# FULLY AUTOMATED DATA ANALYSIS PIPELINE

The COGNISION® data analysis pipeline can be pre-specified to automatically perform all necessary data cleaning, preprocessing, artifact correction, and feature extraction. The resultant data can then be viewed in the application, piped into the Pharmaco-Statistics Dashboard, or output to a preformatted Patient Report to document the clinical effort.
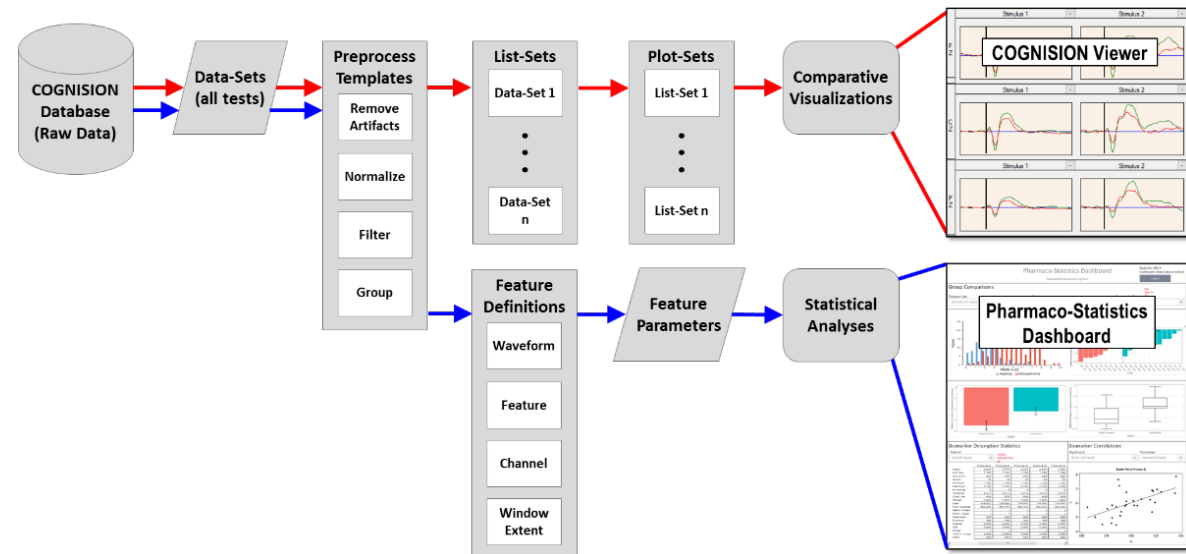
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EVENT RELATED POTENTIALS & QUANTITATIVE EEG

For the evaluation of cognitive function

The hallmark of brain function is synchronized electrical activity which can be measured using event-related potential (ERP) and quantitative EEG (QEEG) techniques.

While many central nervous system (CNS) disorders, and drugs to treat those disorders, can be studied by analyzing ERP and QEEG signals, these signals are small, difficult to measure, and require sophisticated analytical methods to make sense of the measurements.

COGNISION® was developed to simplify this process and bring this powerful biomarker technology to clinicians who treat CNS patients and drug developers trialing new therapies for these disorders.

# THE COGNISION® SYSTEM SPECIFICATIONS

Recent scientific studies using complex ERP/QEEP techniques have detected brainwave signatures for many neurological processes. These scientific advances have now been translated into an easy-to-use system to rapidly test and evaluate these signals in patients and clinical study subjects. The COGNISION® System automatically performs a selection of standardized ERP/QEEG tests, and then uses proprietary AI algorithms to quangify the subject's brainwave signatures.

