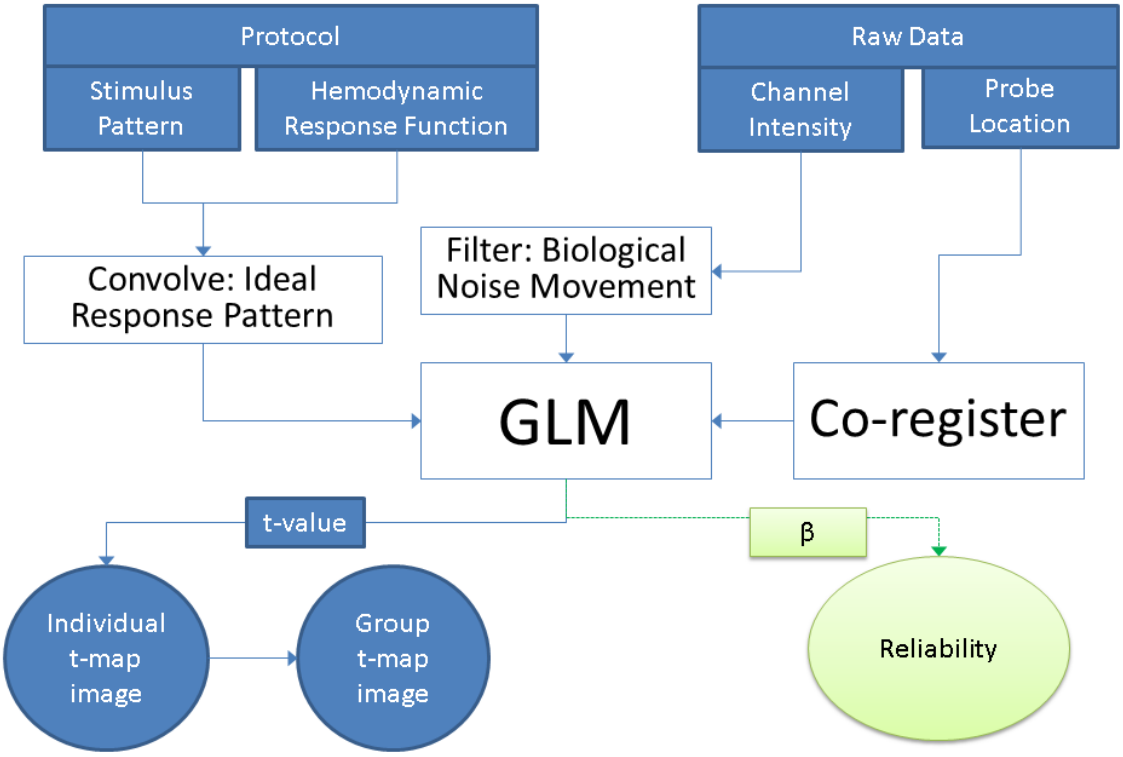


Figure 2.5 NIRS-SPM Analysis

NIRS-SPM uses a general linear model (GLM) to compare the covariance between a theoretical hemodynamic response to the actual response for each channel. The theoretical response is first shown as a square wave indicating the time of the task stimuli blocks as 1 and rest periods as 0. This square wave is convolved with the hemodynamic response wave function to create a theoretical response. The voltage response of the Hitachi instrument for each channel is filtered using a wavelet function and minimum descriptor length to automatically remove noise and biological signals such as heart rate and respiration. The covariance of each of the time points of the theoretical response to the actual response creates a p-value for the t-test statistic for each channel. These values are then spatially weighted by channel to create

a t-map of the cortex for the areas co-registered by NIRS-SPM. Individual false positives are limited with Euler characteristics as suggested by Tak.[21] However using the same correction for group analysis may cause an overcorrection showing no areas of activity, so evaluation with and without Euler characteristics and alpha values of 0.01, 0.05, and 0.10 was used to limit false positives and negatives during group analysis.

Three contrast model matrices were assessed in NIRS-SPM, Task A [1 0 0], Task B [0 1 0], and Task B subtracting Task A [-1 1 0] as subtraction of the simple task from the distracted task should remove associated speech activity and focus on the increased cognitive activity due to distraction. An optimal 3D optode and channel file obtained from the Polhemus measurements was used as a reference for all subjects during image processing.

2.3.5 Intraclass Correlation Coefficients

Even though NIRS-SPM makes use of t-maps to display how closely related the cortex activity is related to the stimulus for an individual or a single group, it does not give the user a way to effectively compare between groups or between multiple sessions of the same group other than a t-map of all the sessions. Similarities and differences between groups and between group's sessions can not be easily quantified as the group analyses are a composite of spatially weighted individual images. However, the GLM analysis used in NIRS SPM also stores a beta value in addition to the p-value for each channel. The beta value corresponds to the mean HbO value for the task analyzed.

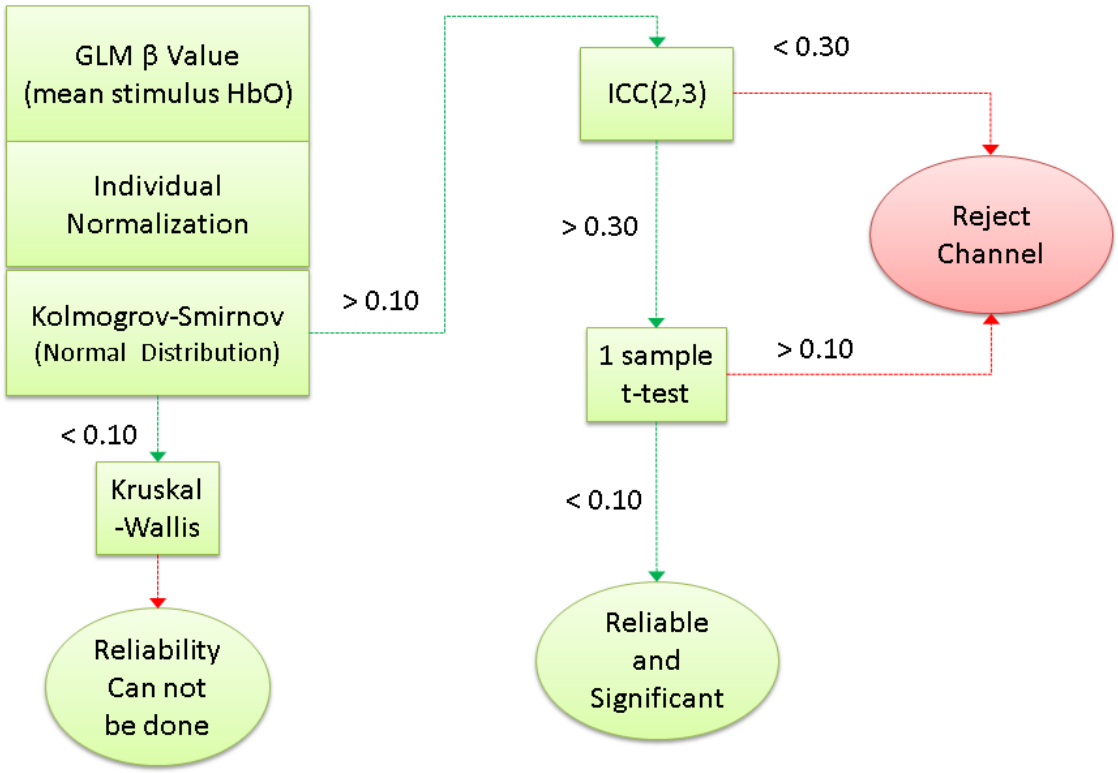


Figure 2.6 Reliability Analysis

Therefore in order to run a reliability analysis across sessions for each channel a method was developed to extract the beta value from NIRS-SPM for each channel for each subject and task. The cbeta_ch and stat_ch respectively store the beta and t-test p-value within the TStatsValues Matlab file for each subject's session data. These values were exported to Excel for analysis in SPSS and Matlab.

So that subjects can by compared upon the same scale each subject was normalized by dividing all of the subject's channels for that session by maximum value for that subject's session. Therefore what is compared is a mean HbO% across subjects and sessions.

To use Intraclass correlation coefficients given by Shrout the data must also be parametric. To determine if the data is parametric, each channel for each session and each task is tested across all subjects using a Kolmogorov-Smirnov one-sample test with a 95% probability assumption that that the data is normally distributed.

To determine the reliability the task protocol in each of the channels across the repeated sessions Intraclass Correlation coefficients are calculated. For this study all six values as given in Shrout and Fleiss[28] were calculated for comparison. One-way random effect analysis is referred to as ICC(1,1) for the individual and ICC(1,k) for the mean reliability. Two-way random effect analysis with absolute agreement is ICC(2,1) for the individual and ICC(2,k) for the mean reliability. While two-way mixed effect analysis with absolute agreement is ICC(3,1) for the individual and ICC(3,k) for the mean reliability. These values were calculated using Brownhill's ICC Matlab function[29] and verified using IBM SPSS software. It should be noted that based upon Wong[30], within SPSS absolute agreement and consistency options over-ride random and mixed effect options. If there is no significant interaction effect present as noted from the repeated measures ANOVA analysis then absolute agreement becomes a two way random effects analysis and consistency equations become two-way mixed effect analysis as given by Schrout and Fleiss. Based upon Wong, if an interaction effect is present, an Interclass correlation coefficient can not be effectively calculated. Wong also states in his paper that little difference would be seen for each of these calculations when the mean difference between the measures is small. Also two-way random effects analysis requires that the data is also in absolute agreement and not just consistent. Therefore, two-way random effects with absolute agreement ICC (2,1) and ICC(2,k) are chosen to demonstrate reliability for this study.

ICC values below 0.3 are in poor agreement, values between 0.3 and 0.5 are in fair agreement, between 0.5 and 0.7 is moderate agreement, between 0.7 and 0.8 is strong agreement, and above 0.8 is almost perfect agreement. ICC values which are negative are considered to be random data. Those channels with at least moderate agreement for ICC(2,k) are considered for the final test of a one-sample t-test for the channel to determine if it is significantly positive or negative.

Chapter 3

Behavioral Analysis

Behavioral data was limited to error rate comparisons as no method was used to automatically collect audio response times to display. Even though audio and video data was collected in time with the protocol most of the audio was unfortunately too low to be heard clearly. Errors were noted by hand by the proctor and verified when possible by audio by all involved. Not clearly saying the correct color within the one second response windows was marked as an error. Also as the image changed every second it may have initially been too short of a period to properly indicate a response. As there is one subject's data missing for session 2 and a different subject's data missing for session 3 the number of subjects tested for repeated measure ANOVA is 12 and for pair-wise t-test analysis is 13. Standard error bars are used in the graphs as standard deviation shows overlap of the tasks which are not easily distinguishable.

3.1 Simple and Interference Tasks

Success rates of tasks seen in Figure 3.1 when analyzed using repeated measures two-way ANOVA indicates an overall significant differences between tasks ($p=0.016$) as well as differences between sessions ($p=0.029$), but no interaction effect ($p=0.684$). Further two-tailed paired t-test analysis reveals significant difference between tasks for session 2 ($p=0.049$).

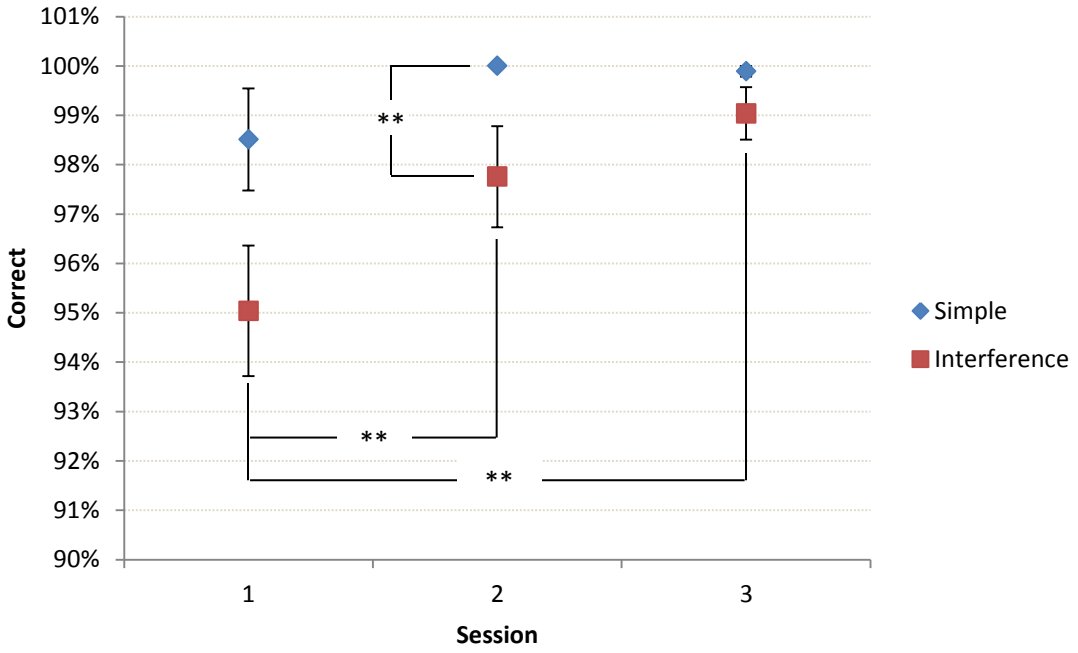


Figure 3.1 Percent Correct By Task and Session with Standard Error

There is no significant difference for the simple task between sessions. In addition, there was 100% success for all subjects with the simple task by session 2. A box plot of the variances (Figure 3.2) with Levene's analysis (p=0.20) reveals that there is no significant difference between the sessions and that the subjects 8 and 9 data are outliers.

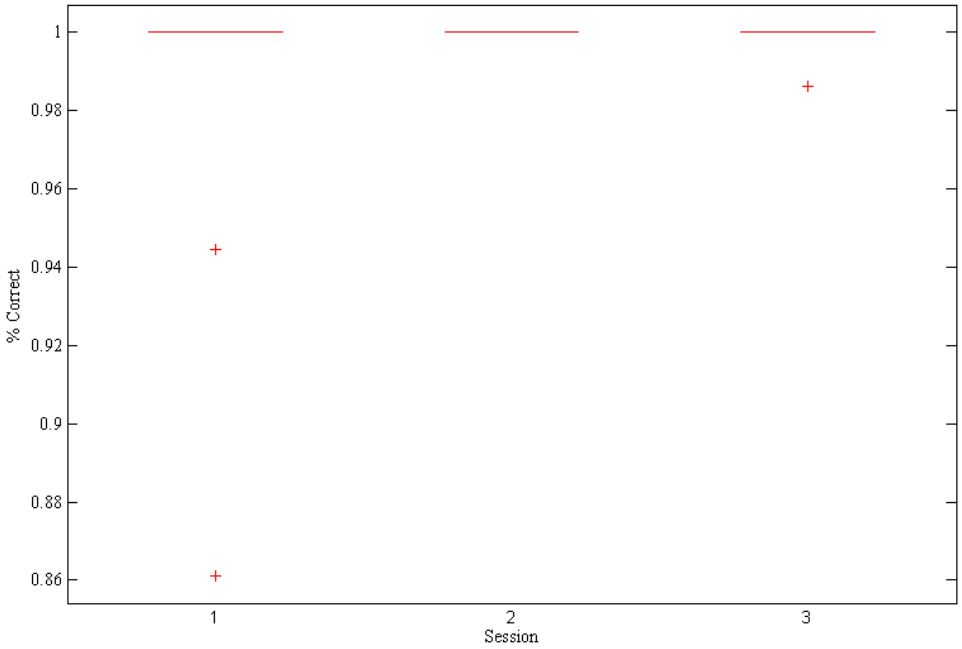


Figure 3.2 Simple Task Variances

The interference task does show significant differences between session 1 and 2 (p=0.004) as well as between session 1 and 3 (p=0.008) and has strong consistent ICC values for the group (2,3)=0.79, while moderate for individual (2,1)=0.55. Levene's test (p=0.23) shows that the variances are not significantly different and that subjects 12 and 14 are considered outliers (Figure 3.3.)

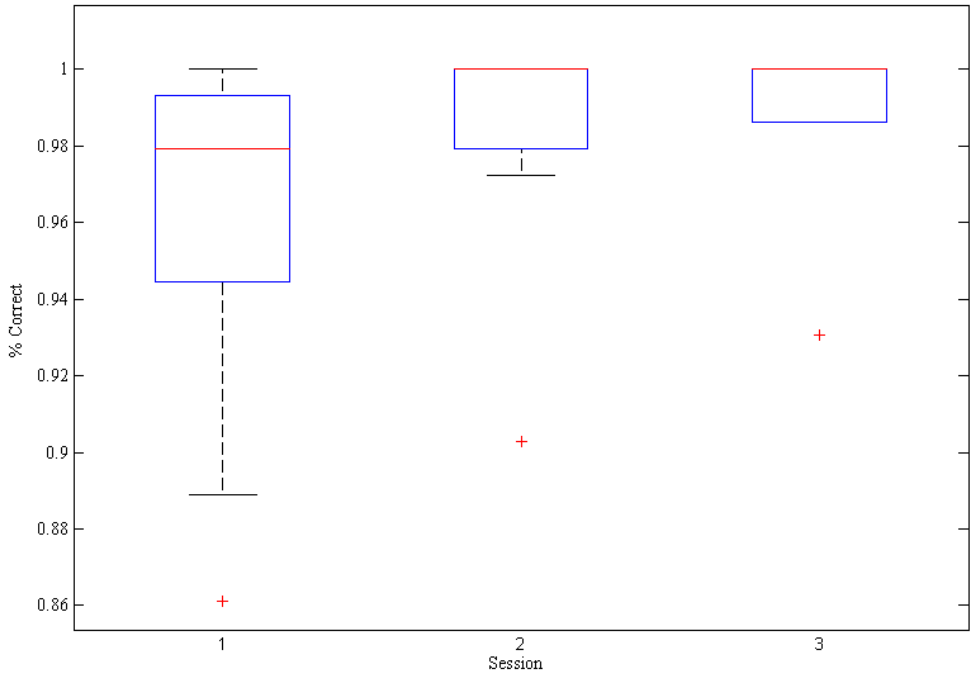


Figure 3.3 Interference Task Variances

Therefore the simple task indicates 100% success so that no effect of habituation should be seen for this task. However, the interference task shows significant improvement with session 2 while being significantly different from the simple task which may indicate effects of habituation to the task or learning by the second session.

3.2 Inhibitory Response

The difference between success rates (B-A) attributed to inhibition of distraction (Figure 3.4), indicates no overall significant difference between sessions (Single Factor ANOVA, $p=0.68$.) While the variances appear different, Levene's test ($p=0.06$) indicates that they are not and that subjects 12 and 14 are outliers. Further intraclass correlation analysis of the inhibitory response across sessions shows that the data is strongly reliable for the group, $(2,3)=0.73$, while moderately reliable for individuals, $(2,1)=0.47$. Therefore it is reasonable to conclude the inhibitory response is consistently reliable across sessions with no significant difference between sessions.

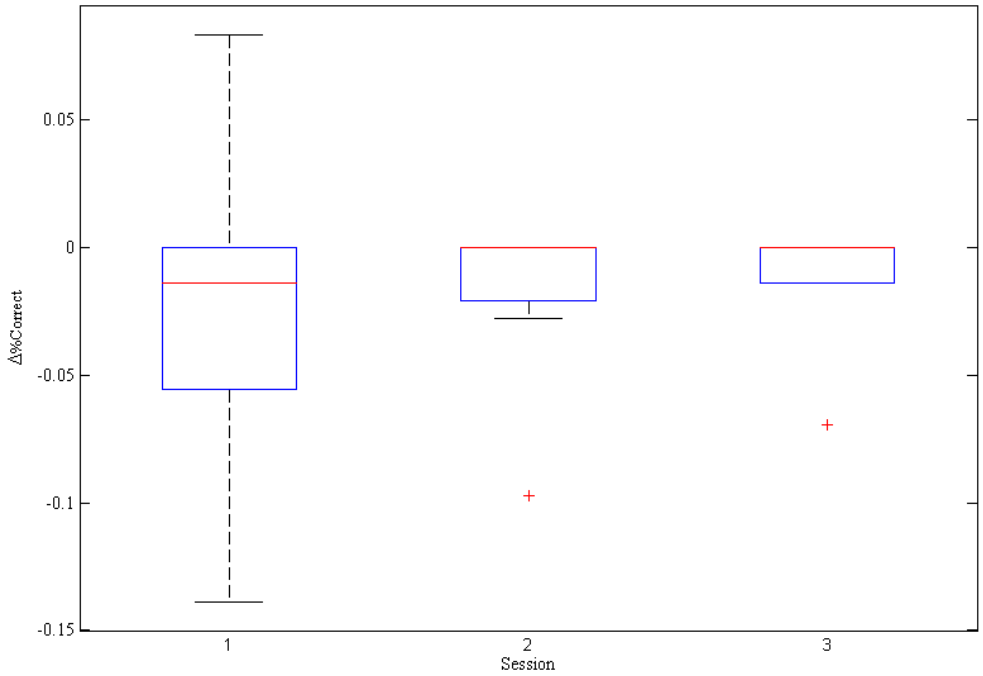


Figure 3.4 Change in %Correct Due to Inhibitory Response

Chapter 4

NIRS-SPM Imaging

4.1 NIRS-SPM Individual Analysis

To determine the regions which are correlated to a task typically a threshold alpha value of 0.05 or 0.01 is chosen. The first subject is used as an example in this chapter for the differences shown for this task when varying the alpha value as well as choosing to correct for Type II errors by using Euler characteristics as suggested by Tak. All subjects' t-map images are shown below using the same setting of 0.05 for the alpha value threshold and Euler characteristics. These images produced the most reasonable settings across all tasks for all subjects based upon minimizing the number of images with no significantly correlated regions compared to all of the frontal cortex being shown as significantly correlated. The Interference Task (B) images are used for comparisons on technique as they have the most consistent activations across all subjects. It should be noted that the import functions for NIRS-SPM for the Hitachi system changes block data to a single event at the start and a single event at the end instead of a stimuli throughout the block time period. To overcome this issue a script was written to modify the import process and speed the process of data conversion by converting a set of files instead of individual files. Also while the stimulus block is 24 seconds these images were processed using a period of 25s as that had been the protocol design and the values from a sample of two subjects show no significant difference between the final images. Finally the Hitachi system includes a 10s prescan period to test signal strength at the conclusion of which is when the protocol begins.

NIRS-SPM provides a 2D view of the activated areas on the cortex. The following pages show each subjects data on a matrix of each Task for the simple task (A), the interference task (B) and the difference between the two (B-A.) The columns represent the point in time of session 1, 2 or 3. Subject 3 had corrupted data during session 2 and could not be used. Subject 13 did not perform the last session. Therefore sessions 2 and 3 only have 13 subjects instead of 14.

Threshold for the images uses a p-value=0.05. These images have a bottom threshold as defined by the p-value for each set of images; however, each image has a different maximum value as each individual and group task has different maximum t-values. Therefore, the upper end of the scale is not included when interpreting the scales between images would be misleading. These differences speak to the degree of which comparisons between groups are confounded using current visual methods.

4.1.1 Simple Task

The simple task (A) shows the greatest variance in images across subjects, some subjects show correlation which shifts from one region to another, while some show medial activity and others bilateral activation. For example subject 1 (Figure 4.1) image with threshold of 0.05 and Euler characteristics shows bilateral activation of the OFPC as well as left VLPFC activation in Session 1. By session two the left VLPFC is no longer apparent, yet medial and left FPC is added. For the final session the OFPC is no longer shown nor is the left FPC. Instead the right and medial DLPFC is shown with significantly correlated activation.

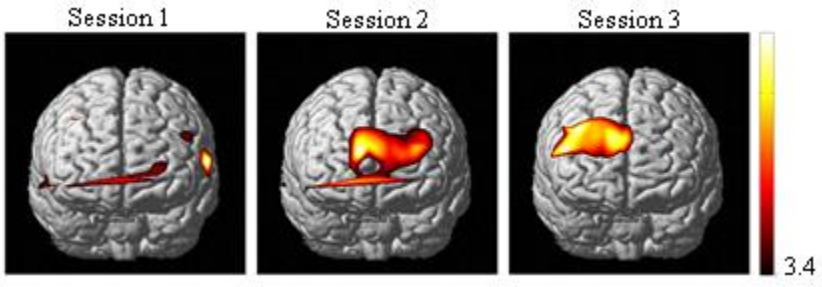


Figure 4.1 Subject 1 Task A by Session, α=0.05, Euler Characteristics

As the threshold value for the images is a matter of interpretation it leaves room for error which may be part of why these images appear to show changes in activation patterns. In fact the previous areas may be just below the threshold in each of the cases so that consistency can not be easily attained from the images alone. One could vary the alpha value and change error correction settings, and do a group analysis of all sessions for an individual, but that would still not quantify the reliability of the areas in question. This problem with determining consistency is why Chapter 5 Reliability was developed. The images in Figure 4.2 and Figure 4.3 are included so that one can view the issue of determining a pattern between

individual image sessions. Images with "n/a" indicate corrupt data or a missed session. Several images have no activation within the limits of the threshold specifications such as all sessions for subject four.