Advanced features include:

- Wireless, battery-powered system for use in an office environment
- Subject-friendly headset fits a large range of head sizes
- Calibrated insert earphones ensure consistent auditory stimuli
- Active electrodes provide high SNR and fewer artifacts
- Integrated action buttons for subject responses
- Convenient Hydro-Dot® Biosensors are easy to apply and deliver very low skin contact impedance

Technical Specifications:

- Channels: Fz, Cz, Pz, F3, P3, F4, P4, M1, M2
- Sampling Rate: 250 samples/sec
- Band Pass: 0.3 - 70Hz
- CMRR (50/60 Hz): >130 dB
- Noise (RTI): <1 μV_{RMS}
- Power: Li-ion Battery
- Data Commnunication: Bluetooth
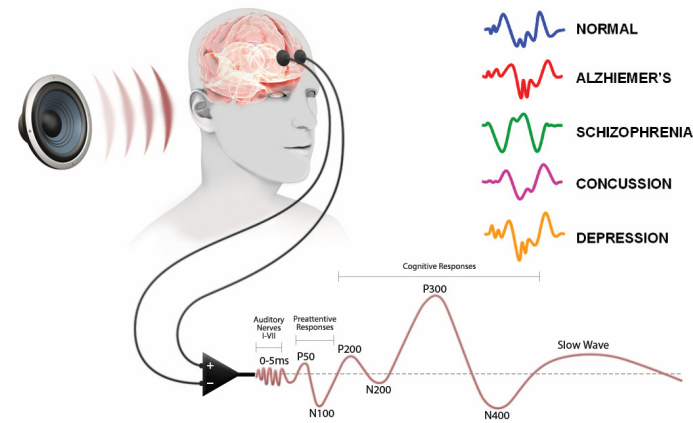
ERP/QEEG BIOMARKERS OF BRAIN FUNCTION

EVENT-RELATED POTENTIALS (ERP)
ERPs are electrical activity generated by the brain during sensory and cognitive processing of external stimuli. The stimuli can be auditory, visual, or tactile and are generally arranged in a long sequence of many repetitions. These sequences can be designed to probe specific cognitive processes such as selective attention, memory encoding, or semantic processing. The ERP provides a real-time electrophysiological biomarker of the underlying cognitive processes. These ERP biomarkers can provide important information about how the brain normally processes information and about how this processing may go awry in many neurological or psychiatric disorders. They can also be used as a measure of a drug's effect on brain function.

QUANTATIVE EEG (QEEG)
The brain generates electrical activity in specific frequencies. The amount of electrical power in these various frequencies, and the specific frequency of maximum power are useful biomarkers of cognitive state. QEEG involves analyzing and quantifying the frequency content of a standard EEG recording session. These QEEG biomarkers can be used to evaluate certain neurological or psychiatric disorders. They can also be used as a measure of a drug's effect on brain function.
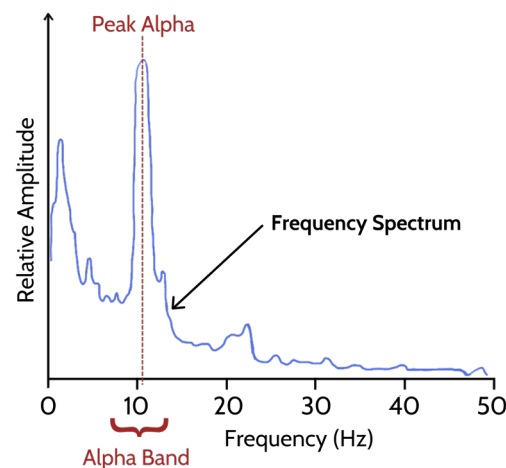
COGNISION® PROTOCOL EDITOR