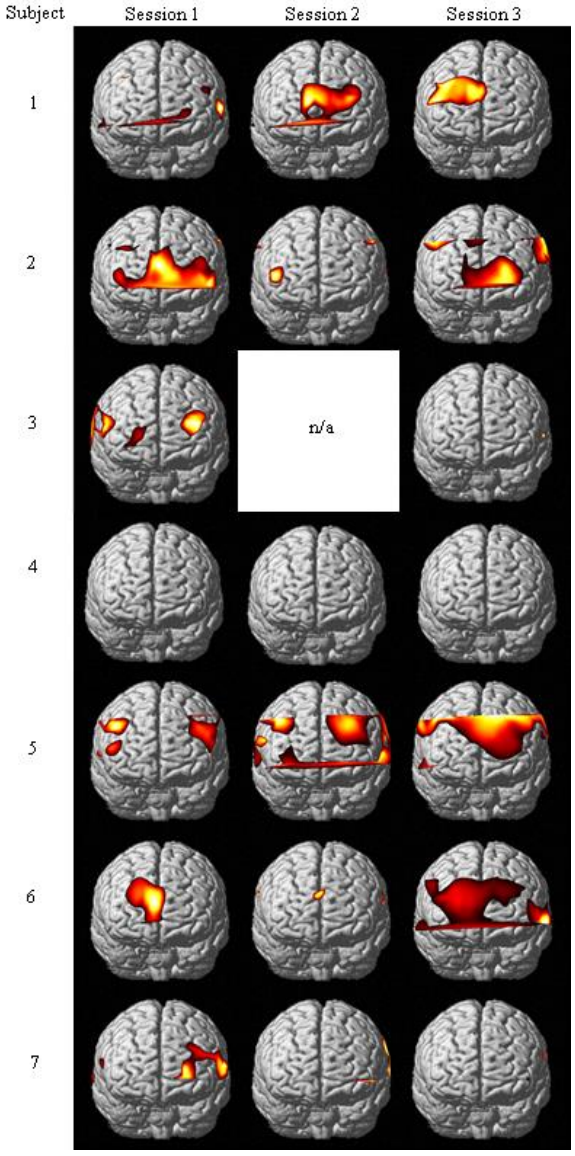


Figure 4.2 Simple Task Subjects 1-7 t-map Images, α=0.05, Euler Characteristics

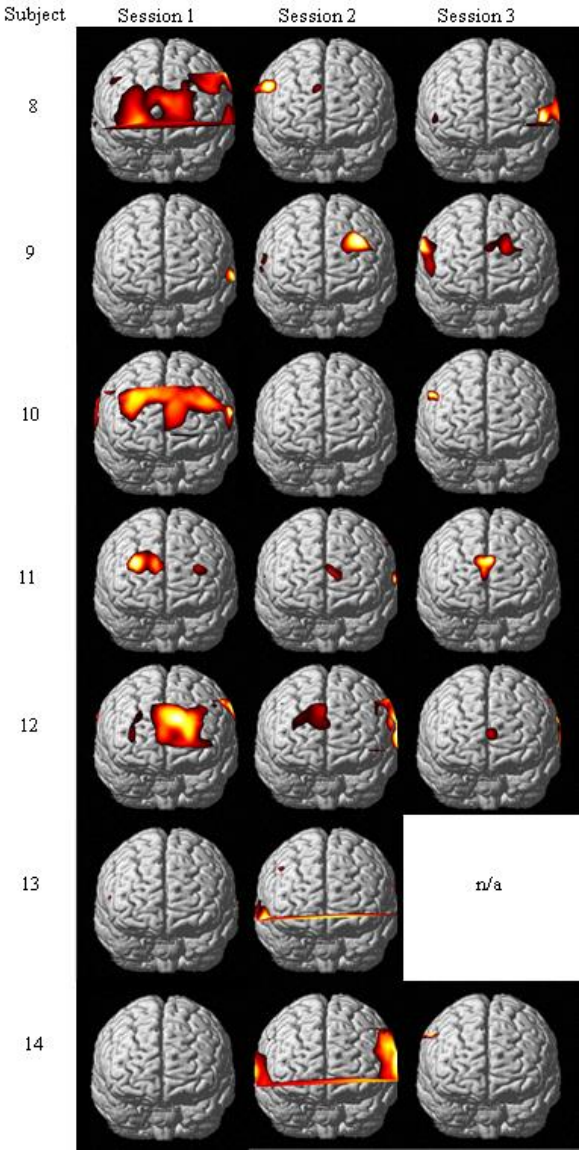


Figure 4.3 Simple Task Subjects 8-14 t-map Images, α=0.05, Euler Characteristics

4.1.2 Interference Task

Individual Subject interference task (B) t-maps show larger areas of correlated activation to the task than the simple task; however, the difficulty with ascertaining a pattern across a subject is still apparent in Figure 4.4 and Figure 4.5. The increased areas of activation may be an indicator due to the decreased success rates for the more difficult interference task increasing the required neural activation to inhibit the distraction of reading the word.

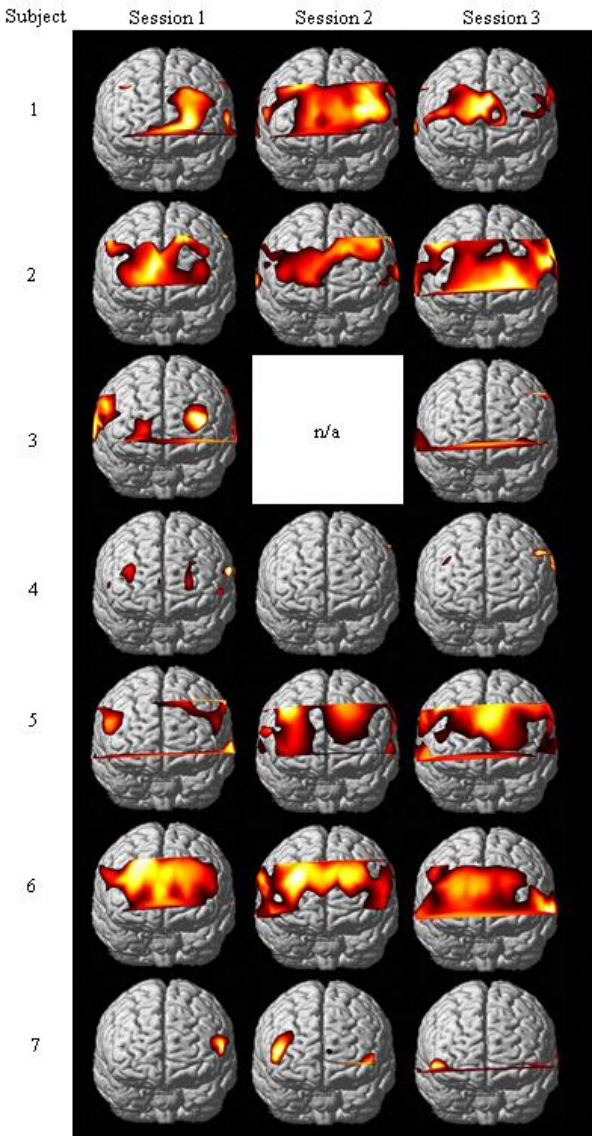


Figure 4.4 Interference Task Subjects 1-7 t-map Images, α=0.05, Euler Characteristics

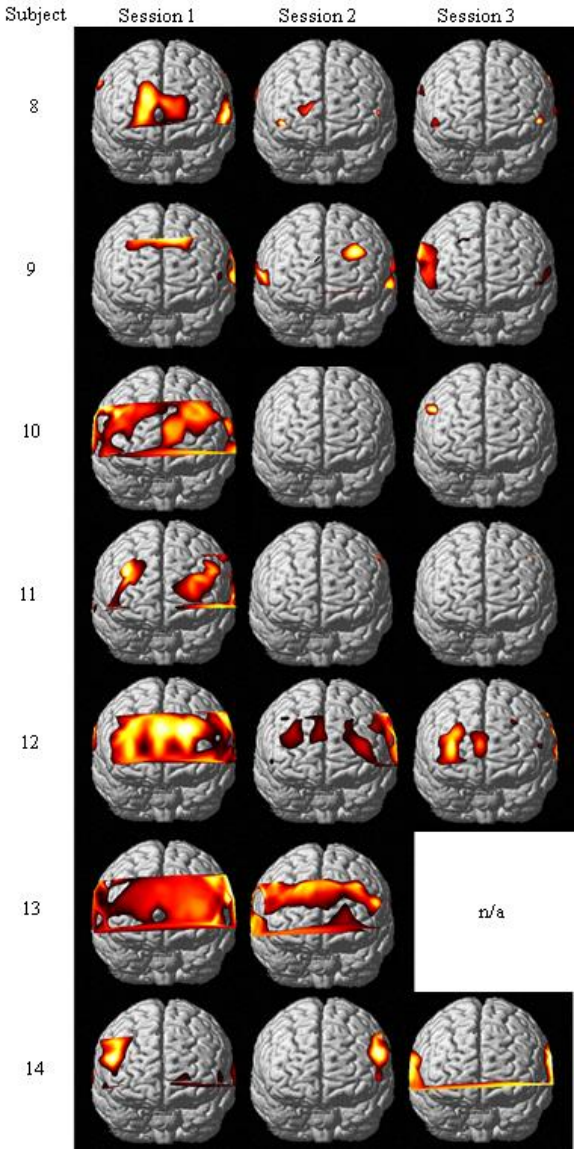


Figure 4.5 Interference Task Subjects 8-14 t-map Images, α=0.05, Euler Characteristics

4.1.3 Inhibition of Distraction

The difference between tasks due to the inhibition of distraction (B-A) should also eliminate the biological noise in this study of saying a color word from the distraction. Areas such as Broca's area in the VLPFC should be removed as the activity in that region should theoretically be the same. One marked exception is subject 14, which also showed to be an outlier in the behavioral analysis.

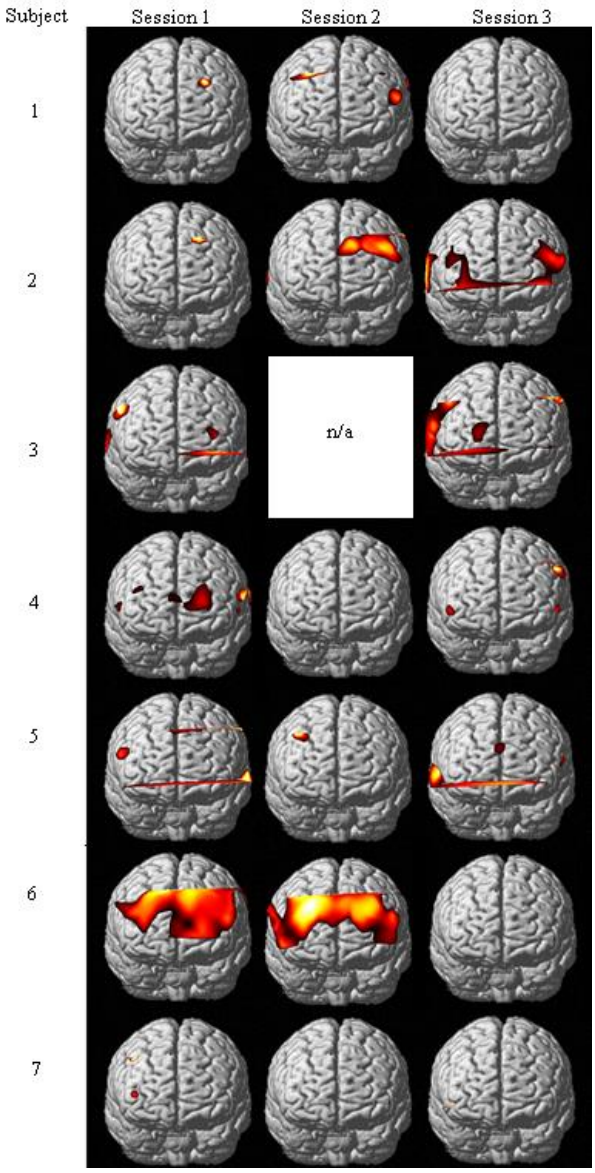


Figure 4.6 Inhibition of Distraction Subjects 1-7 t-map Images, α=0.05, Euler Characteristics

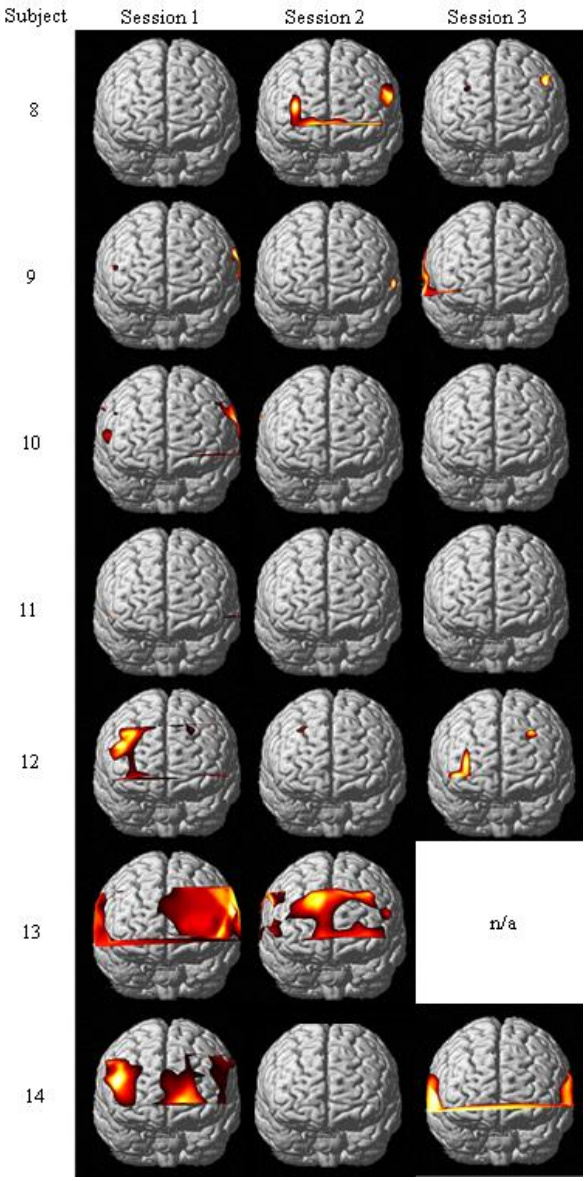


Figure 4.7 Inhibition of Distraction Subjects 8-14 t-map Images, α=0.05, Euler Characteristics

4.2 NIRS-SPM Group Analysis

4.2.1 Simple Task

Group Images of the simple task (A) (Figure 4.8) indicates that there is a pattern of activation consistent across the subjects for medial DLPFC and FPC across sessions as well as activity in the left motor and temporal cortices (seen as a line on the edge of the left frontal cortex in this frontal view), but it appears that other areas of activation disappear with time such as the right DLPFC. The type II error

correction method for Euler characteristics causes there to be no significant areas to be found and as such is too conservative a test. Therefore the group analysis images are performed without correction. For Task A there are no areas above even a 90% threshold with Euler characteristics. The differences in images are shown for Task B.

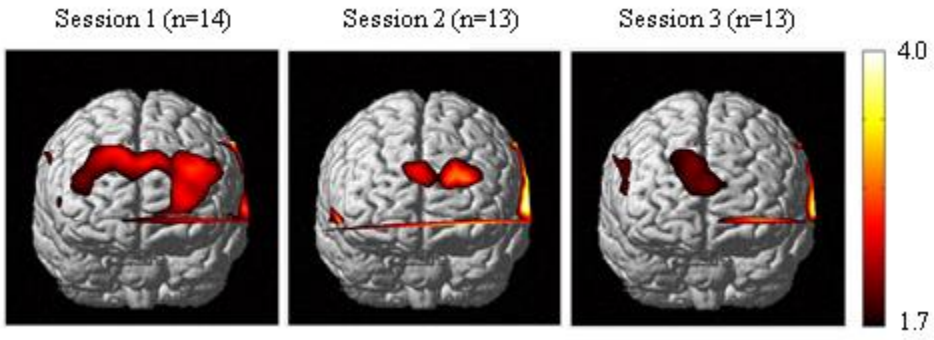


Figure 4.8 Group Simple Task t-maps Images, α=0.05, No Correction

4.2.2 Interference Task

Figure 4.9 uses a threshold of 0.05 for an uncorrected image for the group interference task images. In comparison, Figure 4.10 shows the same data, but with Euler characteristics applied. While the Euler characteristics works well with individual data, when used with group data too many false negatives are created. The end result is the image shows no significant areas of activation. It appears from Figure 4.9 that left and right DLPFC and FPC as well as left VMPFC and left motor cortex activity is consistent across all sessions. Additional comparisons may be viewed in Appendix B.

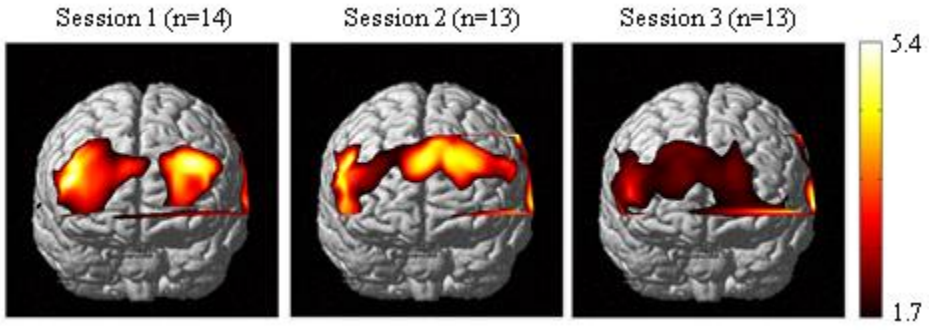


Figure 4.9 Group Interference Task t-maps Images, α=0.05, No Correction

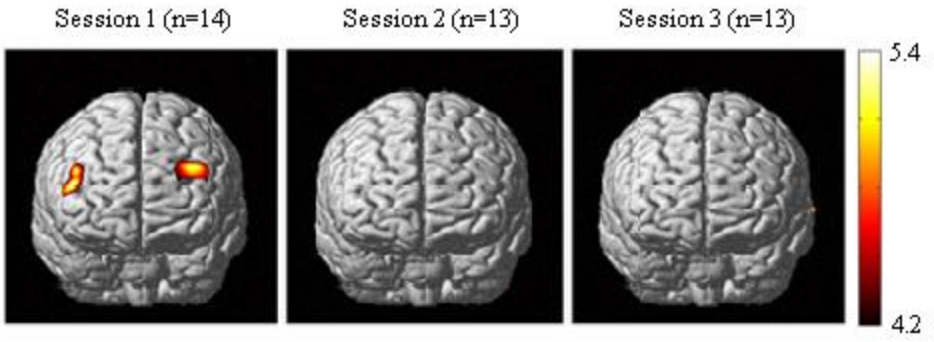


Figure 4.10 Group Interference Task t-maps Images, α=0.05, Euler Characteristics

4.2.3 Inhibition of Distraction

The NIRS-SPM t-map for inhibition of distraction (B-A) (Figure 4.11) shows significant bilateral DLPFC activity, as well as right side frontal polar (FP) activity for controls, which increases in size with session 2 to cover the medial DLPFC and decreases with session 3. Independent task imaging also appears to show the same decrease in activity. This overall trend of reduced activation may be a sign of habituation as the difference between behavioral tasks approaches 0.

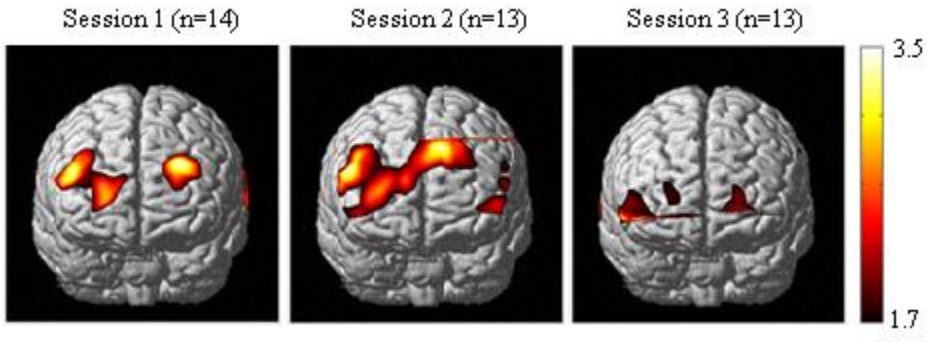


Figure 4.11 Group Inhibition of Distraction t-map Images, α=0.05, No Correction

4.2.4 All Sessions Group Images

Group images of all sessions combined to look for those tasks which show matching covariance across all sessions for each task as shown in Figure 4.12.

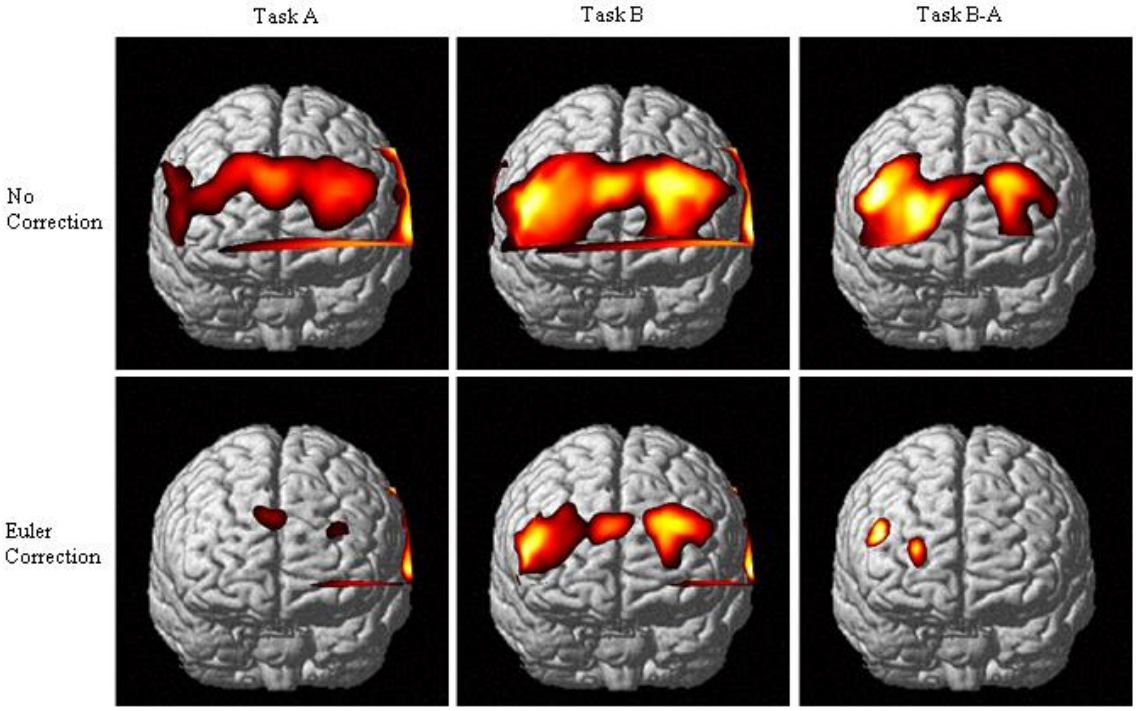


Figure 4.12 Group t-maps Images for All Sessions by Task and Correction Method (n=40)

Chapter 5

Reliability

Based upon Kolmogorov-Smirnov one-sample testing (Appendix C) only channel 48 was not normally distributed for Task A, all channels are normally distributed for Task B and for Task B-A channels 7, 8, 9, 19, 29-32, 42, 45, and 50 were not. While ICC values were calculated for these channels, their values can not be assumed to be valid as they fail the assumption needed for the ICC calculation. The HbO values for those channels do not indicate significant correlation to the task and as such have been ignored. In addition channels 20 and 21 have been ignored as they are not present in the NIRS-SPM frontal view and as such those channels are not calculated by NIRS-SPM for the frontal view.

As part of the ICC calculation a repeated measures ANOVA is performed across the sessions. The channels showing significant effect between sessions with 90% confidence for the simple task are 16, 31, 42, and 43. For the interference task, the channels are 17, 35, 36, and 48. No channels showed significant effect for inhibition of distraction.

All six of the ICC calculations were performed for each channel across sessions (Appendix D); however, only the two-way random effect with absolute agreement is presented here. As predicted by Wong, there is little difference given for the data for each of the ICC calculations when good reliability is shown for any of the calculations. As it is assumed that the sessions and the subjects are random and that absolute agreement and not just consistency is desired to be compared then the (2,1) and (2,k) calculations are used. To ease in the recognition of reliable channels the cells have been colored. If the ICC value is between 0.3 and 0.5, the cell is highlighted in red. If the ICC value is between 0.5 and 0.7, then the cell is highlighted in yellow. If the ICC value is greater than 0.7, then the cell is highlighted in green as these cells are clearly in strong agreement. As there are a large number of random cells it may be reasonable to consider those channels with even moderate reliability as having a lesser degree of connection.

5.1 Simple Task Reliability

Those channels which show moderate or better reliability, ICC(2,k) > 0.5, and have a 90% probability of significant positive or negative normalized mean HbO for the simple task are presented in Table 5.1.

Table 5.1 Reliable and Significant Channels for the Simple Task

	Intraclass Correlation			One-Sample t-test	
Channel	ANOVA (Sig)	(2,1)	(2,3)	T	Sig (two-tailed)
9	0.613	0.297	0.560	1.871	0.069
10	0.788	0.225	0.465	5.196	0.00001
15	0.311	0.286	0.546	3.061	0.004
16	0.060	0.360	0.628	2.024	0.050
25	0.571	0.165	0.372	2.074	0.045
26	0.702	0.422	0.686	1.797	0.080
27	0.678	0.188	0.410	2.580	0.014
30	0.422	0.163	0.369	1.724	0.093
31	0.005	0.489	0.742	4.155	0.0002
34	0.855	0.249	0.498	1.760	0.086
42	0.009	0.263	0.518	7.140	0.000000001
45	0.488	0.488	0.741	1.809	0.078
52	0.694	0.599	0.818	3.920	0.0003

While eight channels show moderate to near perfect reliability with significantly positive mean HbO data for the group (2,3), only channels 16, 31 and 52 also show moderate reliability for the individual ICC calculation. In addition, repeated measures ANOVA analysis indicates channels 16, 31, and 42 show a significant interaction between the sessions and the individuals. Figure 5.1 demonstrates the locations with colored circles corresponding to the ICC value colored cells in Table 5.1. For example channel 15 in the right DLPFC while having moderate group reliability (0.546) and significant positive data (0.00398) has poor (2,1) reliability meaning that there is great individual variation. In contrast, channel 52 shows near perfect group reliability (0.818) with almost strong individual reliability (0.599) and highly significant positive mean HbO (0.00035.) Channel 9 is located in the premotor/motor cortex and shows poor reliability

with a 93.1% probability of positive HbO activity during the task. Channels 26 (medial DLPFC) and 45 (right VLPFC) show strong group reliability and moderate individual reliability with greater than 90% probability of having positive HbO data. No channels show significant negative mean HbO for this task.

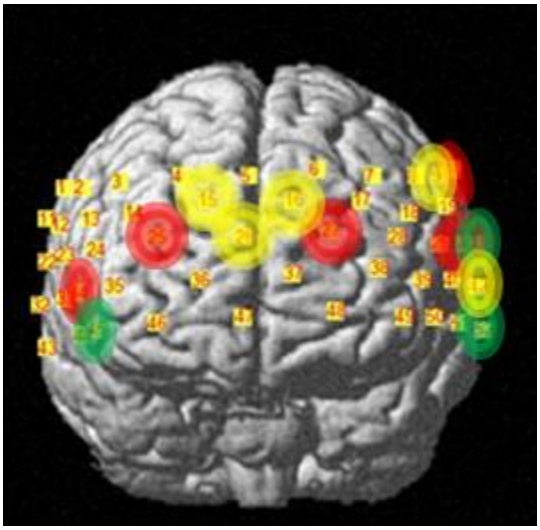


Figure 5.1 Reliable and Significant Channel Locations for the Simple Task

5.2 Interference Task Reliability

The interference task has fourteen channels which meet the reliable and significant criteria, as shown in Table 5.2. Channels 9, 45, and 52 are not shown in this task as it was in Task A. Channel 52, while significantly positive for the simple task, is still significantly positive for the interference task but is not reliable for group data, ICC(2,3)=0.160. Repeated measures ANOVA analysis indicates channels 17, 36, and 48 have significant interaction between individuals and the session. Channels 15 and 26 are shown as reliably positive between both tasks.

Table 5.2 Reliable and Significant Channels for the Interference Task

	Intraclass correlation			One-Sample t-test	
Channel	ANOVA (Sig)	(2,1)	(2,3)	t	Sig (two-tailed)
13	0.754	0.292	0.553	3.098	0.004
15	0.225	0.49	0.742	3.187	0.003
17	0.055	0.373	0.641	3.511	0.001
25	0.372	0.561	0.793	3.989	0.0002
26	0.715	0.454	0.714	4.081	0.0002
27	0.163	0.527	0.769	4.946	0.00001
28	0.106	0.49	0.742	3.525	0.001
32	0.799	0.452	0.712	2.606	0.013
34	0.356	0.38	0.648	2.605	0.013
36	0.063	0.379	0.647	2.327	0.025
37	0.286	0.262	0.516	1.744	0.089
38	0.179	0.486	0.739	3.181	0.003
39	0.475	0.529	0.771	1.901	0.065
42	0.461	0.333	0.599	7.405	0.00000
46	0.102	0.282	0.541	2.959	0.005
48	0.015	0.416	0.681	2.996	0.005
49	0.616	0.555	0.789	2.787	0.008

Channels 13, 15, and 25 are located in the right DLPFC (Figure 5.2.) Channel 26 is in the medial DLPFC. Channel 27 and 28 are in the left DLPFC. Channels 34 and 39 are in the right and left VLPFC respectively. Channel 32 is in the right junction of the temporal, parietal, and motor cortices and 42 at the left junction. Channels 37 and 38 are in the left FPC. Channels 46 and 49 are in the right and left orbitofrontal cortices.

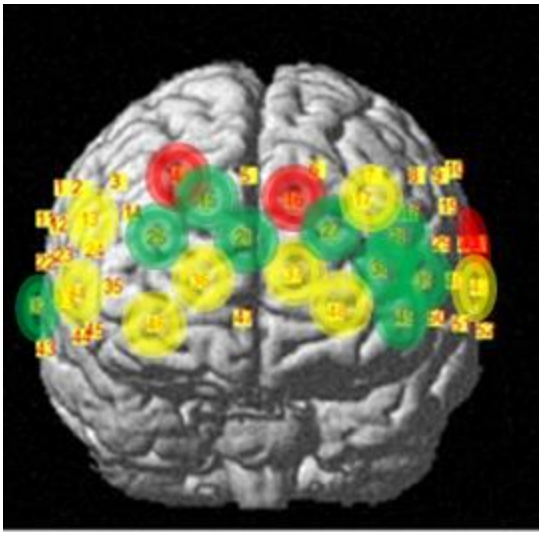


Figure 5.2 Reliable and Significant Channel Locations for the Interference Task

5.3 Inhibition of Distraction Reliability

Changes in neuronal activity due to inhibition of distraction is calculated as the difference between task mean HbO activity (B-A). Based upon the group reliability criteria shown in Table 5.3, only three channels show reliable and significantly positive activity at Channels 25, 26 and 27. They are located in the right and left DLPFC and medial FPC (Figure 5.3.)

Table 5.3 Reliable and Significant Channels for Inhibition of Distraction

	Intraclass correlation			One-Sample t-test	
Channel	ANOVA (Sig)	(2,1)	(2,3)	t	Sig (two-tailed)
25	0.946	0.266	0.468	1.891	0.066
26	0.463	0.437	0.699	3.199	0.003
27	0.165	0.392	0.659	2.279	0.028

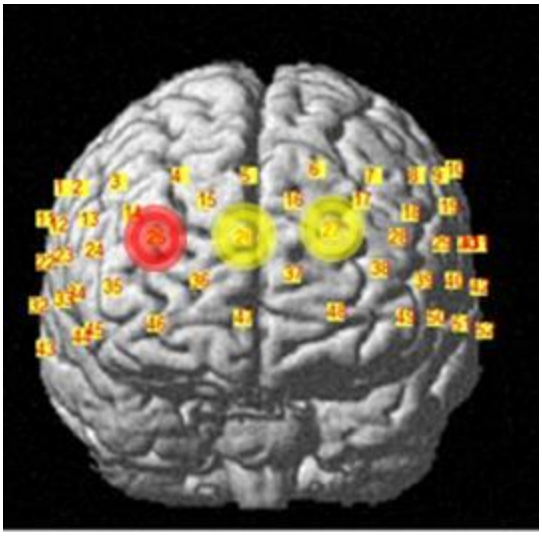


Figure 5.3 Reliable and Significant Channel Locations for Inhibition of Distraction

Chapter 6

Correlation of HbO to Task Performance

The simple (A) and interference (B) tasks as well as the difference between tasks (B-A), were correlated using Pearson interclass coefficients. Channels with no sessions having better than a correlation of 0.30 (fair) are omitted from this chapter for ease of comparison due to the volume of data. Increasingly darker blue color cells indicate increasing negative correlation while increasingly darker maroon color cells indicate increasingly positive correlation. A positive correlation means that as the concentration of HbO increases so does the success rate of the task. A negative correlation means that as the concentration of HbO increases, the success rate of the task decreases. MNI images for channel locations show an overlay of this correlation matching the color of the tables.

Table 6.1 HbO to Task Performance for All Sessions

	Task		
Channel	A	B	B-A
5	-0.46	-0.09	0.01
6	-0.35	-0.03	-0.16
12	-0.31	0.07	-0.15
26	0.08	-0.26	-0.36
28	0.00	-0.17	-0.33
29	-0.02	-0.30	0.14
30	0.08	-0.29	0.21
31	0.18	-0.39	0.19
47	0.02	-0.01	-0.29
50	-0.20	-0.33	-0.02

All sessions were first combined to determine the correlation between HbO and success rates; however this revealed few channels with only fair correlation (Table 6.1.) As the behavioral data indicated a significant difference between sessions 1 and 2 and between sessions 1 and 3, each session was then compared for each of the tasks where possible. While each task shows the correlation values >0.30 only the values with moderate correlation (>0.50) are generally discussed for the individual sessions.

6.1 Simple Task HbO and Performance Correlation

Simple Task Correlation (Table 6.2 and Figure 6.1) initially shows moderate negative correlation in the superior medial to left DLPFC as well as right posterior DLPFC to right premotor cortex. Session 1 also shows moderate positive correlation in the right FPC. Session 2 for the simple task cannot be correlated as all of the subjects answered 100% correct. Session 3 and continues to show right and left DLPFC negative correlation, but also shows right side Wernicke areas to somatosensory cortex and the right side medial and superior temporal gyri as being positively correlated. The correlation over all sessions continues to show a weaker negative correlation for the task in the right, left and medial DLPFC. Also the behavioral analysis revealed that the error rates which are different from 100% success for task A are outliers so the interpretation of correlation for this task is limited. As task performance improves activity increases in the right FPC in the first session and right Wernicke and somatosensory cortices, and right medial and superior temporal gyri in the third session. Also as performance increases activity decreases in the right premotor cortex and right posterior DLPFC as well as the superior medial to left DLPFC over all sessions except session 2 which cannot be determined.

Table 6.2 Simple Task %Success correlation to HbO

	Session		
Channel	1	3	All
2	-0.48	0.16	-0.12
4	-0.31	-0.01	-0.25
5	-0.60	-0.14	-0.46
6	-0.62	-0.63	-0.35
8	0.40	0.09	0.14
9	0.33	0.13	0.16
11	-0.28	0.61	-0.18
12	-0.62	-0.54	-0.31
13	0.21	-0.43	0.04
16	-0.18	-0.36	-0.19

	Session		
Channel	1	3	All
19	0.32	0.09	0.19
22	-0.09	0.38	-0.05
32	-0.30	0.58	-0.14
34	-0.15	-0.51	-0.16
35	0.36	0.12	0.23
36	0.54	0.12	0.25
37	0.32	0.16	0.22
45	0.32	-0.20	0.15
46	0.43	0.24	0.13
51	-0.42	-0.04	-0.14

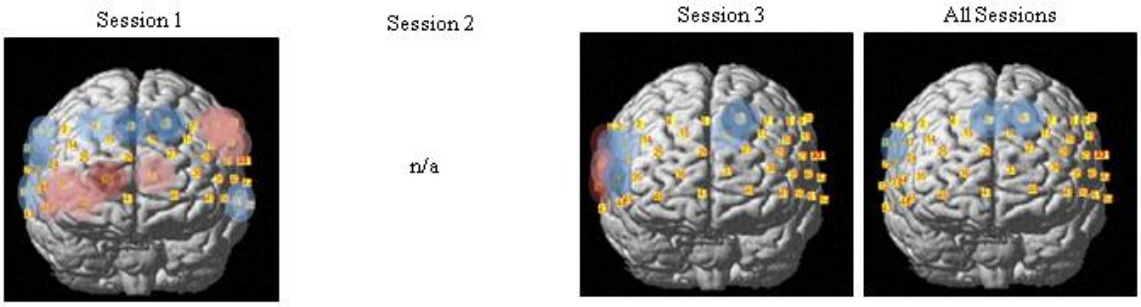


Figure 6.1 Simple Task %Success Correlation to HbO by Session

6.2 Interference Task HbO and Performance Correlation

The interference task shows a fairly negative correlation in Session 1 to the primary somatosensory cortices close to Wernicke's area on both the right and left sides. In Session 2 a moderately negative correlation is observed in the left Broca's area. Session 3 continues the negative correlation to the left side Broca's area and adds left DLPFC and left primary somatosensory cortices. Session 3 also shows a strong positive correlation to the right side medial and superior temporal gyri as was seen in Session 3 for the simple task. Therefore as performance increases activity decreases, initially, bilaterally in the somatosensory cortex, and with repeated sessions shows an increase in the right side medial and temporal gyri. Also with each session an increasingly larger area in the left DLPFC shows a decrease in activity. When looking at all sessions combined the left side Broca's area and somatosensory cortex adjacent to the auditory cortex and Wernicke's area show a decrease in activity with an increase in task performance.

Table 6.3 Interference Task Correlation to %Success

	Session			
Channel	1	2	3	All
2	0.19	0.07	0.57	-0.09
5	-0.14	-0.35	-0.14	-0.09
6	-0.02	-0.17	-0.68	-0.03
9	-0.02	-0.27	-0.51	-0.07
10	-0.15	0.10	-0.56	-0.16
11	-0.42	0.00	-0.12	-0.11
12	-0.06	0.24	0.37	-0.21
13	0.27	0.09	0.37	0.24
16	-0.18	0.35	-0.40	-0.08
17	-0.05	-0.01	-0.54	-0.21
22	-0.50	-0.24	0.22	-0.26
23	-0.10	0.07	0.30	0.07
25	-0.02	0.25	-0.31	-0.03
27	-0.33	0.14	-0.42	-0.26
28	0.09	-0.12	-0.40	-0.17

	Session			
Channel	1	2	3	All
29	0.02	-0.57	-0.50	-0.30
30	-0.36	-0.21	-0.14	-0.29
31	-0.48	-0.32	-0.34	-0.39
32	-0.33	0.30	0.71	0.10
35	-0.01	0.24	-0.47	-0.06
36	0.18	0.31	-0.29	0.07
37	0.06	0.08	-0.29	-0.03
38	0.19	-0.11	-0.40	-0.12
39	-0.06	-0.25	-0.31	-0.16
41	-0.40	-0.24	0.16	-0.16
42	-0.34	-0.25	-0.25	-0.23
46	0.07	0.46	-0.30	0.01
48	0.10	0.20	-0.33	-0.04
50	-0.42	-0.33	0.05	-0.33

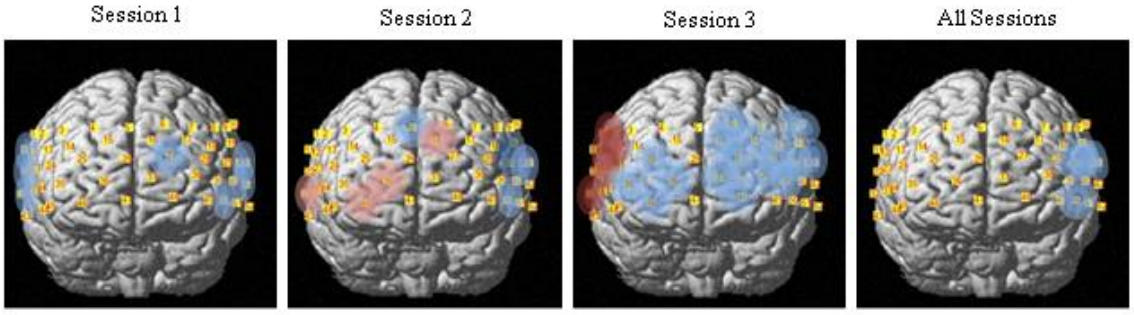


Figure 6.2 Interference Task %Success Correlation to HbO by Session

6.3 HbO and Performance Correlation for the Inhibitory Response

The correlation of the inhibitory response to the difference in HbO concentrations for the tasks (Table 6.4 and Figure 6.3) reveals that in the initial session as the inhibitory response increases there is a moderate correlation to a decrease activity of the medial DLPFC, FPC and OFC, left DLPFC, right Wernicke and somatosensory cortices, and right medial and superior temporal gyri. However, Session 2

indicates that as the inhibitory response increases there is a moderate correlation to an increase in activity in the left sensory, motor, superior temporal, and premotor cortices, left FPC, bilaterally in the DLPFC, right OFC and right superior and medial temporal gyri. Session 2 also shows a moderately negative correlation in the right primary somatosensory cortex. Session 3 shows strong positive correlation to an increase in inhibitory response in the right side supplementary and premotor cortex, Broca's area, DLPFC, and right side superior and medial gyri with a strong negative correlation to the left DLPFC and FPC. When compared over all sessions only a fairly negative correlation is seen to the inhibitory response in the medial FPC, OFC, and left DLPFC/Broca's area.

Table 6.4 Inhibition of Distraction Correlation to HbO Difference

	Session			
Channel	1	2	3	All
1	0.19	-0.41	0.33	0.01
2	-0.08	0.24	0.75	0.12
3	-0.24	0.40	0.89	0.07
4	-0.09	-0.14	0.61	-0.07
7	-0.02	-0.18	-0.67	-0.04
8	-0.05	-0.03	-0.32	0.00
9	0.01	-0.35	0.003	-0.02
10	-0.23	0.53	-0.20	0.15
11	-0.17	-0.51	0.31	-0.19
12	-0.41	0.23	0.05	-0.15
13	0.11	0.21	0.70	0.20
15	-0.03	0.58	-0.10	0.15
16	-0.19	0.42	-0.62	0.04
17	-0.14	0.53	-0.68	-0.06
18	-0.15	-0.40	-0.11	-0.17
19	-0.11	0.60	0.12	0.24
22	-0.58	0.34	0.04	0.03
24	-0.14	-0.33	0.03	-0.17
25	-0.21	0.49	-0.47	0.00
26	-0.59	-0.03	-0.28	-0.36
27	-0.28	0.46	-0.76	-0.08
28	-0.45	-0.15	-0.42	-0.33

	Session			
Channel	1	2	3	All
29	-0.45	0.65	-0.38	0.14
30	-0.22	0.60	-0.27	0.21
31	-0.14	0.56	-0.15	0.19
32	-0.57	0.56	0.74	0.21
33	-0.44	0.18	-0.13	-0.01
35	-0.12	0.42	-0.27	0.04
36	-0.04	0.31	-0.02	0.06
37	-0.17	0.49	0.31	0.03
38	-0.34	0.26	0.03	-0.03
40	-0.37	0.55	-0.24	0.12
41	-0.36	0.49	-0.30	0.14
42	-0.13	0.59	-0.14	0.23
43	-0.53	0.42	0.10	0.12
45	-0.13	0.36	-0.25	0.03
46	-0.25	0.64	-0.47	0.08
47	-0.58	0.02	-0.03	-0.29
48	-0.38	0.60	0.20	0.15
49	-0.62	0.45	-0.18	-0.17
50	-0.36	0.41	-0.35	-0.02
51	-0.36	0.55	-0.32	0.11
52	-0.15	0.55	-0.12	0.18

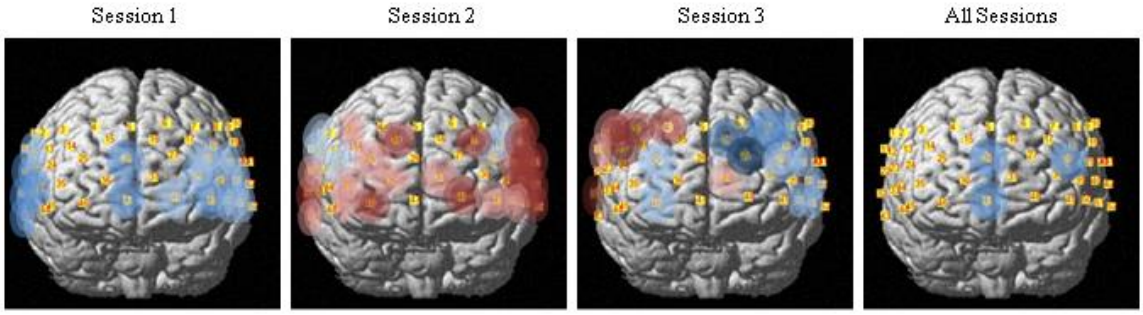


Figure 6.3 Inhibition of Distraction Correlation to HbO Difference by Session

Chapter 7

Discussion

Behavioral analysis indicates a significant difference between the initial session and the other two sessions only for the interference task and between tasks for Session 2. Qualitatively the NIRS-SPM t-maps show regions of interest which are difficult to quantify over time even with sessions over time. It can not be seen by those images alone if the covariance of a single session outweighs others by giving extra weight to the values where there should not be. By combining the group analysis methodology for reliability as a transparent overlay on top of the NIRS-SPM images (Figure 7.1) and further comparison to the correlation of task success to changes in oxygenation several inferences can be made.

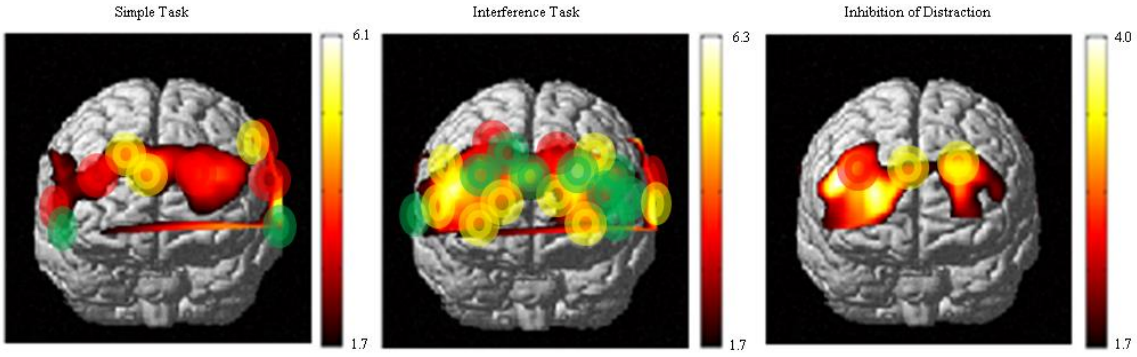


Figure 7.1 Group t-maps for All Sessions by Task with Reliability Overlay

7.1 Simple Task

For the simple task, the most significantly correlated areas using the t-map methodology are from Wernicke's to Broca's areas on the left side. As may be expected for a simple speech task, the left middle temporal gyrus and the right Broca's area and DLPFC demonstrate strong reliability and significant areas of covariance of activation to the task, and left premotor cortex show moderate reliability. What is novel, is that the medial FPC and DLPFC show significant covariance to the task with moderate reliability. Bilaterally the DLPFC shows significant covariance to the simple task, but there is enough variation among

sessions and individuals to lead to a fair to poor reliability in these regions. Most of the regions outside of the t-map threshold area yet within the probe area show random data with no correlation; however, the superior medial DLPFC, superior left DLPFC, and right premotor cortex, do show fairly negative correlation of HbO concentration to task success. Also, the right FPC shows an increase HbO concentration with task success on the initial presentation of an oral Stroop task while the middle temporal gyrus with repeated sessions. Finally, these correlations taken together infer that while bilateral activation of the DLPFC and FPC show significant covariance to the task, bilateral activation of the cortices responsible for speech, right side deactivation of the sensory cortex, and deactivation of the medial DLPFC are important for success in this task.