The COGNISION® System uses an online library of standard ERP/QEEG protocols. These protocols use auditory and/or visual stimuli which are also stored in the library. Additional protocols can be created by the user using predefined paradigm templates. These new protocols may then be shared with other users of the system.
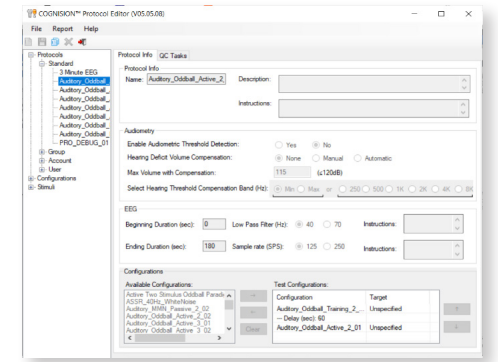
Definitions include:
- Stimulus Settings
- Sequencing
- Timing
- Epoch Grouping
- Analysis Logic

Paradigms include:
- Single Stimulus
- 2 & 3 Deviant Oddball
- Match-mismatch negativity
- Auditory Steady State
- Resting EEG
- Vigilance EEG

Stimuli include:
- Auditory
- Visual
- Combined

COGNISION® PATIENT MANAGER

The COGNISION® System includes an Electronic Health Records (HER) module to simplify the management of patient personal, health, and test data, thereby promoting collaborative research and facilitating complex data-mining functions.

Features of the **Patient Manager** module include:

- HIPAA-compliant security
- Centralized database for all relevant clinical information (Vitals, Family, History, Medical History, Labs, Imaging, Image Findings, Psychometrics, Medications, and Patient Visits)
- Orders for procedures can be entered for partner sites
- Automatic Patient Report generation of the EEG/EP testing sessions
- Clinical findings can be added to the Patient Reports in a streamlined way
- Patient Reports can include the physician's electronic signature
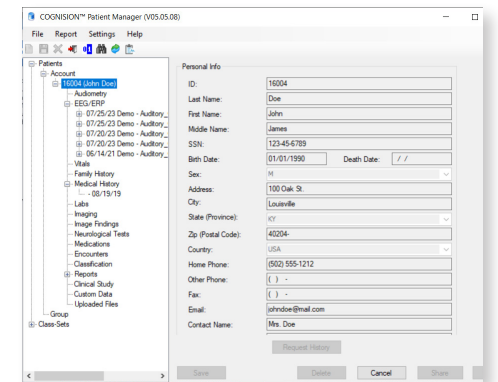

COGNISION® TEST ADMIN

COGNISION® tests are "ordered" in advance through the Patient Manager module and can be performed at any clinical site which has a COGNISION® System. The tests are selected from a testing calendar and are downloaded into the headset specifically for each patient.

Features of the **Test Admin** module include:

- Specific tests are ID'd to each subject
- The test is downloaded to the headset through Bluetooth
- Each test session can include one or more ERP, EEG, and Audiometry tests
- Automated impedance detection is performed before and during each test
- Real-time display of EEG waveforms, artifacts, and task responses
- A test can be paused and restarted
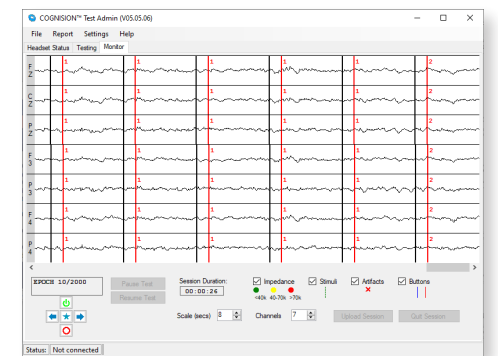
COGNISION® ERP/QEEG VIEWER

The COGNISION® includes an expert Viewer module to display and analyze ERP and QEEG data. Raw, average, and grand average, waves can be displayed using several advanced visualization methods. The data can be automatically preprocessed to facilitate rapid ERP/QEEG assessment.

Features of the **Viewer** module include:

- Can display raw, average, difference, grand average, and difference wave
- Can display power spectrums and wavelets
- Can save all preprocessing, cleaning, artifact removal, and filtering into Preprocess-Templates to facilitate visualization analysis of many data-sets at the same time.
- Can group data-sets into List-Sets to allow efficient management of complex data
- Can plot waveforms from different groups in the same view