7.2 Interference Task

The interference task shows a larger area of significant covariance and reliability than the simple task with the strongly reliable channels located in the right and left DLPFC/FPC, left VLPFC, left OFC, and right medial/superior temporal gyrus. The reliability of the cortices within the threshold of the t-map image also show moderate to strong group reliability. Bilateral deactivation of the somatosensory cortices initially shows fair correlation to task success. Repeated sessions show moderate correlation of deactivation of the left premotor cortex and left DLPFC and activation of the right medial temporal gyrus to task success.

Cortical areas related to speech on the left hand side are not as reliably activated for the interference task as they were for the simple task; however medial and right FPC/DLPFC shows an even greater consistency for activation while also showing strong reliability for the left FPC/DLPFC. Finally, both tasks show increased activity in the medial temporal gyrus shows increased success in the third session.

7.3 Inhibition of Distraction

Inhibition of Distraction shows significant covariance bilaterally in the DLPFC and FPC; however it is moderate to strongly consistent across repeated sessions only in the superior regions of the medial and left FPC while only being fairly consistent in the right FPC. The lack of consistency for the bilateral inferior FPC and right DLPFC leading to Broca's area can be accounted for in the changing poor positive

to negative correlation of the inhibitory response as well as the individual tasks to HbO concentration of those areas with repeated sessions. Finally, as each session is repeated, the right DLPFC shows increasingly positive correlation to the inhibitory response while the left DLPFC shows an increasingly negative correlation to the inhibitory response.

7.4 Conclusion

While NIRS-SPM group t-maps provide a view of the channels which show the covariance of the task to the changes in HbO, it does not directly provide a way to determine which channels can be reliably shown as being consistently activated in any given session. Channel-wise intraclass-correlation analysis provides a method by which the degree of consistent reliability can be seen within the regions of significant activity. In addition those regions which may be otherwise seen as random or of poorer reliability for HbO concentrations may instead show correlation to the task success. In contrast, those areas which indicate high covariance of HbO to the task protocol may show a high degree of variance with individual subject differences and sessions. Therefore, reliability of the data must be considered when looking at repeated sessions for a functional imaging study.

Inhibition of distraction shows moderate to strong reliability in the medial and left DLPFC and FPC for HbO activation. In addition as the inhibitory response increases, HbO decreases in the medial DLPFC/FPC and left DLPFC. These channel locations can be compared to patient data on a group basis and may be sufficiently reliable for individual comparisons. A pattern of increasing positive correlation in the right DLPFC and negative correlation in the left DLPFC/FPC could also be used, but more sessions may be required to do so. Modifying the protocol to record patient's auditory response with timestamp device would also allow for correlation between HbO and the subject's response time. The response time may explain those channels which change in activation during different sessions and determine areas of correlation when the subjects achieve 100% success. It may provide an adequate measure for more than three sessions to be compared as the subject may show a delayed response while still successfully indicating the color. Extending this methodology as a full automated layer of transparency within NIRS-SPM would aid clinicians by providing a basis to compare other patient groups and determine individual responses to treatment.

Appendix A

Brodmann Anatomical References to Channels

The table below is broken down by channel and shows the percentage of Brodmann area coverage in which the channel resides along with the anatomical area. Overlap refers to what percentage of the channel is in the region listed.

Channel	Brodmann	Anatomical Label	Overlap
1	1	Primary Somatosensory Cortex	38.9%
1	2	Primary Somatosensory Cortex	5.3%
1	3	Primary Somatosensory Cortex	23.9%
1	4	Primary Motor Cortex	17.9%
1	43	Subcentral area	14.0%
2	6	Pre-Motor and Supplementary Motor Cortex	60.0%
2	9	Dorsolateral prefrontal cortex	15.3%
2	44	pars opercularis (Broca's area)	24.7%
3	9	Dorsolateral prefrontal cortex	62.2%
3	44	pars opercularis (Broca's area)	20.4%
3	45	pars triangularis Broca's area	11.7%
3	46	Dorsolateral prefrontal cortex	5.7%
4	9	Dorsolateral prefrontal cortex	100.0%
5	8	Includes Frontal eye fields	3.3%
5	9	Dorsolateral prefrontal cortex	96.7%
6	9	Dorsolateral prefrontal cortex	100.0%
7	8	Includes Frontal eye fields	2.3%
7	9	Dorsolateral prefrontal cortex	91.0%
7	45	pars triangularis Broca's area	0.9%
7	46	Dorsolateral prefrontal cortex	5.9%
8	6	Pre-Motor and Supplementary Motor Cortex	11.0%
8	9	Dorsolateral prefrontal cortex	49.8%
8	44	pars opercularis (Broca's area)	39.2%
9	1	Primary Somatosensory Cortex	1.5%
9	3	Primary Somatosensory Cortex	18.7%
9	4	Primary Motor Cortex	35.1%
9	6	Pre-Motor and Supplementary Motor Cortex	41.8%
9	43	Subcentral area	3.0%
10	1	Primary Somatosensory Cortex	19.6%
10	2	Primary Somatosensory Cortex	24.6%
10	3	Primary Somatosensory Cortex	13.8%
10	40	Supramarginal gyrus part of Wernicke's area	42.0%
11	1	Primary Somatosensory Cortex	6.9%

11	2	Primary Somatosensory Cortex	79.4%
11	40	Supramarginal gyrus part of Wernicke's area	13.7%
12	3	Primary Somatosensory Cortex	0.3%
12	4	Primary Motor Cortex	9.6%
12	6	Pre-Motor and Supplementary Motor Cortex	34.6%
12	43	Subcentral area	55.5%
13	44	pars opercularis (Broca's area)	50.9%
13	45	pars triangularis Broca's area	49.1%
14	9	Dorsolateral prefrontal cortex	18.5%
14	45	pars triangularis Broca's area	28.2%
14	46	Dorsolateral prefrontal cortex	53.2%
15	9	Dorsolateral prefrontal cortex	76.5%
15	10	Frontopolar area	17.8%
15	46	Dorsolateral prefrontal cortex	5.7%
16	9	Dorsolateral prefrontal cortex	72.7%
16	10	Frontopolar area	27.3%
17	9	Dorsolateral prefrontal cortex	49.3%
17	46	Dorsolateral prefrontal cortex	50.7%
18	9	Dorsolateral prefrontal cortex	1.6%
18	44	pars opercularis (Broca's area)	18.5%
18	45	pars triangularis Broca's area	69.4%
18	46	Dorsolateral prefrontal cortex	10.5%
19	4	Primary Motor Cortex	8.9%
19	6	Pre-Motor and Supplementary Motor Cortex	67.4%
19	43	Subcentral area	2.2%
19	44	pars opercularis (Broca's area)	21.5%
20	1	Primary Somatosensory Cortex	30.7%
20	2	Primary Somatosensory Cortex	35.3%
20	3	Primary Somatosensory Cortex	4.2%
20	43	Subcentral area	28.8%
20	48	Retrosubicular area	1.0%
21	2	Primary Somatosensory Cortex	6.4%
21	40	Supramarginal gyrus part of Wernicke's area	76.6%
21	48	Retrosubicular area	17.0%
22	2	Primary Somatosensory Cortex	4.0%
22	22	Superior Temporal Gyrus	39.0%
22	43	Subcentral area	56.0%
22	48	Retrosubicular area	0.9%

23	6	Pre-Motor and Supplementary Motor Cortex	48.0%
23	44	pars opercularis (Broca's area)	46.1%
23	45	pars triangularis Broca's area	5.9%
24	45	pars triangularis Broca's area	99.3%
24	46	Dorsolateral prefrontal cortex	0.7%
25	10	Frontopolar area	17.6%
25	46	Dorsolateral prefrontal cortex	82.4%
26	9	Dorsolateral prefrontal cortex	1.4%
26	10	Frontopolar area	98.6%
27	9	Dorsolateral prefrontal cortex	7.8%
27	10	Frontopolar area	55.1%
27	46	Dorsolateral prefrontal cortex	37.1%
28	45	pars triangularis Broca's area	49.8%
28	46	Dorsolateral prefrontal cortex	50.2%
29	44	pars opercularis (Broca's area)	43.0%
29	45	pars triangularis Broca's area	57.0%
30	4	Primary Motor Cortex	1.6%
30	6	Pre-Motor and Supplementary Motor Cortex	13.6%
30	43	Subcentral area	84.8%
31	2	Primary Somatosensory Cortex	46.0%
31	22	Superior Temporal Gyrus	28.7%
31	40	Supramarginal gyrus part of Wernicke's area	2.1%
31	42	Primary and Auditory Association Cortex	6.1%
31	48	Retrosubicular area	17.1%
32	21	Middle Temporal gyrus	45.8%
32	22	Superior Temporal Gyrus	54.2%
33	6	Pre-Motor and Supplementary Motor Cortex	16.6%
33	21	Middle Temporal gyrus	7.0%
33	22	Superior Temporal Gyrus	7.6%
33	38	Temporopolar area	3.0%
33	43	Subcentral area	1.0%
33	48	Retrosubicular area	64.9%
34	38	Temporopolar area	2.3%
34	45	pars triangularis Broca's area	96.1%
34	48	Retrosubicular area	1.6%
35	10	Frontopolar area	7.7%
35	45	pars triangularis Broca's area	4.2%
35	46	Dorsolateral prefrontal cortex	88.1%

36	10	Frontopolar area	100.0%
37	10	Frontopolar area	100.0%
38	10	Frontopolar area	41.5%
38	46	Dorsolateral prefrontal cortex	58.5%
39	45	pars triangularis Broca's area	90.2%
39	46	Dorsolateral prefrontal cortex	9.8%
40	6	Pre-Motor and Supplementary Motor Cortex	47.6%
40	44	pars opercularis (Broca's area)	31.3%
40	45	pars triangularis Broca's area	0.7%
40	48	Retrosubicular area	20.5%
41	21	Middle Temporal gyrus	1.6%
41	22	Superior Temporal Gyrus	80.9%
41	43	Subcentral area	12.2%
41	48	Retrosubicular area	5.3%
42	21	Middle Temporal gyrus	6.8%
42	22	Superior Temporal Gyrus	92.9%
42	42	Primary and Auditory Association Cortex	0.3%
43	21	Middle Temporal gyrus	97.1%
43	22	Superior Temporal Gyrus	2.9%
44	38	Temporopolar area	88.4%
44	48	Retrosubicular area	11.6%
45	45	pars triangularis Broca's area	25.0%
45	46	Dorsolateral prefrontal cortex	62.2%
45	47	Inferior prefrontal gyrus	12.8%
46	10	Frontopolar area	40.8%
46	11	Orbitofrontal area	55.0%
46	46	Dorsolateral prefrontal cortex	0.3%
46	47	Inferior prefrontal gyrus	3.8%
47	10	Frontopolar area	81.7%
47	11	Orbitofrontal area	18.3%
48	10	Frontopolar area	52.6%
48	11	Orbitofrontal area	47.4%
49	10	Frontopolar area	6.8%
49	45	pars triangularis Broca's area	1.5%
49	46	Dorsolateral prefrontal cortex	91.6%
50	38	Temporopolar area	26.8%
50	45	pars triangularis Broca's area	67.1%
50	47	Inferior prefrontal gyrus	0.6%

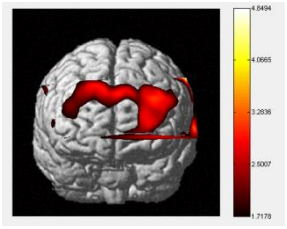
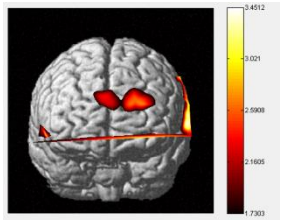
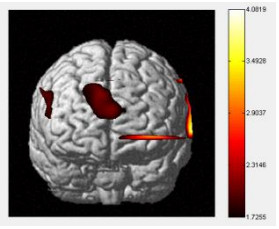
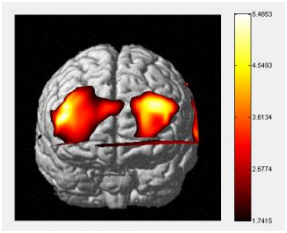
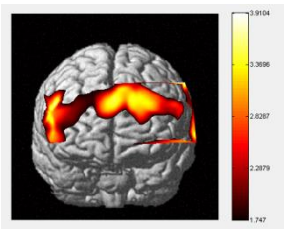
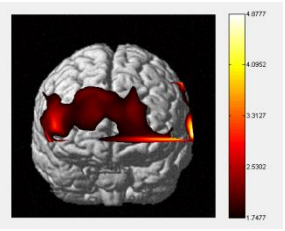
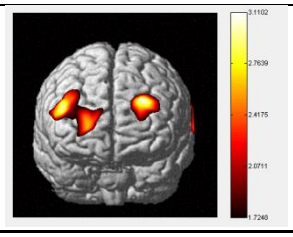
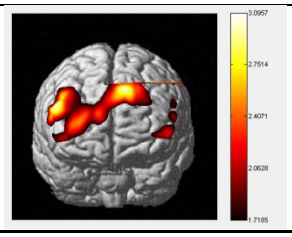
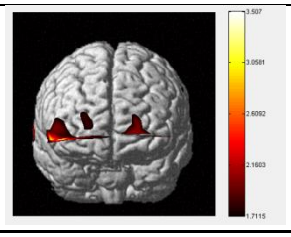
50	48	Retrosubicular area	5.4%
51	21	Middle Temporal gyrus	50.0%
51	22	Superior Temporal Gyrus	4.3%
51	38	Temporopolar area	7.3%
51	48	Retrosubicular area	38.3%
52	20	Inferior Temporal gyrus	0.3%
52	21	Middle Temporal gyrus	90.1%
52	22	Superior Temporal Gyrus	9.6%

Appendix B

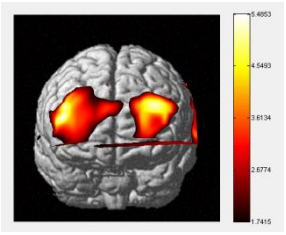
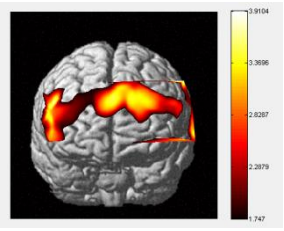
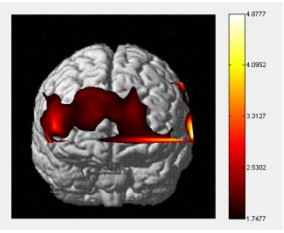
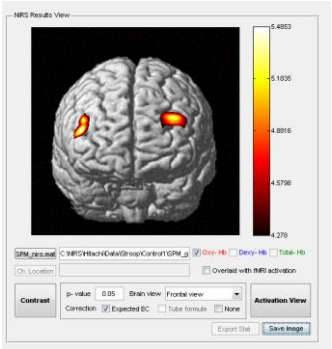
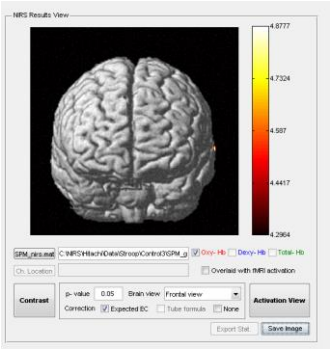
Group NIRS-SPM t-maps

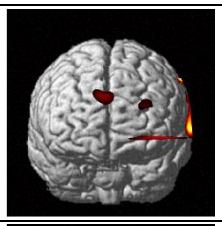
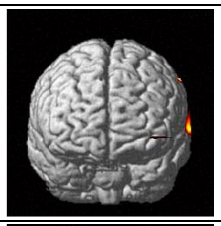
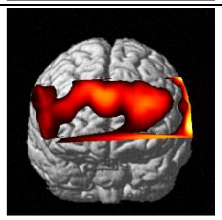
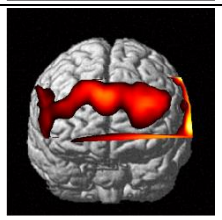
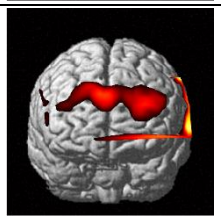
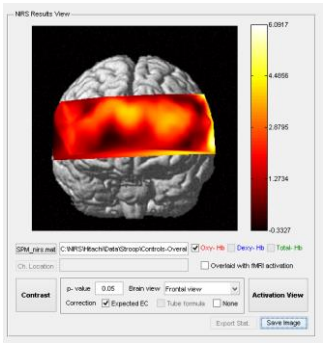
To decide upon the optimal threshold settings, several different views of the image were performed using different numbers of sessions combined, correction type, and alpha threshold. What follows are those different image settings for each task as well as a copy of the image without any threshold.

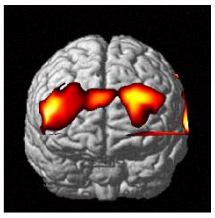
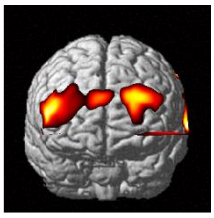
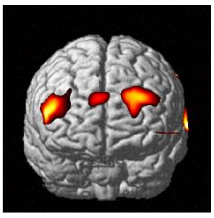
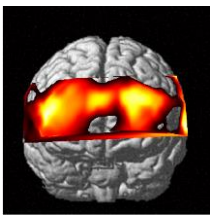
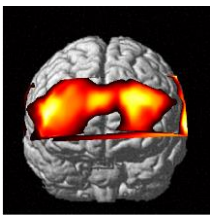
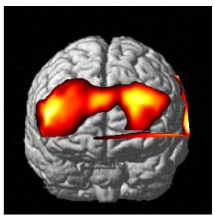
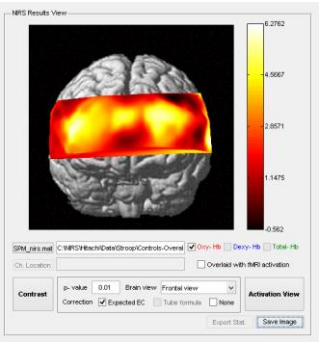
Group (with no correction)

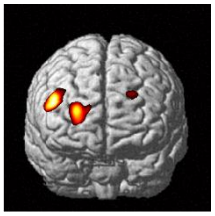
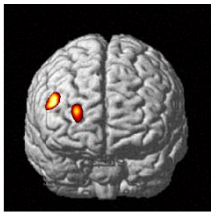
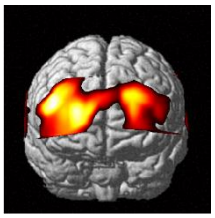
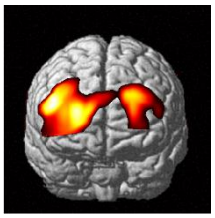
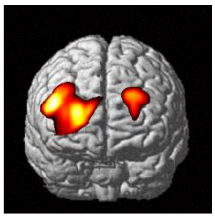
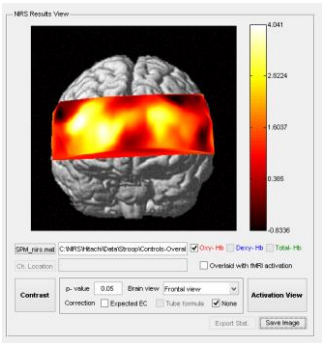
Task	Session 1 (n=14)	Session 2 (n=13)	Session 3 (n=13)
A			
B			
B-A			

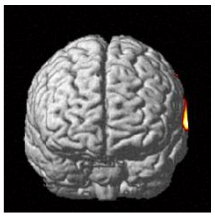
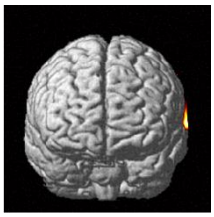
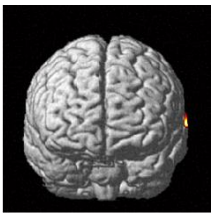
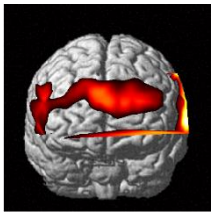
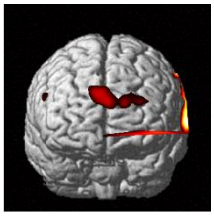
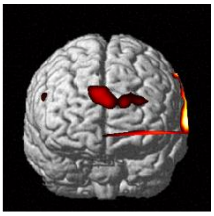
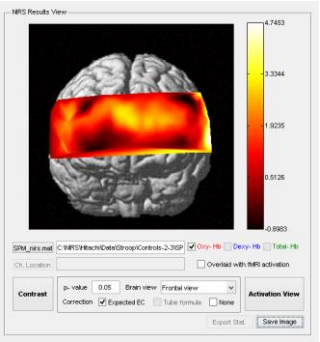
Control Group Task B (Without and With Euler Characteristics)

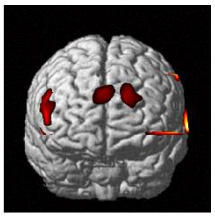
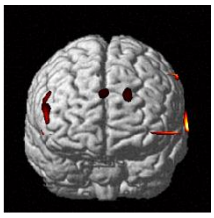
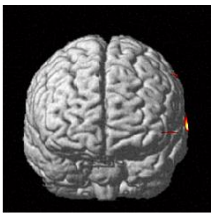
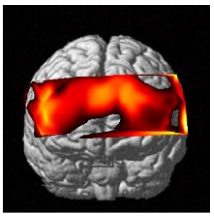
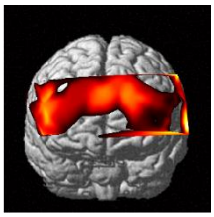
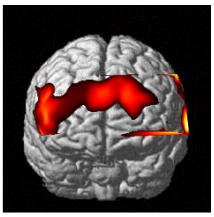
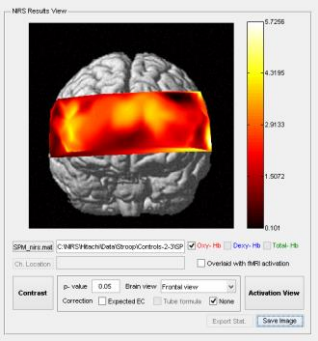
Task	Session 1 (n=14)	Session 2 (n=13)	Session 3 (n=13)
No Correction			
Euler		No significant areas	

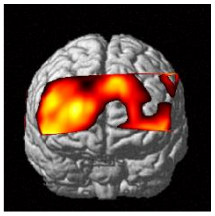
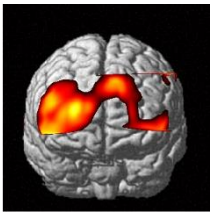
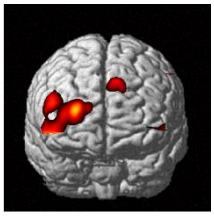
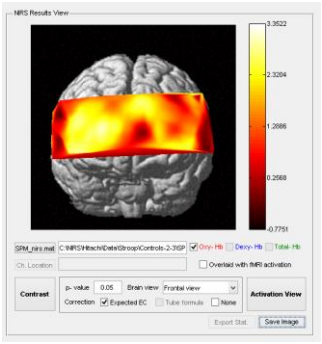
Task A for all Sessions and varied threshold			
Threshold	α = 0.10	α = 0.05	α = 0.01
EC			
No Correction			
No Threshold			

Task B for All Sessions and varied threshold			
Threshold	α = 0.10	α = 0.05	α = 0.01
EC			
No Correction			
No Threshold			

Task B-A for All Sessions and varied threshold			
Threshold	α = 0.10	α = 0.05	α = 0.01
Euler			No significant areas
No Correction			
No Threshold			

Task A for Sessions 2 and 3 and varied threshold			
Threshold	α = 0.10	α = 0.05	α = 0.01
Euler			
No Correction			
No Threshold			

Task B for Sessions 2 and 3 and varied threshold			
Threshold	α = 0.10	α = 0.05	α = 0.01
Euler			
No Correction			
No Threshold			

Task B-A for Sessions 2 and 3 and varied threshold			
Threshold	α = 0.10	α = 0.05	α = 0.01
Euler	No significant areas	No significant areas	No significant areas
No Correction			
No Threshold			

Appendix C

Kolmogorov-Smirnov One Sample Tests

The Kolmogorov-Smirnov one-sample test is used to determine if a data set follows a normal distribution. Below is the output from IBM SPSS for all channels except channel 20 and 21 for each session. Digits before the period are the channel number. The digit after the period is the session. Letters refer to Task A, B or B-A. A significance value less than 0.05 means the data has 95% confidence of the data not having a normal distribution and the decision is highlighted in yellow when this hypothesis is violated.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of Ch1.1A is normal with mean 0.219 and standard deviation 0.24.	One-Sample Kolmogorov-Smirnov Test	.996	Retain the null hypothesis.
2	The distribution of Ch1.2A is normal with mean -0.021 and standard deviation 0.40.	One-Sample Kolmogorov-Smirnov Test	.348	Retain the null hypothesis.
3	The distribution of Ch1.3A is normal with mean 0.021 and standard deviation 0.22.	One-Sample Kolmogorov-Smirnov Test	.601	Retain the null hypothesis.
4	The distribution of Ch1.1B is normal with mean 0.171 and standard deviation 0.27.	One-Sample Kolmogorov-Smirnov Test	.740	Retain the null hypothesis.
5	The distribution of Ch1.2B is normal with mean 0.056 and standard deviation 0.35.	One-Sample Kolmogorov-Smirnov Test	.311	Retain the null hypothesis.
6	The distribution of Ch1.3B is normal with mean 0.070 and standard deviation 0.25.	One-Sample Kolmogorov-Smirnov Test	.499	Retain the null hypothesis.
7	The distribution of Ch16.1A is normal with mean 0.177 and standard deviation 0.21.	One-Sample Kolmogorov-Smirnov Test	.881	Retain the null hypothesis.
8	The distribution of Ch16.2A is normal with mean 0.015 and standard deviation 0.25.	One-Sample Kolmogorov-Smirnov Test	.870	Retain the null hypothesis.
9	The distribution of Ch16.3A is normal with mean 0.033 and standard deviation 0.25.	One-Sample Kolmogorov-Smirnov Test	1.000	Retain the null hypothesis.
10	The distribution of Ch16.1B is normal with mean 0.088 and standard deviation 0.34.	One-Sample Kolmogorov-Smirnov Test	.395	Retain the null hypothesis.
11	The distribution of Ch16.2B is normal with mean 0.138 and standard deviation 0.19.	One-Sample Kolmogorov-Smirnov Test	.984	Retain the null hypothesis.
12	The distribution of Ch16.3B is normal with mean 0.097 and standard deviation 0.15.	One-Sample Kolmogorov-Smirnov Test	.988	Retain the null hypothesis.
13	The distribution of Ch26.1A is normal with mean 0.163 and standard deviation 0.38.	One-Sample Kolmogorov-Smirnov Test	.529	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
14	The distribution of Ch26.2A is normal with mean 0.043 and standard deviation 0.48.	One-Sample Kolmogorov-Smirnov Test	.301	Retain the null hypothesis.
15	The distribution of Ch26.3A is normal with mean 0.128 and standard deviation 0.34.	One-Sample Kolmogorov-Smirnov Test	.561	Retain the null hypothesis.
16	The distribution of Ch26.1B is normal with mean 0.213 and standard deviation 0.24.	One-Sample Kolmogorov-Smirnov Test	.839	Retain the null hypothesis.
17	The distribution of Ch26.2B is normal with mean 0.184 and standard deviation 0.25.	One-Sample Kolmogorov-Smirnov Test	.850	Retain the null hypothesis.
18	The distribution of Ch26.3B is normal with mean 0.152 and standard deviation 0.37.	One-Sample Kolmogorov-Smirnov Test	.495	Retain the null hypothesis.
19	The distribution of Ch27.1A is normal with mean 0.164 and standard deviation 0.31.	One-Sample Kolmogorov-Smirnov Test	.473	Retain the null hypothesis.
20	The distribution of Ch27.2A is normal with mean 0.126 and standard deviation 0.28.	One-Sample Kolmogorov-Smirnov Test	.977	Retain the null hypothesis.
21	The distribution of Ch27.3A is normal with mean 0.048 and standard deviation 0.26.	One-Sample Kolmogorov-Smirnov Test	.810	Retain the null hypothesis.
22	The distribution of Ch27.1B is normal with mean 0.253 and standard deviation 0.26.	One-Sample Kolmogorov-Smirnov Test	.716	Retain the null hypothesis.
23	The distribution of Ch27.2B is normal with mean 0.191 and standard deviation 0.22.	One-Sample Kolmogorov-Smirnov Test	.936	Retain the null hypothesis.
24	The distribution of Ch27.3B is normal with mean 0.131 and standard deviation 0.26.	One-Sample Kolmogorov-Smirnov Test	.948	Retain the null hypothesis.
25	The distribution of Ch36.1B is normal with mean 0.191 and standard deviation 0.27.	One-Sample Kolmogorov-Smirnov Test	.932	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
26	The distribution of Ch36.2B is normal with mean -0.016 and standard deviation 0.33.	One-Sample Kolmogorov-Smirnov Test	.837	Retain the null hypothesis.
27	The distribution of Ch36.3B is normal with mean 0.119 and standard deviation 0.17.	One-Sample Kolmogorov-Smirnov Test	.973	Retain the null hypothesis.
28	The distribution of Ch36.1A is normal with mean -0.007 and standard deviation 0.47.	One-Sample Kolmogorov-Smirnov Test	.370	Retain the null hypothesis.
29	The distribution of Ch36.2A is normal with mean -0.195 and standard deviation 0.73.	One-Sample Kolmogorov-Smirnov Test	.369	Retain the null hypothesis.
30	The distribution of Ch36.3A is normal with mean 0.060 and standard deviation 0.36.	One-Sample Kolmogorov-Smirnov Test	.980	Retain the null hypothesis.
31	The distribution of Ch17.1B is normal with mean 0.234 and standard deviation 0.30.	One-Sample Kolmogorov-Smirnov Test	.434	Retain the null hypothesis.
32	The distribution of Ch17.2B is normal with mean 0.158 and standard deviation 0.25.	One-Sample Kolmogorov-Smirnov Test	.871	Retain the null hypothesis.
33	The distribution of Ch17.3B is normal with mean 0.048 and standard deviation 0.23.	One-Sample Kolmogorov-Smirnov Test	.769	Retain the null hypothesis.
34	The distribution of Ch2.1B is normal with mean 0.079 and standard deviation 0.37.	One-Sample Kolmogorov-Smirnov Test	.886	Retain the null hypothesis.
35	The distribution of Ch3.1B is normal with mean 0.093 and standard deviation 0.31.	One-Sample Kolmogorov-Smirnov Test	.902	Retain the null hypothesis.
36	The distribution of Ch4.1B is normal with mean 0.119 and standard deviation 0.28.	One-Sample Kolmogorov-Smirnov Test	.862	Retain the null hypothesis.
37	The distribution of Ch5.1B is normal with mean -0.040 and standard deviation 0.47.	One-Sample Kolmogorov-Smirnov Test	.303	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
38	The distribution of Ch6.1B is normal with mean 0.003 and standard deviation 0.48.	One-Sample Kolmogorov-Smirnov Test	.245	Retain the null hypothesis.
39	The distribution of Ch7.1B is normal with mean -0.164 and standard deviation 0.69.	One-Sample Kolmogorov-Smirnov Test	.083	Retain the null hypothesis.
40	The distribution of Ch8.1B is normal with mean -0.046 and standard deviation 0.51.	One-Sample Kolmogorov-Smirnov Test	.063	Retain the null hypothesis.
41	The distribution of Ch9.1B is normal with mean 0.054 and standard deviation 0.80.	One-Sample Kolmogorov-Smirnov Test	.120	Retain the null hypothesis.
42	The distribution of Ch10.1B is normal with mean 0.326 and standard deviation 0.35.	One-Sample Kolmogorov-Smirnov Test	.916	Retain the null hypothesis.
43	The distribution of Ch11.1B is normal with mean 0.214 and standard deviation 0.40.	One-Sample Kolmogorov-Smirnov Test	.652	Retain the null hypothesis.
44	The distribution of Ch12.1B is normal with mean 0.066 and standard deviation 0.35.	One-Sample Kolmogorov-Smirnov Test	.975	Retain the null hypothesis.
45	The distribution of Ch13.1B is normal with mean 0.112 and standard deviation 0.36.	One-Sample Kolmogorov-Smirnov Test	.988	Retain the null hypothesis.
46	The distribution of Ch14.1B is normal with mean 0.150 and standard deviation 0.15.	One-Sample Kolmogorov-Smirnov Test	.938	Retain the null hypothesis.
47	The distribution of Ch15.1B is normal with mean 0.191 and standard deviation 0.32.	One-Sample Kolmogorov-Smirnov Test	.989	Retain the null hypothesis.
48	The distribution of Ch18.1B is normal with mean 0.135 and standard deviation 0.23.	One-Sample Kolmogorov-Smirnov Test	.587	Retain the null hypothesis.
49	The distribution of Ch19.1B is normal with mean -0.002 and standard deviation 0.54.	One-Sample Kolmogorov-Smirnov Test	.407	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
50	The distribution of Ch22.1B is normal with mean 0.177 and standard deviation 0.41.	One-Sample Kolmogorov-Smirnov Test	.753	Retain the null hypothesis.
51	The distribution of Ch23.1B is normal with mean 0.085 and standard deviation 0.27.	One-Sample Kolmogorov-Smirnov Test	.762	Retain the null hypothesis.
52	The distribution of Ch24.1B is normal with mean 0.275 and standard deviation 0.28.	One-Sample Kolmogorov-Smirnov Test	.662	Retain the null hypothesis.
53	The distribution of Ch25.1B is normal with mean 0.284 and standard deviation 0.30.	One-Sample Kolmogorov-Smirnov Test	.582	Retain the null hypothesis.
54	The distribution of Ch28.1B is normal with mean 0.221 and standard deviation 0.20.	One-Sample Kolmogorov-Smirnov Test	.767	Retain the null hypothesis.
55	The distribution of Ch29.1B is normal with mean 0.164 and standard deviation 0.30.	One-Sample Kolmogorov-Smirnov Test	.684	Retain the null hypothesis.
56	The distribution of Ch30.1B is normal with mean 0.252 and standard deviation 0.55.	One-Sample Kolmogorov-Smirnov Test	.655	Retain the null hypothesis.
57	The distribution of Ch31.1B is normal with mean 0.434 and standard deviation 0.39.	One-Sample Kolmogorov-Smirnov Test	.976	Retain the null hypothesis.
58	The distribution of Ch32.1B is normal with mean 0.171 and standard deviation 0.38.	One-Sample Kolmogorov-Smirnov Test	.662	Retain the null hypothesis.
59	The distribution of Ch33.1B is normal with mean 0.082 and standard deviation 0.27.	One-Sample Kolmogorov-Smirnov Test	.973	Retain the null hypothesis.
60	The distribution of Ch34.1B is normal with mean 0.081 and standard deviation 0.23.	One-Sample Kolmogorov-Smirnov Test	.907	Retain the null hypothesis.
61	The distribution of Ch35.1B is normal with mean 0.258 and standard deviation 0.29.	One-Sample Kolmogorov-Smirnov Test	.770	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
62	The distribution of Ch37.1B is normal with mean 0.164 and standard deviation 0.37.	One-Sample Kolmogorov-Smirnov Test	.710	Retain the null hypothesis.
63	The distribution of Ch38.1B is normal with mean 0.224 and standard deviation 0.23.	One-Sample Kolmogorov-Smirnov Test	.891	Retain the null hypothesis.
64	The distribution of Ch39.1B is normal with mean 0.135 and standard deviation 0.36.	One-Sample Kolmogorov-Smirnov Test	.600	Retain the null hypothesis.
65	The distribution of Ch40.1B is normal with mean 0.057 and standard deviation 0.70.	One-Sample Kolmogorov-Smirnov Test	.656	Retain the null hypothesis.
66	The distribution of Ch41.1B is normal with mean 0.004 and standard deviation 0.52.	One-Sample Kolmogorov-Smirnov Test	.994	Retain the null hypothesis.
67	The distribution of Ch42.1B is normal with mean 0.412 and standard deviation 0.38.	One-Sample Kolmogorov-Smirnov Test	.574	Retain the null hypothesis.
68	The distribution of Ch43.1B is normal with mean 0.137 and standard deviation 0.52.	One-Sample Kolmogorov-Smirnov Test	.536	Retain the null hypothesis.
69	The distribution of Ch44.1B is normal with mean 0.073 and standard deviation 0.54.	One-Sample Kolmogorov-Smirnov Test	.802	Retain the null hypothesis.
70	The distribution of Ch45.1B is normal with mean 0.088 and standard deviation 0.25.	One-Sample Kolmogorov-Smirnov Test	.984	Retain the null hypothesis.
71	The distribution of Ch46.1B is normal with mean 0.274 and standard deviation 0.34.	One-Sample Kolmogorov-Smirnov Test	.868	Retain the null hypothesis.
72	The distribution of Ch47.1B is normal with mean 0.153 and standard deviation 0.45.	One-Sample Kolmogorov-Smirnov Test	.324	Retain the null hypothesis.
73	The distribution of Ch48.1B is normal with mean 0.203 and standard deviation 0.19.	One-Sample Kolmogorov-Smirnov Test	.926	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
74	The distribution of Ch49.1B is normal with mean 0.107 and standard deviation 0.33.	One-Sample Kolmogorov-Smirnov Test	.978	Retain the null hypothesis.
75	The distribution of Ch50.1B is normal with mean 0.142 and standard deviation 0.56.	One-Sample Kolmogorov-Smirnov Test	.765	Retain the null hypothesis.
76	The distribution of Ch51.1B is normal with mean 0.130 and standard deviation 0.73.	One-Sample Kolmogorov-Smirnov Test	.915	Retain the null hypothesis.
77	The distribution of Ch52.1B is normal with mean 0.235 and standard deviation 0.56.	One-Sample Kolmogorov-Smirnov Test	.470	Retain the null hypothesis.
78	The distribution of Ch2.2B is normal with mean 0.049 and standard deviation 0.39.	One-Sample Kolmogorov-Smirnov Test	.489	Retain the null hypothesis.
79	The distribution of Ch3.2B is normal with mean 0.090 and standard deviation 0.26.	One-Sample Kolmogorov-Smirnov Test	.545	Retain the null hypothesis.
80	The distribution of Ch4.2B is normal with mean 0.028 and standard deviation 0.25.	One-Sample Kolmogorov-Smirnov Test	.988	Retain the null hypothesis.
81	The distribution of Ch5.2B is normal with mean 0.052 and standard deviation 0.16.	One-Sample Kolmogorov-Smirnov Test	.816	Retain the null hypothesis.
82	The distribution of Ch6.2B is normal with mean 0.075 and standard deviation 0.17.	One-Sample Kolmogorov-Smirnov Test	.942	Retain the null hypothesis.
83	The distribution of Ch7.2B is normal with mean -0.046 and standard deviation 0.38.	One-Sample Kolmogorov-Smirnov Test	.708	Retain the null hypothesis.
84	The distribution of Ch8.2B is normal with mean 0.011 and standard deviation 0.30.	One-Sample Kolmogorov-Smirnov Test	.582	Retain the null hypothesis.
85	The distribution of Ch9.2B is normal with mean 0.122 and standard deviation 0.22.	One-Sample Kolmogorov-Smirnov Test	.957	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
86	The distribution of Ch10.2B is normal with mean 0.298 and standard deviation 0.31.	One-Sample Kolmogorov-Smirnov Test	.201	Retain the null hypothesis.
87	The distribution of Ch11.2B is normal with mean 0.256 and standard deviation 0.45.	One-Sample Kolmogorov-Smirnov Test	.998	Retain the null hypothesis.
88	The distribution of Ch12.2B is normal with mean 0.033 and standard deviation 0.41.	One-Sample Kolmogorov-Smirnov Test	1.000	Retain the null hypothesis.
89	The distribution of Ch13.2B is normal with mean 0.205 and standard deviation 0.26.	One-Sample Kolmogorov-Smirnov Test	.642	Retain the null hypothesis.
90	The distribution of Ch14.2B is normal with mean 0.090 and standard deviation 0.30.	One-Sample Kolmogorov-Smirnov Test	.962	Retain the null hypothesis.
91	The distribution of Ch15.2B is normal with mean 0.098 and standard deviation 0.28.	One-Sample Kolmogorov-Smirnov Test	.632	Retain the null hypothesis.
92	The distribution of Ch18.2B is normal with mean 0.086 and standard deviation 0.21.	One-Sample Kolmogorov-Smirnov Test	.539	Retain the null hypothesis.
93	The distribution of Ch19.2B is normal with mean 0.111 and standard deviation 0.22.	One-Sample Kolmogorov-Smirnov Test	.912	Retain the null hypothesis.
94	The distribution of Ch22.2B is normal with mean 0.037 and standard deviation 0.74.	One-Sample Kolmogorov-Smirnov Test	.720	Retain the null hypothesis.
95	The distribution of Ch23.2B is normal with mean 0.127 and standard deviation 0.73.	One-Sample Kolmogorov-Smirnov Test	.384	Retain the null hypothesis.
96	The distribution of Ch24.2B is normal with mean 0.153 and standard deviation 0.14.	One-Sample Kolmogorov-Smirnov Test	.991	Retain the null hypothesis.
97	The distribution of Ch25.2B is normal with mean 0.183 and standard deviation 0.39.	One-Sample Kolmogorov-Smirnov Test	.615	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
98	The distribution of Ch28.2B is normal with mean 0.114 and standard deviation 0.26.	One-Sample Kolmogorov-Smirnov Test	.784	Retain the null hypothesis.
99	The distribution of Ch29.2B is normal with mean 0.162 and standard deviation 0.29.	One-Sample Kolmogorov-Smirnov Test	.812	Retain the null hypothesis.
100	The distribution of Ch30.2B is normal with mean 0.193 and standard deviation 0.46.	One-Sample Kolmogorov-Smirnov Test	.584	Retain the null hypothesis.
101	The distribution of Ch31.2B is normal with mean 0.286 and standard deviation 0.33.	One-Sample Kolmogorov-Smirnov Test	.997	Retain the null hypothesis.
102	The distribution of Ch32.2B is normal with mean 0.232 and standard deviation 0.49.	One-Sample Kolmogorov-Smirnov Test	.828	Retain the null hypothesis.
103	The distribution of Ch33.2B is normal with mean -0.056 and standard deviation 1.04.	One-Sample Kolmogorov-Smirnov Test	.640	Retain the null hypothesis.
104	The distribution of Ch34.2B is normal with mean 0.124 and standard deviation 0.33.	One-Sample Kolmogorov-Smirnov Test	.932	Retain the null hypothesis.
105	The distribution of Ch35.2B is normal with mean 0.128 and standard deviation 0.33.	One-Sample Kolmogorov-Smirnov Test	.499	Retain the null hypothesis.
106	The distribution of Ch37.2B is normal with mean -0.009 and standard deviation 0.34.	One-Sample Kolmogorov-Smirnov Test	.886	Retain the null hypothesis.
107	The distribution of Ch38.2B is normal with mean 0.056 and standard deviation 0.23.	One-Sample Kolmogorov-Smirnov Test	1.000	Retain the null hypothesis.
108	The distribution of Ch39.2B is normal with mean 0.092 and standard deviation 0.36.	One-Sample Kolmogorov-Smirnov Test	.561	Retain the null hypothesis.
109	The distribution of Ch40.2B is normal with mean 0.082 and standard deviation 0.53.	One-Sample Kolmogorov-Smirnov Test	.622	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
110	The distribution of Ch41.2B is normal with mean 0.042 and standard deviation 0.59.	One-Sample Kolmogorov-Smirnov Test	.755	Retain the null hypothesis.
111	The distribution of Ch42.2B is normal with mean 0.382 and standard deviation 0.28.	One-Sample Kolmogorov-Smirnov Test	.913	Retain the null hypothesis.
112	The distribution of Ch43.2B is normal with mean -0.000 and standard deviation 0.55.	One-Sample Kolmogorov-Smirnov Test	.492	Retain the null hypothesis.
113	The distribution of Ch44.2B is normal with mean -0.026 and standard deviation 0.80.	One-Sample Kolmogorov-Smirnov Test	.559	Retain the null hypothesis.
114	The distribution of Ch45.2B is normal with mean 0.225 and standard deviation 0.26.	One-Sample Kolmogorov-Smirnov Test	.842	Retain the null hypothesis.
115	The distribution of Ch46.2B is normal with mean 0.028 and standard deviation 0.30.	One-Sample Kolmogorov-Smirnov Test	.999	Retain the null hypothesis.
116	The distribution of Ch47.2B is normal with mean -0.050 and standard deviation 0.33.	One-Sample Kolmogorov-Smirnov Test	.923	Retain the null hypothesis.
117	The distribution of Ch48.2B is normal with mean 0.006 and standard deviation 0.26.	One-Sample Kolmogorov-Smirnov Test	.518	Retain the null hypothesis.
118	The distribution of Ch49.2B is normal with mean 0.102 and standard deviation 0.31.	One-Sample Kolmogorov-Smirnov Test	.878	Retain the null hypothesis.
119	The distribution of Ch50.2B is normal with mean 0.109 and standard deviation 0.48.	One-Sample Kolmogorov-Smirnov Test	.925	Retain the null hypothesis.
120	The distribution of Ch51.2B is normal with mean 0.178 and standard deviation 0.58.	One-Sample Kolmogorov-Smirnov Test	.997	Retain the null hypothesis.
121	The distribution of Ch52.2B is normal with mean 0.182 and standard deviation 0.34.	One-Sample Kolmogorov-Smirnov Test	.966	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
122	The distribution of Ch2.3B is normal with mean 0.120 and standard deviation 0.30.	One-Sample Kolmogorov-Smirnov Test	.989	Retain the null hypothesis.
123	The distribution of Ch3.3B is normal with mean 0.078 and standard deviation 0.29.	One-Sample Kolmogorov-Smirnov Test	.880	Retain the null hypothesis.
124	The distribution of Ch4.3B is normal with mean 0.038 and standard deviation 0.13.	One-Sample Kolmogorov-Smirnov Test	.876	Retain the null hypothesis.
125	The distribution of Ch5.3B is normal with mean 0.057 and standard deviation 0.17.	One-Sample Kolmogorov-Smirnov Test	.744	Retain the null hypothesis.
126	The distribution of Ch6.3B is normal with mean 0.055 and standard deviation 0.10.	One-Sample Kolmogorov-Smirnov Test	.696	Retain the null hypothesis.
127	The distribution of Ch7.3B is normal with mean -0.004 and standard deviation 0.11.	One-Sample Kolmogorov-Smirnov Test	.848	Retain the null hypothesis.
128	The distribution of Ch8.3B is normal with mean -0.048 and standard deviation 0.30.	One-Sample Kolmogorov-Smirnov Test	.461	Retain the null hypothesis.
129	The distribution of Ch9.3B is normal with mean 0.099 and standard deviation 0.31.	One-Sample Kolmogorov-Smirnov Test	1.000	Retain the null hypothesis.
130	The distribution of Ch10.3B is normal with mean 0.219 and standard deviation 0.23.	One-Sample Kolmogorov-Smirnov Test	.911	Retain the null hypothesis.
131	The distribution of Ch11.3B is normal with mean 0.115 and standard deviation 0.41.	One-Sample Kolmogorov-Smirnov Test	.792	Retain the null hypothesis.
132	The distribution of Ch12.3B is normal with mean -0.032 and standard deviation 0.52.	One-Sample Kolmogorov-Smirnov Test	.985	Retain the null hypothesis.
133	The distribution of Ch13.3B is normal with mean 0.179 and standard deviation 0.38.	One-Sample Kolmogorov-Smirnov Test	.944	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
134	The distribution of Ch14.3B is normal with mean 0.049 and standard deviation 0.14.	One-Sample Kolmogorov-Smirnov Test	.803	Retain the null hypothesis.
135	The distribution of Ch15.3B is normal with mean 0.124 and standard deviation 0.22.	One-Sample Kolmogorov-Smirnov Test	.972	Retain the null hypothesis.
136	The distribution of Ch18.3B is normal with mean -0.022 and standard deviation 0.25.	One-Sample Kolmogorov-Smirnov Test	.559	Retain the null hypothesis.
137	The distribution of Ch19.3B is normal with mean 0.032 and standard deviation 0.26.	One-Sample Kolmogorov-Smirnov Test	.413	Retain the null hypothesis.
138	The distribution of Ch22.3B is normal with mean 0.021 and standard deviation 0.51.	One-Sample Kolmogorov-Smirnov Test	.800	Retain the null hypothesis.
139	The distribution of Ch23.3B is normal with mean 0.148 and standard deviation 0.56.	One-Sample Kolmogorov-Smirnov Test	1.000	Retain the null hypothesis.
140	The distribution of Ch24.3B is normal with mean 0.126 and standard deviation 0.22.	One-Sample Kolmogorov-Smirnov Test	.568	Retain the null hypothesis.
141	The distribution of Ch25.3B is normal with mean 0.176 and standard deviation 0.35.	One-Sample Kolmogorov-Smirnov Test	.260	Retain the null hypothesis.
142	The distribution of Ch28.3B is normal with mean 0.083 and standard deviation 0.29.	One-Sample Kolmogorov-Smirnov Test	.965	Retain the null hypothesis.
143	The distribution of Ch29.3B is normal with mean 0.013 and standard deviation 0.32.	One-Sample Kolmogorov-Smirnov Test	.632	Retain the null hypothesis.
144	The distribution of Ch30.3B is normal with mean 0.049 and standard deviation 0.58.	One-Sample Kolmogorov-Smirnov Test	.163	Retain the null hypothesis.
145	The distribution of Ch31.3B is normal with mean 0.205 and standard deviation 0.60.	One-Sample Kolmogorov-Smirnov Test	.564	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
146	The distribution of Ch32.3B is normal with mean 0.157 and standard deviation 0.51.	One-Sample Kolmogorov-Smirnov Test	.750	Retain the null hypothesis.
147	The distribution of Ch33.3B is normal with mean -0.122 and standard deviation 0.79.	One-Sample Kolmogorov-Smirnov Test	.468	Retain the null hypothesis.
148	The distribution of Ch34.3B is normal with mean 0.234 and standard deviation 0.47.	One-Sample Kolmogorov-Smirnov Test	.910	Retain the null hypothesis.
149	The distribution of Ch35.3B is normal with mean 0.165 and standard deviation 0.26.	One-Sample Kolmogorov-Smirnov Test	.989	Retain the null hypothesis.
150	The distribution of Ch37.3B is normal with mean 0.117 and standard deviation 0.29.	One-Sample Kolmogorov-Smirnov Test	.815	Retain the null hypothesis.
151	The distribution of Ch38.3B is normal with mean 0.117 and standard deviation 0.33.	One-Sample Kolmogorov-Smirnov Test	.709	Retain the null hypothesis.
152	The distribution of Ch39.3B is normal with mean 0.111 and standard deviation 0.43.	One-Sample Kolmogorov-Smirnov Test	.402	Retain the null hypothesis.
153	The distribution of Ch40.3B is normal with mean 0.038 and standard deviation 0.39.	One-Sample Kolmogorov-Smirnov Test	.498	Retain the null hypothesis.
154	The distribution of Ch41.3B is normal with mean 0.168 and standard deviation 0.53.	One-Sample Kolmogorov-Smirnov Test	.951	Retain the null hypothesis.
155	The distribution of Ch42.3B is normal with mean 0.467 and standard deviation 0.42.	One-Sample Kolmogorov-Smirnov Test	.635	Retain the null hypothesis.
156	The distribution of Ch43.3B is normal with mean -0.057 and standard deviation 1.10.	One-Sample Kolmogorov-Smirnov Test	.474	Retain the null hypothesis.
157	The distribution of Ch44.3B is normal with mean 0.145 and standard deviation 0.75.	One-Sample Kolmogorov-Smirnov Test	.785	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
158	The distribution of Ch45.3B is normal with mean 0.258 and standard deviation 0.31.	One-Sample Kolmogorov-Smirnov Test	.966	Retain the null hypothesis.
159	The distribution of Ch46.3B is normal with mean 0.160 and standard deviation 0.35.	One-Sample Kolmogorov-Smirnov Test	.494	Retain the null hypothesis.
160	The distribution of Ch47.3B is normal with mean 0.141 and standard deviation 0.30.	One-Sample Kolmogorov-Smirnov Test	.539	Retain the null hypothesis.
161	The distribution of Ch48.3B is normal with mean 0.132 and standard deviation 0.26.	One-Sample Kolmogorov-Smirnov Test	.832	Retain the null hypothesis.
162	The distribution of Ch49.3B is normal with mean 0.168 and standard deviation 0.22.	One-Sample Kolmogorov-Smirnov Test	.983	Retain the null hypothesis.
163	The distribution of Ch50.3B is normal with mean 0.089 and standard deviation 0.27.	One-Sample Kolmogorov-Smirnov Test	.933	Retain the null hypothesis.
164	The distribution of Ch51.3B is normal with mean 0.071 and standard deviation 0.45.	One-Sample Kolmogorov-Smirnov Test	.609	Retain the null hypothesis.
165	The distribution of Ch52.3B is normal with mean 0.221 and standard deviation 0.33.	One-Sample Kolmogorov-Smirnov Test	.763	Retain the null hypothesis.
166	The distribution of Ch2.1A is normal with mean 0.138 and standard deviation 0.27.	One-Sample Kolmogorov-Smirnov Test	.822	Retain the null hypothesis.
167	The distribution of Ch3.1A is normal with mean 0.083 and standard deviation 0.26.	One-Sample Kolmogorov-Smirnov Test	.974	Retain the null hypothesis.
168	The distribution of Ch4.1A is normal with mean 0.139 and standard deviation 0.20.	One-Sample Kolmogorov-Smirnov Test	.999	Retain the null hypothesis.
169	The distribution of Ch5.1A is normal with mean 0.096 and standard deviation 0.23.	One-Sample Kolmogorov-Smirnov Test	.274	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
170	The distribution of Ch6.1A is normal with mean -0.007 and standard deviation 0.20.	One-Sample Kolmogorov-Smirnov Test	.632	Retain the null hypothesis.
171	The distribution of Ch7.1A is normal with mean 0.008 and standard deviation 0.30.	One-Sample Kolmogorov-Smirnov Test	.929	Retain the null hypothesis.
172	The distribution of Ch8.1A is normal with mean 0.161 and standard deviation 0.40.	One-Sample Kolmogorov-Smirnov Test	.936	Retain the null hypothesis.
173	The distribution of Ch9.1A is normal with mean 0.199 and standard deviation 0.45.	One-Sample Kolmogorov-Smirnov Test	.818	Retain the null hypothesis.
174	The distribution of Ch10.1A is normal with mean 0.295 and standard deviation 0.27.	One-Sample Kolmogorov-Smirnov Test	.954	Retain the null hypothesis.
175	The distribution of Ch11.1A is normal with mean 0.148 and standard deviation 0.43.	One-Sample Kolmogorov-Smirnov Test	.881	Retain the null hypothesis.
176	The distribution of Ch12.1A is normal with mean 0.124 and standard deviation 0.44.	One-Sample Kolmogorov-Smirnov Test	.848	Retain the null hypothesis.
177	The distribution of Ch13.1A is normal with mean 0.111 and standard deviation 0.18.	One-Sample Kolmogorov-Smirnov Test	.969	Retain the null hypothesis.
178	The distribution of Ch14.1A is normal with mean 0.103 and standard deviation 0.25.	One-Sample Kolmogorov-Smirnov Test	.523	Retain the null hypothesis.
179	The distribution of Ch15.1A is normal with mean 0.215 and standard deviation 0.35.	One-Sample Kolmogorov-Smirnov Test	.635	Retain the null hypothesis.
180	The distribution of Ch17.1A is normal with mean 0.187 and standard deviation 0.31.	One-Sample Kolmogorov-Smirnov Test	.865	Retain the null hypothesis.
181	The distribution of Ch18.1A is normal with mean 0.125 and standard deviation 0.30.	One-Sample Kolmogorov-Smirnov Test	.610	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
182	The distribution of Ch19.1A is normal with mean 0.013 and standard deviation 0.42.	One-Sample Kolmogorov-Smirnov Test	.885	Retain the null hypothesis.
183	The distribution of Ch22.1A is normal with mean 0.044 and standard deviation 0.46.	One-Sample Kolmogorov-Smirnov Test	.577	Retain the null hypothesis.
184	The distribution of Ch23.1A is normal with mean -0.012 and standard deviation 0.35.	One-Sample Kolmogorov-Smirnov Test	.981	Retain the null hypothesis.
185	The distribution of Ch24.1A is normal with mean 0.123 and standard deviation 0.27.	One-Sample Kolmogorov-Smirnov Test	.988	Retain the null hypothesis.
186	The distribution of Ch25.1A is normal with mean 0.208 and standard deviation 0.44.	One-Sample Kolmogorov-Smirnov Test	.877	Retain the null hypothesis.
187	The distribution of Ch28.1A is normal with mean 0.193 and standard deviation 0.35.	One-Sample Kolmogorov-Smirnov Test	.898	Retain the null hypothesis.
188	The distribution of Ch29.1A is normal with mean 0.057 and standard deviation 0.33.	One-Sample Kolmogorov-Smirnov Test	.995	Retain the null hypothesis.
189	The distribution of Ch30.1A is normal with mean 0.132 and standard deviation 0.34.	One-Sample Kolmogorov-Smirnov Test	.681	Retain the null hypothesis.
190	The distribution of Ch31.1A is normal with mean 0.176 and standard deviation 0.47.	One-Sample Kolmogorov-Smirnov Test	.998	Retain the null hypothesis.
191	The distribution of Ch32.1A is normal with mean 0.156 and standard deviation 0.41.	One-Sample Kolmogorov-Smirnov Test	.975	Retain the null hypothesis.
192	The distribution of Ch33.1A is normal with mean -0.074 and standard deviation 0.60.	One-Sample Kolmogorov-Smirnov Test	.950	Retain the null hypothesis.
193	The distribution of Ch34.1A is normal with mean 0.171 and standard deviation 0.41.	One-Sample Kolmogorov-Smirnov Test	.988	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
194	The distribution of Ch35.1A is normal with mean 0.133 and standard deviation 0.49.	One-Sample Kolmogorov-Smirnov Test	.702	Retain the null hypothesis.
195	The distribution of Ch37.1A is normal with mean 0.045 and standard deviation 0.48.	One-Sample Kolmogorov-Smirnov Test	.941	Retain the null hypothesis.
196	The distribution of Ch38.1A is normal with mean 0.190 and standard deviation 0.34.	One-Sample Kolmogorov-Smirnov Test	.796	Retain the null hypothesis.
197	The distribution of Ch39.1A is normal with mean 0.003 and standard deviation 0.43.	One-Sample Kolmogorov-Smirnov Test	.926	Retain the null hypothesis.
198	The distribution of Ch40.1A is normal with mean 0.091 and standard deviation 0.68.	One-Sample Kolmogorov-Smirnov Test	.557	Retain the null hypothesis.
199	The distribution of Ch41.1A is normal with mean 0.030 and standard deviation 0.53.	One-Sample Kolmogorov-Smirnov Test	.618	Retain the null hypothesis.
200	The distribution of Ch42.1A is normal with mean 0.251 and standard deviation 0.33.	One-Sample Kolmogorov-Smirnov Test	.981	Retain the null hypothesis.
201	The distribution of Ch43.1A is normal with mean 0.034 and standard deviation 0.61.	One-Sample Kolmogorov-Smirnov Test	.716	Retain the null hypothesis.
202	The distribution of Ch44.1A is normal with mean 0.082 and standard deviation 0.64.	One-Sample Kolmogorov-Smirnov Test	.999	Retain the null hypothesis.
203	The distribution of Ch45.1A is normal with mean 0.094 and standard deviation 0.30.	One-Sample Kolmogorov-Smirnov Test	.996	Retain the null hypothesis.
204	The distribution of Ch46.1A is normal with mean 0.103 and standard deviation 0.31.	One-Sample Kolmogorov-Smirnov Test	.908	Retain the null hypothesis.
205	The distribution of Ch47.1A is normal with mean 0.114 and standard deviation 0.34.	One-Sample Kolmogorov-Smirnov Test	.915	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
206	The distribution of Ch48.1A is normal with mean 0.162 and standard deviation 0.29.	One-Sample Kolmogorov-Smirnov Test	.723	Retain the null hypothesis.
207	The distribution of Ch49.1A is normal with mean 0.066 and standard deviation 0.45.	One-Sample Kolmogorov-Smirnov Test	.420	Retain the null hypothesis.
208	The distribution of Ch50.1A is normal with mean 0.176 and standard deviation 0.46.	One-Sample Kolmogorov-Smirnov Test	.913	Retain the null hypothesis.
209	The distribution of Ch51.1A is normal with mean 0.246 and standard deviation 0.50.	One-Sample Kolmogorov-Smirnov Test	.967	Retain the null hypothesis.
210	The distribution of Ch52.1A is normal with mean 0.253 and standard deviation 0.50.	One-Sample Kolmogorov-Smirnov Test	.723	Retain the null hypothesis.
211	The distribution of Ch2.2A is norma with mean -0.168 and standard deviation 0.55.	One-Sample Kolmogorov-Smirnov Test	.468	Retain the null hypothesis.
212	The distribution of Ch3.2A is norma with mean -0.022 and standard deviation 0.29.	One-Sample Kolmogorov-Smirnov Test	.923	Retain the null hypothesis.
213	The distribution of Ch4.2A is norma with mean -0.033 and standard deviation 0.25.	One-Sample Kolmogorov-Smirnov Test	.281	Retain the null hypothesis.
214	The distribution of Ch5.2A is norma with mean -0.030 and standard deviation 0.14.	One-Sample Kolmogorov-Smirnov Test	.863	Retain the null hypothesis.
215	The distribution of Ch6.2A is norma with mean -0.030 and standard deviation 0.20.	One-Sample Kolmogorov-Smirnov Test	.958	Retain the null hypothesis.
216	The distribution of Ch7.2A is norma with mean -0.023 and standard deviation 0.29.	One-Sample Kolmogorov-Smirnov Test	.672	Retain the null hypothesis.
217	The distribution of Ch8.2A is norma with mean -0.080 and standard deviation 0.33.	One-Sample Kolmogorov-Smirnov Test	.963	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
218	The distribution of Ch9.2A is normal with mean 0.047 and standard deviation 0.42.	One-Sample Kolmogorov-Smirnov Test	.426	Retain the null hypothesis.
219	The distribution of Ch10.2A is normal with mean 0.197 and standard deviation 0.32.	One-Sample Kolmogorov-Smirnov Test	.918	Retain the null hypothesis.
220	The distribution of Ch11.2A is normal with mean 0.088 and standard deviation 0.44.	One-Sample Kolmogorov-Smirnov Test	.763	Retain the null hypothesis.
221	The distribution of Ch12.2A is normal with mean -0.176 and standard deviation 0.89.	One-Sample Kolmogorov-Smirnov Test	.207	Retain the null hypothesis.
222	The distribution of Ch13.2A is normal with mean 0.069 and standard deviation 0.41.	One-Sample Kolmogorov-Smirnov Test	.204	Retain the null hypothesis.
223	The distribution of Ch14.2A is normal with mean -0.041 and standard deviation 0.26.	One-Sample Kolmogorov-Smirnov Test	.661	Retain the null hypothesis.
224	The distribution of Ch15.2A is normal with mean 0.046 and standard deviation 0.17.	One-Sample Kolmogorov-Smirnov Test	.915	Retain the null hypothesis.
225	The distribution of Ch17.2A is normal with mean 0.042 and standard deviation 0.32.	One-Sample Kolmogorov-Smirnov Test	.589	Retain the null hypothesis.
226	The distribution of Ch18.2A is normal with mean -0.063 and standard deviation 0.26.	One-Sample Kolmogorov-Smirnov Test	.331	Retain the null hypothesis.
227	The distribution of Ch19.2A is normal with mean -0.008 and standard deviation 0.37.	One-Sample Kolmogorov-Smirnov Test	.726	Retain the null hypothesis.
228	The distribution of Ch22.2A is normal with mean 0.058 and standard deviation 0.53.	One-Sample Kolmogorov-Smirnov Test	.644	Retain the null hypothesis.
229	The distribution of Ch23.2A is normal with mean 0.119 and standard deviation 0.62.	One-Sample Kolmogorov-Smirnov Test	.835	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
230	The distribution of Ch24.2A is normal with mean -0.001 and standard deviation 0.20.	One-Sample Kolmogorov-Smirnov Test	.694	Retain the null hypothesis.
231	The distribution of Ch25.2A is normal with mean 0.052 and standard deviation 0.34.	One-Sample Kolmogorov-Smirnov Test	.542	Retain the null hypothesis.
232	The distribution of Ch28.2A is normal with mean -0.034 and standard deviation 0.44.	One-Sample Kolmogorov-Smirnov Test	.277	Retain the null hypothesis.
233	The distribution of Ch29.2A is normal with mean -0.032 and standard deviation 0.33.	One-Sample Kolmogorov-Smirnov Test	.581	Retain the null hypothesis.
234	The distribution of Ch30.2A is normal with mean 0.231 and standard deviation 0.45.	One-Sample Kolmogorov-Smirnov Test	.857	Retain the null hypothesis.
235	The distribution of Ch31.2A is normal with mean 0.356 and standard deviation 0.33.	One-Sample Kolmogorov-Smirnov Test	.833	Retain the null hypothesis.
236	The distribution of Ch32.2A is normal with mean 0.250 and standard deviation 0.48.	One-Sample Kolmogorov-Smirnov Test	.681	Retain the null hypothesis.
237	The distribution of Ch33.2A is normal with mean 0.097 and standard deviation 0.96.	One-Sample Kolmogorov-Smirnov Test	.337	Retain the null hypothesis.
238	The distribution of Ch34.2A is normal with mean 0.070 and standard deviation 0.25.	One-Sample Kolmogorov-Smirnov Test	.885	Retain the null hypothesis.
239	The distribution of Ch35.2A is normal with mean -0.005 and standard deviation 0.34.	One-Sample Kolmogorov-Smirnov Test	.610	Retain the null hypothesis.
240	The distribution of Ch37.2A is normal with mean -0.037 and standard deviation 0.39.	One-Sample Kolmogorov-Smirnov Test	.630	Retain the null hypothesis.
241	The distribution of Ch38.2A is normal with mean -0.042 and standard deviation 0.33.	One-Sample Kolmogorov-Smirnov Test	.573	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
242	The distribution of Ch39.2A is normal with mean -0.168 and standard deviation 0.55.	One-Sample Kolmogorov-Smirnov Test	.132	Retain the null hypothesis.
243	The distribution of Ch40.2A is normal with mean 0.123 and standard deviation 0.53.	One-Sample Kolmogorov-Smirnov Test	.884	Retain the null hypothesis.
244	The distribution of Ch41.2A is normal with mean 0.076 and standard deviation 0.66.	One-Sample Kolmogorov-Smirnov Test	.484	Retain the null hypothesis.
245	The distribution of Ch42.2A is normal with mean 0.499 and standard deviation 0.31.	One-Sample Kolmogorov-Smirnov Test	.876	Retain the null hypothesis.
246	The distribution of Ch43.2A is normal with mean 0.263 and standard deviation 0.66.	One-Sample Kolmogorov-Smirnov Test	.948	Retain the null hypothesis.
247	The distribution of Ch44.2A is normal with mean 0.334 and standard deviation 0.54.	One-Sample Kolmogorov-Smirnov Test	.954	Retain the null hypothesis.
248	The distribution of Ch45.2A is normal with mean 0.153 and standard deviation 0.27.	One-Sample Kolmogorov-Smirnov Test	.733	Retain the null hypothesis.
249	The distribution of Ch46.2A is normal with mean -0.127 and standard deviation 0.58.	One-Sample Kolmogorov-Smirnov Test	.449	Retain the null hypothesis.
250	The distribution of Ch47.2A is normal with mean -0.261 and standard deviation 0.95.	One-Sample Kolmogorov-Smirnov Test	.078	Retain the null hypothesis.
251	The distribution of Ch48.2A is normal with mean -0.296 and standard deviation 1.08.	One-Sample Kolmogorov-Smirnov Test	.045	Reject the null hypothesis.
252	The distribution of Ch49.2A is normal with mean -0.208 and standard deviation 0.52.	One-Sample Kolmogorov-Smirnov Test	.261	Retain the null hypothesis.
253	The distribution of Ch50.2A is normal with mean -0.086 and standard deviation 0.64.	One-Sample Kolmogorov-Smirnov Test	.557	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
254	The distribution of Ch51.2A is normal with mean 0.204 and standard deviation 0.47.	One-Sample Kolmogorov-Smirnov Test	.877	Retain the null hypothesis.
255	The distribution of Ch52.2A is normal with mean 0.251 and standard deviation 0.34.	One-Sample Kolmogorov-Smirnov Test	.960	Retain the null hypothesis.
256	The distribution of Ch2.3A is normal with mean 0.128 and standard deviation 0.34.	One-Sample Kolmogorov-Smirnov Test	.892	Retain the null hypothesis.
257	The distribution of Ch3.3A is normal with mean 0.114 and standard deviation 0.44.	One-Sample Kolmogorov-Smirnov Test	.996	Retain the null hypothesis.
258	The distribution of Ch4.3A is normal with mean 0.043 and standard deviation 0.20.	One-Sample Kolmogorov-Smirnov Test	.769	Retain the null hypothesis.
259	The distribution of Ch5.3A is normal with mean 0.069 and standard deviation 0.19.	One-Sample Kolmogorov-Smirnov Test	.643	Retain the null hypothesis.
260	The distribution of Ch6.3A is normal with mean 0.099 and standard deviation 0.15.	One-Sample Kolmogorov-Smirnov Test	.821	Retain the null hypothesis.
261	The distribution of Ch7.3A is normal with mean -0.057 and standard deviation 0.25.	One-Sample Kolmogorov-Smirnov Test	.091	Retain the null hypothesis.
262	The distribution of Ch8.3A is normal with mean -0.160 and standard deviation 0.31.	One-Sample Kolmogorov-Smirnov Test	.724	Retain the null hypothesis.
263	The distribution of Ch9.3A is normal with mean 0.111 and standard deviation 0.37.	One-Sample Kolmogorov-Smirnov Test	.777	Retain the null hypothesis.
264	The distribution of Ch10.3A is normal with mean 0.191 and standard deviation 0.26.	One-Sample Kolmogorov-Smirnov Test	.561	Retain the null hypothesis.
265	The distribution of Ch11.3A is normal with mean -0.086 and standard deviation 0.36.	One-Sample Kolmogorov-Smirnov Test	.793	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
266	The distribution of Ch12.3A is normal with mean -0.063 and standard deviation 0.59.	One-Sample Kolmogorov-Smirnov Test	.851	Retain the null hypothesis.
267	The distribution of Ch13.3A is normal with mean 0.168 and standard deviation 0.38.	One-Sample Kolmogorov-Smirnov Test	.900	Retain the null hypothesis.
268	The distribution of Ch14.3A is normal with mean 0.041 and standard deviation 0.18.	One-Sample Kolmogorov-Smirnov Test	.993	Retain the null hypothesis.
269	The distribution of Ch15.3A is normal with mean 0.122 and standard deviation 0.25.	One-Sample Kolmogorov-Smirnov Test	.706	Retain the null hypothesis.
270	The distribution of Ch17.3A is normal with mean 0.022 and standard deviation 0.22.	One-Sample Kolmogorov-Smirnov Test	.924	Retain the null hypothesis.
271	The distribution of Ch18.3A is normal with mean 0.053 and standard deviation 0.22.	One-Sample Kolmogorov-Smirnov Test	.622	Retain the null hypothesis.
272	The distribution of Ch19.3A is normal with mean -0.068 and standard deviation 0.26.	One-Sample Kolmogorov-Smirnov Test	.990	Retain the null hypothesis.
273	The distribution of Ch22.3A is normal with mean -0.203 and standard deviation 0.66.	One-Sample Kolmogorov-Smirnov Test	.828	Retain the null hypothesis.
274	The distribution of Ch23.3A is normal with mean 0.090 and standard deviation 0.73.	One-Sample Kolmogorov-Smirnov Test	.816	Retain the null hypothesis.
275	The distribution of Ch24.3A is normal with mean 0.109 and standard deviation 0.28.	One-Sample Kolmogorov-Smirnov Test	.933	Retain the null hypothesis.
276	The distribution of Ch25.3A is normal with mean 0.113 and standard deviation 0.38.	One-Sample Kolmogorov-Smirnov Test	.357	Retain the null hypothesis.
277	The distribution of Ch28.3A is normal with mean 0.087 and standard deviation 0.20.	One-Sample Kolmogorov-Smirnov Test	.655	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
278	The distribution of Ch29.3A is normal with mean 0.063 and standard deviation 0.25.	One-Sample Kolmogorov-Smirnov Test	.969	Retain the null hypothesis.
279	The distribution of Ch30.3A is normal with mean 0.002 and standard deviation 0.54.	One-Sample Kolmogorov-Smirnov Test	.756	Retain the null hypothesis.
280	The distribution of Ch31.3A is normal with mean 0.273 and standard deviation 0.40.	One-Sample Kolmogorov-Smirnov Test	.910	Retain the null hypothesis.
281	The distribution of Ch32.3A is normal with mean -0.117 and standard deviation 0.68.	One-Sample Kolmogorov-Smirnov Test	.997	Retain the null hypothesis.
282	The distribution of Ch33.3A is normal with mean -0.228 and standard deviation 0.50.	One-Sample Kolmogorov-Smirnov Test	.782	Retain the null hypothesis.
283	The distribution of Ch34.3A is normal with mean 0.072 and standard deviation 0.46.	One-Sample Kolmogorov-Smirnov Test	.971	Retain the null hypothesis.
284	The distribution of Ch35.3A is normal with mean 0.083 and standard deviation 0.23.	One-Sample Kolmogorov-Smirnov Test	.900	Retain the null hypothesis.
285	The distribution of Ch37.3A is normal with mean 0.107 and standard deviation 0.27.	One-Sample Kolmogorov-Smirnov Test	.740	Retain the null hypothesis.
286	The distribution of Ch38.3A is normal with mean 0.076 and standard deviation 0.23.	One-Sample Kolmogorov-Smirnov Test	.763	Retain the null hypothesis.
287	The distribution of Ch39.3A is normal with mean 0.051 and standard deviation 0.31.	One-Sample Kolmogorov-Smirnov Test	.957	Retain the null hypothesis.
288	The distribution of Ch40.3A is normal with mean 0.014 and standard deviation 0.63.	One-Sample Kolmogorov-Smirnov Test	.649	Retain the null hypothesis.
289	The distribution of Ch41.3A is normal with mean 0.221 and standard deviation 0.50.	One-Sample Kolmogorov-Smirnov Test	1.000	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
290	The distribution of Ch42.3A is normal with mean 0.471 and standard deviation 0.39.	One-Sample Kolmogorov-Smirnov Test	.727	Retain the null hypothesis.
291	The distribution of Ch43.3A is normal with mean -0.240 and standard deviation 0.51.	One-Sample Kolmogorov-Smirnov Test	1.000	Retain the null hypothesis.
292	The distribution of Ch44.3A is normal with mean -0.100 and standard deviation 0.62.	One-Sample Kolmogorov-Smirnov Test	.998	Retain the null hypothesis.
293	The distribution of Ch45.3A is normal with mean 0.020 and standard deviation 0.37.	One-Sample Kolmogorov-Smirnov Test	.902	Retain the null hypothesis.
294	The distribution of Ch46.3A is normal with mean 0.020 and standard deviation 0.31.	One-Sample Kolmogorov-Smirnov Test	.680	Retain the null hypothesis.
295	The distribution of Ch47.3A is normal with mean 0.057 and standard deviation 0.27.	One-Sample Kolmogorov-Smirnov Test	.854	Retain the null hypothesis.
296	The distribution of Ch48.3A is normal with mean 0.074 and standard deviation 0.26.	One-Sample Kolmogorov-Smirnov Test	.703	Retain the null hypothesis.
297	The distribution of Ch49.3A is normal with mean 0.121 and standard deviation 0.35.	One-Sample Kolmogorov-Smirnov Test	.235	Retain the null hypothesis.
298	The distribution of Ch50.3A is normal with mean -0.082 and standard deviation 0.63.	One-Sample Kolmogorov-Smirnov Test	.927	Retain the null hypothesis.
299	The distribution of Ch51.3A is normal with mean 0.155 and standard deviation 0.65.	One-Sample Kolmogorov-Smirnov Test	.774	Retain the null hypothesis.
300	The distribution of Ch52.3A is normal with mean 0.268 and standard deviation 0.42.	One-Sample Kolmogorov-Smirnov Test	.785	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of Ch1.1BA is normal with mean 0.010 and standard deviation 0.61.	One-Sample Kolmogorov-Smirnov Test	.701	Retain the null hypothesis.
2	The distribution of Ch2.1BA is normal with mean 0.016 and standard deviation 0.44.	One-Sample Kolmogorov-Smirnov Test	.939	Retain the null hypothesis.
3	The distribution of Ch3.1BA is normal with mean 0.067 and standard deviation 0.40.	One-Sample Kolmogorov-Smirnov Test	.944	Retain the null hypothesis.
4	The distribution of Ch4.1BA is normal with mean 0.063 and standard deviation 0.35.	One-Sample Kolmogorov-Smirnov Test	.981	Retain the null hypothesis.
5	The distribution of Ch5.1BA is normal with mean -0.105 and standard deviation 0.43.	One-Sample Kolmogorov-Smirnov Test	.816	Retain the null hypothesis.
6	The distribution of Ch6.1BA is normal with mean 0.030 and standard deviation 0.50.	One-Sample Kolmogorov-Smirnov Test	.881	Retain the null hypothesis.
7	The distribution of Ch7.1BA is normal with mean -0.358 and standard deviation 1.07.	One-Sample Kolmogorov-Smirnov Test	.022	Reject the null hypothesis.
8	The distribution of Ch8.1BA is normal with mean -0.721 and standard deviation 2.27.	One-Sample Kolmogorov-Smirnov Test	.047	Reject the null hypothesis.
9	The distribution of Ch9.1BA is normal with mean -0.239 and standard deviation 1.14.	One-Sample Kolmogorov-Smirnov Test	.006	Reject the null hypothesis.
10	The distribution of Ch10.1BA is normal with mean 0.100 and standard deviation 0.36.	One-Sample Kolmogorov-Smirnov Test	.388	Retain the null hypothesis.
11	The distribution of Ch11.1BA is normal with mean 0.036 and standard deviation 0.60.	One-Sample Kolmogorov-Smirnov Test	.315	Retain the null hypothesis.
12	The distribution of Ch12.1BA is normal with mean -0.001 and standard deviation 0.50.	One-Sample Kolmogorov-Smirnov Test	.979	Retain the null hypothesis.
13	The distribution of Ch13.1BA is normal with mean -0.030 and standard deviation 0.46.	One-Sample Kolmogorov-Smirnov Test	.917	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
14	The distribution of Ch14.1BA is normal with mean 0.072 and standard deviation 0.49.	One-Sample Kolmogorov-Smirnov Test	.050	Retain the null hypothesis.
15	The distribution of Ch15.1BA is normal with mean 0.119 and standard deviation 0.39.	One-Sample Kolmogorov-Smirnov Test	.643	Retain the null hypothesis.
16	The distribution of Ch16.1BA is normal with mean -0.011 and standard deviation 0.32.	One-Sample Kolmogorov-Smirnov Test	.961	Retain the null hypothesis.
17	The distribution of Ch17.1BA is normal with mean 0.125 and standard deviation 0.46.	One-Sample Kolmogorov-Smirnov Test	.943	Retain the null hypothesis.
18	The distribution of Ch18.1BA is normal with mean -0.109 and standard deviation 0.82.	One-Sample Kolmogorov-Smirnov Test	.104	Retain the null hypothesis.
19	The distribution of Ch19.1BA is normal with mean -0.098 and standard deviation 0.70.	One-Sample Kolmogorov-Smirnov Test	.453	Retain the null hypothesis.
20	The distribution of Ch22.1BA is normal with mean 0.178 and standard deviation 0.43.	One-Sample Kolmogorov-Smirnov Test	.988	Retain the null hypothesis.
21	The distribution of Ch23.1BA is normal with mean -0.084 and standard deviation 0.66.	One-Sample Kolmogorov-Smirnov Test	.473	Retain the null hypothesis.
22	The distribution of Ch24.1BA is normal with mean 0.156 and standard deviation 0.50.	One-Sample Kolmogorov-Smirnov Test	.643	Retain the null hypothesis.
23	The distribution of Ch25.1BA is normal with mean 0.169 and standard deviation 0.52.	One-Sample Kolmogorov-Smirnov Test	.880	Retain the null hypothesis.
24	The distribution of Ch26.1BA is normal with mean 0.127 and standard deviation 0.22.	One-Sample Kolmogorov-Smirnov Test	.413	Retain the null hypothesis.
25	The distribution of Ch27.1BA is normal with mean 0.216 and standard deviation 0.33.	One-Sample Kolmogorov-Smirnov Test	.634	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
26	The distribution of Ch28.1BA is normal with mean 0.090 and standard deviation 0.32.	One-Sample Kolmogorov-Smirnov Test	.739	Retain the null hypothesis.
27	The distribution of Ch29.1BA is normal with mean 0.073 and standard deviation 0.36.	One-Sample Kolmogorov-Smirnov Test	.801	Retain the null hypothesis.
28	The distribution of Ch30.1BA is normal with mean 0.142 and standard deviation 0.65.	One-Sample Kolmogorov-Smirnov Test	.871	Retain the null hypothesis.
29	The distribution of Ch31.1BA is normal with mean 0.277 and standard deviation 0.52.	One-Sample Kolmogorov-Smirnov Test	.904	Retain the null hypothesis.
30	The distribution of Ch32.1BA is normal with mean 0.029 and standard deviation 0.48.	One-Sample Kolmogorov-Smirnov Test	.999	Retain the null hypothesis.
31	The distribution of Ch33.1BA is normal with mean 0.074 and standard deviation 0.50.	One-Sample Kolmogorov-Smirnov Test	.616	Retain the null hypothesis.
32	The distribution of Ch34.1BA is normal with mean -0.173 and standard deviation 0.76.	One-Sample Kolmogorov-Smirnov Test	.388	Retain the null hypothesis.
33	The distribution of Ch35.1BA is normal with mean 0.018 and standard deviation 0.68.	One-Sample Kolmogorov-Smirnov Test	.420	Retain the null hypothesis.
34	The distribution of Ch36.1BA is normal with mean 0.261 and standard deviation 0.21.	One-Sample Kolmogorov-Smirnov Test	.929	Retain the null hypothesis.
35	The distribution of Ch37.1BA is normal with mean 0.133 and standard deviation 0.39.	One-Sample Kolmogorov-Smirnov Test	.967	Retain the null hypothesis.
36	The distribution of Ch38.1BA is normal with mean 0.118 and standard deviation 0.26.	One-Sample Kolmogorov-Smirnov Test	.964	Retain the null hypothesis.
37	The distribution of Ch39.1BA is normal with mean 0.080 and standard deviation 0.49.	One-Sample Kolmogorov-Smirnov Test	.997	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
38	The distribution of Ch40.1BA is normal with mean -0.162 and standard deviation 0.87.	One-Sample Kolmogorov-Smirnov Test	.637	Retain the null hypothesis.
39	The distribution of Ch41.1BA is normal with mean -0.177 and standard deviation 0.83.	One-Sample Kolmogorov-Smirnov Test	.641	Retain the null hypothesis.
40	The distribution of Ch42.1BA is normal with mean 0.187 and standard deviation 0.57.	One-Sample Kolmogorov-Smirnov Test	.810	Retain the null hypothesis.
41	The distribution of Ch43.1BA is normal with mean 0.093 and standard deviation 0.51.	One-Sample Kolmogorov-Smirnov Test	.598	Retain the null hypothesis.
42	The distribution of Ch44.1BA is normal with mean -0.139 and standard deviation 0.78.	One-Sample Kolmogorov-Smirnov Test	.810	Retain the null hypothesis.
43	The distribution of Ch45.1BA is normal with mean -0.310 and standard deviation 1.38.	One-Sample Kolmogorov-Smirnov Test	.050	Reject the null hypothesis.
44	The distribution of Ch46.1BA is normal with mean 0.138 and standard deviation 0.56.	One-Sample Kolmogorov-Smirnov Test	.361	Retain the null hypothesis.
45	The distribution of Ch47.1BA is normal with mean 0.050 and standard deviation 0.40.	One-Sample Kolmogorov-Smirnov Test	.552	Retain the null hypothesis.
46	The distribution of Ch48.1BA is normal with mean 0.031 and standard deviation 0.35.	One-Sample Kolmogorov-Smirnov Test	.664	Retain the null hypothesis.
47	The distribution of Ch49.1BA is normal with mean 0.029 and standard deviation 0.40.	One-Sample Kolmogorov-Smirnov Test	.941	Retain the null hypothesis.
48	The distribution of Ch50.1BA is normal with mean -0.068 and standard deviation 0.87.	One-Sample Kolmogorov-Smirnov Test	.299	Retain the null hypothesis.
49	The distribution of Ch51.1BA is normal with mean -0.183 and standard deviation 1.02.	One-Sample Kolmogorov-Smirnov Test	.857	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
50	The distribution of Ch52.1BA is normal with mean -0.058 and standard deviation 1.13.	One-Sample Kolmogorov-Smirnov Test	.434	Retain the null hypothesis.
51	The distribution of Ch1.2BA is normal with mean 0.003 and standard deviation 0.60.	One-Sample Kolmogorov-Smirnov Test	.114	Retain the null hypothesis.
52	The distribution of Ch2.2BA is normal with mean 0.109 and standard deviation 0.36.	One-Sample Kolmogorov-Smirnov Test	.979	Retain the null hypothesis.
53	The distribution of Ch3.2BA is normal with mean 0.097 and standard deviation 0.27.	One-Sample Kolmogorov-Smirnov Test	.997	Retain the null hypothesis.
54	The distribution of Ch4.2BA is normal with mean 0.032 and standard deviation 0.40.	One-Sample Kolmogorov-Smirnov Test	.929	Retain the null hypothesis.
55	The distribution of Ch5.2BA is normal with mean 0.115 and standard deviation 0.25.	One-Sample Kolmogorov-Smirnov Test	.779	Retain the null hypothesis.
56	The distribution of Ch6.2BA is normal with mean 0.211 and standard deviation 0.45.	One-Sample Kolmogorov-Smirnov Test	.650	Retain the null hypothesis.
57	The distribution of Ch7.2BA is normal with mean -0.161 and standard deviation 0.90.	One-Sample Kolmogorov-Smirnov Test	.187	Retain the null hypothesis.
58	The distribution of Ch8.2BA is normal with mean 0.131 and standard deviation 0.24.	One-Sample Kolmogorov-Smirnov Test	.792	Retain the null hypothesis.
59	The distribution of Ch9.2BA is normal with mean 0.029 and standard deviation 0.43.	One-Sample Kolmogorov-Smirnov Test	.519	Retain the null hypothesis.
60	The distribution of Ch10.2BA is normal with mean -0.027 and standard deviation 1.10.	One-Sample Kolmogorov-Smirnov Test	.053	Retain the null hypothesis.
61	The distribution of Ch11.2BA is normal with mean 0.176 and standard deviation 0.52.	One-Sample Kolmogorov-Smirnov Test	.933	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
62	The distribution of Ch12.2BA is normal with mean -0.122 and standard deviation 0.51.	One-Sample Kolmogorov-Smirnov Test	.992	Retain the null hypothesis.
63	The distribution of Ch13.2BA is normal with mean 0.085 and standard deviation 0.41.	One-Sample Kolmogorov-Smirnov Test	.475	Retain the null hypothesis.
64	The distribution of Ch14.2BA is normal with mean 0.212 and standard deviation 0.26.	One-Sample Kolmogorov-Smirnov Test	.896	Retain the null hypothesis.
65	The distribution of Ch15.2BA is normal with mean -0.018 and standard deviation 0.56.	One-Sample Kolmogorov-Smirnov Test	.318	Retain the null hypothesis.
66	The distribution of Ch16.2BA is normal with mean 0.181 and standard deviation 0.19.	One-Sample Kolmogorov-Smirnov Test	.946	Retain the null hypothesis.
67	The distribution of Ch17.2BA is normal with mean 0.083 and standard deviation 0.41.	One-Sample Kolmogorov-Smirnov Test	.858	Retain the null hypothesis.
68	The distribution of Ch18.2BA is normal with mean 0.184 and standard deviation 0.39.	One-Sample Kolmogorov-Smirnov Test	.361	Retain the null hypothesis.
69	The distribution of Ch19.2BA is normal with mean -0.307 and standard deviation 1.83.	One-Sample Kolmogorov-Smirnov Test	.016	Reject the null hypothesis.
70	The distribution of Ch22.2BA is normal with mean -0.844 and standard deviation 2.10.	One-Sample Kolmogorov-Smirnov Test	.083	Retain the null hypothesis.
71	The distribution of Ch23.2BA is normal with mean -0.442 and standard deviation 1.50.	One-Sample Kolmogorov-Smirnov Test	.210	Retain the null hypothesis.
72	The distribution of Ch24.2BA is normal with mean 0.279 and standard deviation 0.24.	One-Sample Kolmogorov-Smirnov Test	.998	Retain the null hypothesis.
73	The distribution of Ch25.2BA is normal with mean 0.125 and standard deviation 0.59.	One-Sample Kolmogorov-Smirnov Test	.579	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
74	The distribution of Ch26.2BA is normal with mean 0.143 and standard deviation 0.15.	One-Sample Kolmogorov-Smirnov Test	.787	Retain the null hypothesis.
75	The distribution of Ch27.2BA is normal with mean 0.010 and standard deviation 0.44.	One-Sample Kolmogorov-Smirnov Test	.181	Retain the null hypothesis.
76	The distribution of Ch28.2BA is normal with mean 0.100 and standard deviation 0.25.	One-Sample Kolmogorov-Smirnov Test	.643	Retain the null hypothesis.
77	The distribution of Ch29.2BA is normal with mean -0.132 and standard deviation 1.45.	One-Sample Kolmogorov-Smirnov Test	.021	Reject the null hypothesis.
78	The distribution of Ch30.2BA is normal with mean -1.075 and standard deviation 3.55.	One-Sample Kolmogorov-Smirnov Test	.042	Reject the null hypothesis.
79	The distribution of Ch31.2BA is normal with mean -0.761 and standard deviation 2.45.	One-Sample Kolmogorov-Smirnov Test	.030	Reject the null hypothesis.
80	The distribution of Ch32.2BA is normal with mean -0.899 and standard deviation 3.24.	One-Sample Kolmogorov-Smirnov Test	.043	Reject the null hypothesis.
81	The distribution of Ch33.2BA is normal with mean -1.427 and standard deviation 3.34.	One-Sample Kolmogorov-Smirnov Test	.094	Retain the null hypothesis.
82	The distribution of Ch34.2BA is normal with mean -0.217 and standard deviation 0.87.	One-Sample Kolmogorov-Smirnov Test	.273	Retain the null hypothesis.
83	The distribution of Ch35.2BA is normal with mean 0.087 and standard deviation 0.58.	One-Sample Kolmogorov-Smirnov Test	.763	Retain the null hypothesis.
84	The distribution of Ch36.2BA is normal with mean 0.031 and standard deviation 0.50.	One-Sample Kolmogorov-Smirnov Test	.319	Retain the null hypothesis.
85	The distribution of Ch37.2BA is normal with mean -0.121 and standard deviation 0.35.	One-Sample Kolmogorov-Smirnov Test	.649	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
86	The distribution of Ch38.2BA is normal with mean -0.064 and standard deviation 0.60.	One-Sample Kolmogorov-Smirnov Test	.564	Retain the null hypothesis.
87	The distribution of Ch39.2BA is normal with mean 0.179 and standard deviation 0.30.	One-Sample Kolmogorov-Smirnov Test	.753	Retain the null hypothesis.
88	The distribution of Ch40.2BA is normal with mean -0.909 and standard deviation 2.82.	One-Sample Kolmogorov-Smirnov Test	.141	Retain the null hypothesis.
89	The distribution of Ch41.2BA is normal with mean -1.321 and standard deviation 3.67.	One-Sample Kolmogorov-Smirnov Test	.063	Retain the null hypothesis.
90	The distribution of Ch42.2BA is normal with mean -1.069 and standard deviation 3.48.	One-Sample Kolmogorov-Smirnov Test	.040	Reject the null hypothesis.
91	The distribution of Ch43.2BA is normal with mean -1.710 and standard deviation 3.95.	One-Sample Kolmogorov-Smirnov Test	.123	Retain the null hypothesis.
92	The distribution of Ch44.2BA is normal with mean -1.456 and standard deviation 3.52.	One-Sample Kolmogorov-Smirnov Test	.055	Retain the null hypothesis.
93	The distribution of Ch45.2BA is normal with mean -0.059 and standard deviation 0.72.	One-Sample Kolmogorov-Smirnov Test	.134	Retain the null hypothesis.
94	The distribution of Ch46.2BA is normal with mean -0.083 and standard deviation 0.80.	One-Sample Kolmogorov-Smirnov Test	.343	Retain the null hypothesis.
95	The distribution of Ch47.2BA is normal with mean 0.011 and standard deviation 0.41.	One-Sample Kolmogorov-Smirnov Test	.584	Retain the null hypothesis.
96	The distribution of Ch48.2BA is normal with mean -0.078 and standard deviation 0.81.	One-Sample Kolmogorov-Smirnov Test	.078	Retain the null hypothesis.
97	The distribution of Ch49.2BA is normal with mean 0.117 and standard deviation 0.44.	One-Sample Kolmogorov-Smirnov Test	.519	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
98	The distribution of Ch50.2BA is normal with mean -0.338 and standard deviation 1.48.	One-Sample Kolmogorov-Smirnov Test	.050	Reject the null hypothesis.
99	The distribution of Ch51.2BA is normal with mean -1.040 and standard deviation 3.43.	One-Sample Kolmogorov-Smirnov Test	.060	Retain the null hypothesis.
100	The distribution of Ch52.2BA is normal with mean -1.086 and standard deviation 3.34.	One-Sample Kolmogorov-Smirnov Test	.053	Retain the null hypothesis.
101	The distribution of Ch1.3BA is normal with mean 0.053 and standard deviation 0.24.	One-Sample Kolmogorov-Smirnov Test	.768	Retain the null hypothesis.
102	The distribution of Ch2.3BA is normal with mean 0.008 and standard deviation 0.47.	One-Sample Kolmogorov-Smirnov Test	.515	Retain the null hypothesis.
103	The distribution of Ch3.3BA is normal with mean 0.020 and standard deviation 0.41.	One-Sample Kolmogorov-Smirnov Test	.602	Retain the null hypothesis.
104	The distribution of Ch4.3BA is normal with mean 0.014 and standard deviation 0.17.	One-Sample Kolmogorov-Smirnov Test	1.000	Retain the null hypothesis.
105	The distribution of Ch5.3BA is normal with mean -0.002 and standard deviation 0.16.	One-Sample Kolmogorov-Smirnov Test	.654	Retain the null hypothesis.
106	The distribution of Ch6.3BA is normal with mean 0.013 and standard deviation 0.12.	One-Sample Kolmogorov-Smirnov Test	.962	Retain the null hypothesis.
107	The distribution of Ch7.3BA is normal with mean 0.026 and standard deviation 0.21.	One-Sample Kolmogorov-Smirnov Test	.920	Retain the null hypothesis.
108	The distribution of Ch8.3BA is normal with mean 0.056 and standard deviation 0.46.	One-Sample Kolmogorov-Smirnov Test	.607	Retain the null hypothesis.
109	The distribution of Ch9.3BA is normal with mean -0.095 and standard deviation 0.46.	One-Sample Kolmogorov-Smirnov Test	.235	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
110	The distribution of Ch10.3BA is normal with mean 0.086 and standard deviation 0.21.	One-Sample Kolmogorov-Smirnov Test	.903	Retain the null hypothesis.
111	The distribution of Ch11.3BA is normal with mean 0.083 and standard deviation 0.40.	One-Sample Kolmogorov-Smirnov Test	.951	Retain the null hypothesis.
112	The distribution of Ch12.3BA is normal with mean -0.176 and standard deviation 0.64.	One-Sample Kolmogorov-Smirnov Test	.517	Retain the null hypothesis.
113	The distribution of Ch13.3BA is normal with mean 0.023 and standard deviation 0.34.	One-Sample Kolmogorov-Smirnov Test	.963	Retain the null hypothesis.
114	The distribution of Ch14.3BA is normal with mean 0.058 and standard deviation 0.21.	One-Sample Kolmogorov-Smirnov Test	.896	Retain the null hypothesis.
115	The distribution of Ch15.3BA is normal with mean 0.017 and standard deviation 0.24.	One-Sample Kolmogorov-Smirnov Test	.403	Retain the null hypothesis.
116	The distribution of Ch16.3BA is normal with mean 0.097 and standard deviation 0.15.	One-Sample Kolmogorov-Smirnov Test	.988	Retain the null hypothesis.
117	The distribution of Ch17.3BA is normal with mean 0.028 and standard deviation 0.43.	One-Sample Kolmogorov-Smirnov Test	.580	Retain the null hypothesis.
118	The distribution of Ch18.3BA is normal with mean -0.118 and standard deviation 0.55.	One-Sample Kolmogorov-Smirnov Test	.064	Retain the null hypothesis.
119	The distribution of Ch19.3BA is normal with mean 0.029 and standard deviation 0.20.	One-Sample Kolmogorov-Smirnov Test	.291	Retain the null hypothesis.
120	The distribution of Ch22.3BA is normal with mean -0.029 and standard deviation 0.80.	One-Sample Kolmogorov-Smirnov Test	.970	Retain the null hypothesis.
121	The distribution of Ch23.3BA is normal with mean -0.125 and standard deviation 0.80.	One-Sample Kolmogorov-Smirnov Test	.792	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
122	The distribution of Ch24.3BA is normal with mean 0.012 and standard deviation 0.34.	One-Sample Kolmogorov-Smirnov Test	.486	Retain the null hypothesis.
123	The distribution of Ch25.3BA is normal with mean 0.126 and standard deviation 0.27.	One-Sample Kolmogorov-Smirnov Test	.988	Retain the null hypothesis.
124	The distribution of Ch26.3BA is normal with mean 0.061 and standard deviation 0.28.	One-Sample Kolmogorov-Smirnov Test	.638	Retain the null hypothesis.
125	The distribution of Ch27.3BA is normal with mean 0.167 and standard deviation 0.32.	One-Sample Kolmogorov-Smirnov Test	.296	Retain the null hypothesis.
126	The distribution of Ch28.3BA is normal with mean 0.012 and standard deviation 0.40.	One-Sample Kolmogorov-Smirnov Test	.717	Retain the null hypothesis.
127	The distribution of Ch29.3BA is normal with mean -0.122 and standard deviation 0.47.	One-Sample Kolmogorov-Smirnov Test	.217	Retain the null hypothesis.
128	The distribution of Ch30.3BA is normal with mean 0.003 and standard deviation 0.41.	One-Sample Kolmogorov-Smirnov Test	.769	Retain the null hypothesis.
129	The distribution of Ch31.3BA is normal with mean 0.011 and standard deviation 0.37.	One-Sample Kolmogorov-Smirnov Test	.980	Retain the null hypothesis.
130	The distribution of Ch32.3BA is normal with mean 0.286 and standard deviation 0.35.	One-Sample Kolmogorov-Smirnov Test	.493	Retain the null hypothesis.
131	The distribution of Ch33.3BA is normal with mean -0.397 and standard deviation 1.54.	One-Sample Kolmogorov-Smirnov Test	.124	Retain the null hypothesis.
132	The distribution of Ch34.3BA is normal with mean 0.026 and standard deviation 0.56.	One-Sample Kolmogorov-Smirnov Test	.431	Retain the null hypothesis.
133	The distribution of Ch35.3BA is normal with mean 0.180 and standard deviation 0.40.	One-Sample Kolmogorov-Smirnov Test	.954	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
134	The distribution of Ch36.3BA is normal with mean 0.119 and standard deviation 0.17.	One-Sample Kolmogorov-Smirnov Test	.973	Retain the null hypothesis.
135	The distribution of Ch37.3BA is normal with mean 0.035 and standard deviation 0.20.	One-Sample Kolmogorov-Smirnov Test	.766	Retain the null hypothesis.
136	The distribution of Ch38.3BA is normal with mean 0.019 and standard deviation 0.35.	One-Sample Kolmogorov-Smirnov Test	.423	Retain the null hypothesis.
137	The distribution of Ch39.3BA is normal with mean 0.017 and standard deviation 0.48.	One-Sample Kolmogorov-Smirnov Test	.666	Retain the null hypothesis.
138	The distribution of Ch40.3BA is normal with mean -0.189 and standard deviation 0.72.	One-Sample Kolmogorov-Smirnov Test	.499	Retain the null hypothesis.
139	The distribution of Ch41.3BA is normal with mean -0.084 and standard deviation 0.75.	One-Sample Kolmogorov-Smirnov Test	.270	Retain the null hypothesis.
140	The distribution of Ch42.3BA is normal with mean 0.111 and standard deviation 0.41.	One-Sample Kolmogorov-Smirnov Test	.743	Retain the null hypothesis.
141	The distribution of Ch43.3BA is normal with mean -0.056 and standard deviation 1.47.	One-Sample Kolmogorov-Smirnov Test	.294	Retain the null hypothesis.
142	The distribution of Ch44.3BA is normal with mean 0.045 and standard deviation 1.04.	One-Sample Kolmogorov-Smirnov Test	.591	Retain the null hypothesis.
143	The distribution of Ch45.3BA is normal with mean 0.283 and standard deviation 0.34.	One-Sample Kolmogorov-Smirnov Test	.933	Retain the null hypothesis.
144	The distribution of Ch46.3BA is normal with mean 0.221 and standard deviation 0.41.	One-Sample Kolmogorov-Smirnov Test	.832	Retain the null hypothesis.
145	The distribution of Ch47.3BA is normal with mean 0.092 and standard deviation 0.26.	One-Sample Kolmogorov-Smirnov Test	.700	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
146	The distribution of Ch48.3BA is normal with mean 0.130 and standard deviation 0.16.	One-Sample Kolmogorov-Smirnov Test	.591	Retain the null hypothesis.
147	The distribution of Ch49.3BA is normal with mean 0.104 and standard deviation 0.40.	One-Sample Kolmogorov-Smirnov Test	.475	Retain the null hypothesis.
148	The distribution of Ch50.3BA is normal with mean -0.014 and standard deviation 0.54.	One-Sample Kolmogorov-Smirnov Test	.345	Retain the null hypothesis.
149	The distribution of Ch51.3BA is normal with mean -0.444 and standard deviation 1.25.	One-Sample Kolmogorov-Smirnov Test	.086	Retain the null hypothesis.
150	The distribution of Ch52.3BA is normal with mean -0.092 and standard deviation 0.97.	One-Sample Kolmogorov-Smirnov Test	.278	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Appendix D

Channel-wise Statistics

Intraclass Correlation for all six of Shrout and Fleiss models are given below as calculated in Matlab. These values were compared to SPSS as suggested by Wong and the values are equivalent. A channel and task shaded in yellow indicates that the data for that task and channel for at least one session failed the Kolmogorov-Smirnov test (Appendix C.) Yellow entries for ANOVA indicate a significance of 90% or greater chance of an interaction effect across sessions. A red line around the ANOVA cell indicates there is greater than a 95% chance of an interaction effect across sessions. For ICC calculations a red cell indicates values between 0.3 and 0.5, yellow indicates between 0.5 and 0.7 and green indicates values greater than 0.7. For one-sample t-test values those showing 90% to 95% probability of a significant positive or negative values (as indicated by the t-value), while green indicates a 95% or greater probability. ICC (1,1) and (1,k) refer to one-way random effects analysis, (2,1) and (2,k) refer to two-way random effects analysis with absolute agreement, while (3,1) and (3,k) refer to two-way mixed effect analysis with consistency.

			Intraclass Correlation						One-sample	
Ch	Task	ANOVA	(1,1)	(2,1)	(3,1)	(1,k)	(2,k)	(3,k)	t-value	p-value
1	A	0.203	0.042	0.058	0.062	0.115	0.157	0.165	1.573	0.124
2	A	0.077	-0.187	-0.127	-0.150	-0.898	-0.509	-0.641	0.540	0.592
3	A	0.274	-0.090	-0.079	-0.081	-0.331	-0.280	-0.291	1.121	0.269
4	A	0.101	-0.068	-0.026	-0.030	-0.236	-0.083	-0.095	1.482	0.146
5	A	0.14	-0.085	-0.052	-0.057	-0.309	-0.174	-0.194	1.506	0.140
6	A	0.131	0.122	0.146	0.158	0.295	0.338	0.361	0.671	0.506
7	A	0.971	-0.122	-0.160	-0.145	-0.485	-0.708	-0.616	-0.533	0.597
8	A	0.141	-0.052	-0.021	-0.023	-0.173	-0.064	-0.071	-0.368	0.715
9	A	0.613	0.305	0.297	0.289	0.568	0.560	0.549	1.871	0.069
10	A	0.788	0.238	0.225	0.213	0.484	0.465	0.449	5.196	0.000
11	A	0.594	0.101	0.090	0.087	0.252	0.228	0.221	0.801	0.428
12	A	0.448	0.249	0.246	0.244	0.498	0.495	0.491	-0.329	0.744
13	A	0.424	-0.109	-0.113	-0.112	-0.418	-0.436	-0.431	2.219	0.032
14	A	0.287	-0.064	-0.055	-0.056	-0.222	-0.184	-0.190	0.972	0.337
15	A	0.311	0.283	0.286	0.290	0.542	0.546	0.550	3.061	0.004
16	A	0.06	0.338	0.360	0.400	0.605	0.628	0.667	2.024	0.050
17	A	0.373	-0.065	-0.064	-0.064	-0.225	-0.221	-0.222	1.862	0.070
18	A	0.245	-0.242	-0.222	-0.233	-1.410	-1.199	-1.314	0.947	0.350
19	A	0.816	-0.052	-0.079	-0.073	-0.175	-0.282	-0.258	-0.363	0.718
22	A	0.675	0.186	0.175	0.167	0.407	0.388	0.376	-0.363	0.719

23	A	0.693	0.287	0.277	0.267	0.547	0.535	0.522	0.703	0.487
24	A	0.155	0.030	0.054	0.058	0.084	0.146	0.157	1.961	0.057
25	A	0.571	0.173	0.165	0.160	0.386	0.372	0.363	2.074	0.045
26	A	0.702	0.428	0.422	0.408	0.692	0.686	0.674	1.797	0.080
27	A	0.678	0.199	0.188	0.180	0.427	0.410	0.397	2.580	0.014
28	A	0.295	-0.010	-0.002	-0.002	-0.030	-0.005	-0.005	1.550	0.129
29	A	0.441	-0.044	-0.048	-0.048	-0.143	-0.160	-0.157	0.625	0.536
30	A	0.422	0.165	0.163	0.162	0.373	0.369	0.367	1.724	0.093
31	A	0.005	0.459	0.489	0.585	0.718	0.742	0.809	4.155	0.000
32	A	0.083	0.571	0.578	0.612	0.800	0.805	0.826	1.140	0.261
33	A	0.553	0.237	0.231	0.225	0.483	0.474	0.465	-0.613	0.543
34	A	0.855	0.263	0.249	0.235	0.517	0.498	0.480	1.760	0.086
35	A	0.759	-0.003	-0.025	-0.023	-0.009	-0.079	-0.074	1.242	0.222
36	A	0.285	0.316	0.320	0.326	0.581	0.586	0.592	-0.547	0.588
37	A	0.583	0.199	0.190	0.184	0.426	0.413	0.404	0.633	0.530
38	A	0.213	0.169	0.181	0.189	0.379	0.398	0.411	1.564	0.126
39	A	0.115	0.245	0.264	0.286	0.494	0.519	0.546	-0.532	0.598
40	A	0.214	-0.053	-0.034	-0.036	-0.179	-0.111	-0.117	0.799	0.429
41	A	0.401	0.306	0.305	0.304	0.569	0.568	0.568	1.207	0.235
42	A	0.009	0.207	0.263	0.334	0.440	0.518	0.601	7.140	0.000
43	A	0.068	0.492	0.505	0.544	0.744	0.754	0.782	0.199	0.843
44	A	0.213	0.080	0.095	0.099	0.207	0.239	0.248	1.079	0.287
45	A	0.488	0.490	0.488	0.483	0.743	0.741	0.737	1.809	0.078
46	A	0.482	0.002	-0.005	-0.005	0.005	-0.016	-0.015	0.020	0.984
47	A	0.297	0.012	0.020	0.020	0.036	0.057	0.058	-0.279	0.782
48	A	0.167	0.117	0.136	0.145	0.285	0.320	0.337	-0.146	0.885
49	A	0.096	0.014	0.051	0.058	0.042	0.139	0.155	-0.069	0.945
50	A	0.44	0.047	0.043	0.043	0.129	0.119	0.118	0.075	0.941
51	A	0.528	0.071	0.062	0.061	0.186	0.166	0.162	2.427	0.020
52	A	0.694	0.602	0.599	0.586	0.819	0.818	0.809	3.920	0.000
1	B	0.449	-0.047	-0.053	-0.052	-0.157	-0.176	-0.173	2.208	0.033
2	B	0.951	0.140	0.119	0.110	0.329	0.288	0.271	1.496	0.143
3	B	0.982	-0.053	-0.087	-0.080	-0.179	-0.318	-0.285	1.962	0.057
4	B	0.575	0.253	0.246	0.239	0.504	0.494	0.485	1.740	0.090
5	B	0.768	0.094	0.076	0.072	0.238	0.198	0.188	0.449	0.656
6	B	0.785	0.295	0.284	0.271	0.557	0.543	0.527	0.905	0.371
7	B	0.567	0.212	0.204	0.199	0.446	0.435	0.426	-1.017	0.315
8	B	0.834	0.032	0.009	0.008	0.090	0.025	0.024	-0.473	0.639
9	B	0.837	0.056	0.033	0.031	0.150	0.094	0.088	1.139	0.262
10	B	0.666	0.063	0.048	0.045	0.167	0.130	0.125	5.975	0.000

11	B	0.718	-0.233	-0.264	-0.246	-1.312	-1.674	-1.447	3.002	0.005
12	B	0.679	0.530	0.526	0.513	0.772	0.769	0.759	0.352	0.726
13	B	0.754	0.303	0.292	0.280	0.566	0.553	0.538	3.098	0.004
14	B	0.421	0.084	0.082	0.081	0.216	0.210	0.209	2.975	0.005
15	B	0.225	0.486	0.490	0.502	0.739	0.742	0.752	3.187	0.003
16	B	0.934	0.431	0.126	0.406	0.694	0.301	0.672	2.852	0.007
17	B	0.055	0.351	0.373	0.415	0.618	0.641	0.680	3.511	0.001
18	B	0.196	0.084	0.100	0.106	0.215	0.250	0.262	1.817	0.077
19	B	0.631	0.022	0.007	0.007	0.064	0.021	0.020	0.791	0.434
22	B	0.772	0.360	0.351	0.336	0.628	0.618	0.603	0.918	0.364
23	B	0.88	0.249	0.234	0.221	0.499	0.479	0.460	1.412	0.166
24	B	0.168	-0.206	-0.172	-0.188	-1.053	-0.787	-0.904	5.244	0.000
25	B	0.372	0.561	0.561	0.562	0.793	0.793	0.794	3.989	0.000
26	B	0.715	0.460	0.454	0.440	0.719	0.714	0.702	4.081	0.000
27	B	0.163	0.521	0.527	0.546	0.765	0.769	0.783	4.946	0.000
28	B	0.106	0.480	0.490	0.519	0.735	0.742	0.764	3.525	0.001
29	B	0.243	0.059	0.071	0.074	0.158	0.186	0.192	2.397	0.021
30	B	0.622	0.038	0.023	0.022	0.105	0.067	0.064	2.003	0.052
31	B	0.921	0.206	0.189	0.177	0.438	0.411	0.392	4.367	0.000
32	B	0.799	0.459	0.452	0.436	0.718	0.712	0.698	2.606	0.013
33	B	0.732	0.213	0.200	0.191	0.448	0.429	0.414	-0.247	0.806
34	B	0.356	0.379	0.380	0.382	0.647	0.648	0.649	2.605	0.013
35	B	0.407	0.094	0.092	0.092	0.237	0.234	0.233	3.993	0.000
36	B	0.063	0.500	0.379	0.564	0.750	0.647	0.795	2.327	0.025
37	B	0.286	0.258	0.262	0.268	0.510	0.516	0.523	1.744	0.089
38	B	0.179	0.480	0.486	0.503	0.734	0.739	0.752	3.181	0.003
39	B	0.475	0.530	0.529	0.524	0.772	0.771	0.767	1.901	0.065
40	B	0.826	0.008	-0.016	-0.015	0.024	-0.050	-0.047	0.683	0.498
41	B	0.56	0.044	0.033	0.032	0.122	0.094	0.091	0.817	0.419
42	B	0.461	0.335	0.333	0.329	0.602	0.599	0.596	7.405	0.000
43	B	0.687	0.165	0.152	0.145	0.371	0.349	0.337	0.247	0.806
44	B	0.806	0.210	0.195	0.185	0.444	0.421	0.405	0.591	0.558
45	B	0.388	-0.057	-0.057	-0.057	-0.192	-0.193	-0.193	4.268	0.000
46	B	0.102	0.262	0.282	0.307	0.516	0.541	0.571	2.959	0.005
47	B	0.206	0.266	0.276	0.287	0.521	0.533	0.547	1.424	0.162
48	B	0.015	0.385	0.416	0.488	0.653	0.681	0.741	2.996	0.005
49	B	0.616	0.557	0.555	0.544	0.791	0.789	0.782	2.787	0.008
50	B	0.87	-0.047	-0.076	-0.070	-0.156	-0.269	-0.245	1.627	0.112
51	B	0.791	0.010	-0.013	-0.012	0.030	-0.039	-0.036	1.358	0.182
52	B	0.981	0.085	0.060	0.055	0.219	0.160	0.149	3.212	0.003

1	B-A	0.959	0.102	0.078	0.073	0.255	0.203	0.190	0.272	0.787
2	B-A	0.68	-0.137	-0.160	-0.151	-0.566	-0.709	-0.650	0.665	0.510
3	B-A	0.833	-0.340	-0.386	-0.350	-3.200	-5.506	-3.507	1.081	0.286
4	B-A	0.957	0.354	0.342	0.324	0.622	0.609	0.589	0.737	0.465
5	B-A	0.212	0.270	0.279	0.290	0.525	0.537	0.550	-0.005	0.996
6	B-A	0.296	0.297	0.301	0.306	0.559	0.564	0.570	1.326	0.192
7	B-A	0.504	-0.011	-0.020	-0.019	-0.034	-0.061	-0.059	-1.308	0.199
8	B-A	0.233	-0.159	-0.139	-0.147	-0.697	-0.578	-0.622	-0.869	0.390
9	B-A	0.578	-0.211	-0.230	-0.220	-1.095	-1.275	-1.174	-0.886	0.381
10	B-A	0.923	0.028	0.001	0.001	0.080	0.004	0.004	0.521	0.605
11	B-A	0.941	0.024	-0.004	-0.003	0.069	-0.011	-0.010	1.218	0.231
12	B-A	0.772	0.116	0.099	0.094	0.283	0.248	0.236	-1.135	0.263
13	B-A	0.737	0.031	0.012	0.011	0.088	0.034	0.032	0.393	0.696
14	B-A	0.506	-0.027	-0.036	-0.035	-0.086	-0.117	-0.114	2.068	0.045
15	B-A	0.384	0.096	0.096	0.096	0.241	0.241	0.241	0.636	0.528
16	B-A	0.141	0.061	0.085	0.093	0.162	0.219	0.235	2.268	0.029
17	B-A	0.754	0.326	0.316	0.303	0.592	0.581	0.566	1.187	0.242
18	B-A	0.371	-0.042	-0.041	-0.041	-0.137	-0.133	-0.133	-0.170	0.866
19	B-A	0.802	-0.070	-0.097	-0.090	-0.245	-0.362	-0.331	-0.711	0.481
22	B-A	0.147	0.034	0.060	0.065	0.096	0.160	0.172	-1.039	0.305
23	B-A	0.736	-0.032	-0.054	-0.050	-0.101	-0.180	-0.168	-1.314	0.197
24	B-A	0.209	-0.069	-0.048	-0.051	-0.239	-0.161	-0.172	2.460	0.018
25	B-A	0.946	0.243	0.226	0.212	0.491	0.468	0.447	1.891	0.066
26	B-A	0.463	0.438	0.437	0.432	0.701	0.699	0.696	3.199	0.003
27	B-A	0.165	0.383	0.392	0.411	0.651	0.659	0.676	2.279	0.028
28	B-A	0.622	0.345	0.338	0.329	0.612	0.605	0.595	1.325	0.193
29	B-A	0.756	-0.051	-0.075	-0.071	-0.172	-0.266	-0.246	-0.412	0.683
30	B-A	0.338	-0.052	-0.047	-0.048	-0.173	-0.157	-0.159	-0.903	0.372
31	B-A	0.251	-0.045	-0.032	-0.033	-0.149	-0.101	-0.105	-0.629	0.533
32	B-A	0.298	-0.073	-0.064	-0.066	-0.255	-0.220	-0.226	-0.629	0.533
33	B-A	0.231	-0.044	-0.028	-0.029	-0.145	-0.088	-0.093	-1.664	0.104
34	B-A	0.631	0.143	0.132	0.127	0.334	0.313	0.303	-1.060	0.296
35	B-A	0.762	0.069	0.050	0.047	0.182	0.137	0.130	1.056	0.298
36	B-A	0.218	-0.209	-0.185	-0.197	-1.081	-0.884	-0.976	2.674	0.011
37	B-A	0.114	0.117	0.143	0.157	0.284	0.334	0.359	0.359	0.722
38	B-A	0.6	0.206	0.198	0.191	0.438	0.425	0.415	0.405	0.688
39	B-A	0.525	0.230	0.224	0.219	0.472	0.464	0.457	1.358	0.182
40	B-A	0.531	-0.133	-0.146	-0.141	-0.544	-0.618	-0.590	-1.514	0.138
41	B-A	0.33	-0.087	-0.082	-0.083	-0.317	-0.293	-0.299	-1.485	0.146
42	B-A	0.295	-0.066	-0.057	-0.059	-0.229	-0.194	-0.200	-0.756	0.454

43	B-A	0.181	-0.149	-0.121	-0.130	-0.637	-0.478	-0.529	-1.373	0.178
44	B-A	0.214	-0.090	-0.070	-0.074	-0.328	-0.243	-0.259	-1.463	0.151
45	B-A	0.291	-0.031	-0.022	-0.022	-0.098	-0.069	-0.071	-0.240	0.812
46	B-A	0.436	-0.007	-0.011	-0.011	-0.021	-0.033	-0.033	0.976	0.335
47	B-A	0.781	0.218	0.204	0.194	0.455	0.434	0.419	0.908	0.369
48	B-A	0.502	0.076	0.069	0.068	0.199	0.183	0.179	0.344	0.732
49	B-A	0.935	0.240	0.223	0.209	0.486	0.463	0.443	1.278	0.209
50	B-A	0.707	-0.132	-0.157	-0.147	-0.537	-0.685	-0.625	-0.858	0.396
51	B-A	0.674	-0.124	-0.146	-0.138	-0.493	-0.620	-0.571	-1.613	0.115
52	B-A	0.474	-0.094	-0.102	-0.100	-0.348	-0.384	-0.374	-1.218	0.231

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Biographical Information

Matthew Allen Cloud graduated from Texas A & M University in 1996 with a Bachelor of Science in Radiological Health Engineering. He built a software consulting firm over 12 years beginning with clients of the University of Texas at Houston Health Science Center and the US Navy which broadened into real estate and business analysis. From 2007 to 2008, his immediate family encountered a series of health issues including epilepsy, spinal injury, sensory dysfunction, Down Syndrome, and stroke. These issues turned focused his energy back towards a way to improve healthcare. Desirous of a way to combine software analysis with assessing brain function, he met with Dr. Hanli Liu about her work in fNIRS at the University of Texas at Arlington. He formally entered the Bioengineering graduate program in the Fall of 2010 as well as one of Dr. Liu's Graduate Research Assistants. From 2011 to 2013 he worked as a Research Assistant to Dr. Patrick Plenger at Pate Rehabilitation to specifically analyze the three years of data they had taken on post-acute patients using fNIRS. With their support and guidance he presented their work on the potential to impact stroke and traumatic brain injured patients, nationally and internationally. He plans to continue to apply software techniques and analysis that will aid clinical practitioners with ways to easily and effectively use functional imaging to guide patient care.