Available online at www.sciencedirect.com
SCIENCE DIRECT
Neuroscience Letters 391 (2005) 43–47
Neuroscience Letters
www.elsevier.com/locate/neulet

A pre-task resting condition neither ‘baseline’ nor ‘zero’

José A. González-Hernández [a,*], Yamilka Céspedes-García [a], Kenneth Campbell [b], Werner A. Scherbaum [c], Jorge Bosch-Bayard [d], Pedro Figueredo-Rodríguez [a]

[a] *Section of Cognitive Research and Psychophysiology, Department of Clinical Neurophysiology, ‘Hermanos Ameijeiras’ Hospital, San Lázaro 701, Havana 3, 10300, Cuba*
[b] *School of Psychology, University of Ottawa, Ottawa, Canada*
[c] *Department of Endocrinology, Diabetes and Rheumatology, University of Düsseldorf, Moorenstr. 5, 40225 Düsseldorf, Germany*
[d] *Cuban Neuroscience Centre, Havana, Cuba*

Received 16 June 2005; received in revised form 10 August 2005; accepted 15 August 2005

Abstract

This study introduce the comparison of a ’reference state’ versus a resting condition (zero), defined upon normative developmental equations. We compared pre-task ’resting’ data from healthy individuals with the Normative Cuban digital resting EEG-database recently calculated for VARETA (qEEG/VARETA). The results allowed us to state that a ’pre-task resting conditions’ exists as a state beyond the ’zero’ or ’baseline’ condition. The pre-task ’resting’ condition is never truly ’at rest’, however most of the previous published fMRI/PET studies assumed such a pre-task condition as reference/baseline condition. By defining different ’resting states’ by qEEG/VARETA analyses, we have a potential methodology which can define resting state conditions and to be sure that they are consistent when comparing within group analyses across tasks or between groups either void of task or for task specific conditions.
© 2005 Elsevier Ireland Ltd. All rights reserved.

Keywords: Baseline; Zero; Prefrontal cortex; Alpha oscillations; VARETA

Perhaps the most commonly used standard clinical neurophysiological procedure is the recording of the electroencephalogram (EEG) during a so-called “resting state”. The eyes may be open or closed. This resting EEG has typically been scored or quantified using manual methods. With the advent of rapid digital computers, complex spectral analysis algorithms have been developed to describe mathematically this presumably stationary oscillatory activity [10]. Quantitative EEG (qEEG) provides a reliable description of local brain activity and the interaction among different brain regions [10]. Age-matched normative data banks for this quantitative analysis of the resting EEG are now available [10,19]. The central tendency of the power spectrum is a result of regulation of anatomically complex homeostatic systems in the brain. Brainstem, limbic, thalamic and cortical processes involving large neuronal populations mediate this regulation [9]. The power spectrum is very stable across intervals of hours, days, and even years [11], probably because of this homeostatic system. Its distribution does shift with electrode position and factors such as age, and neurological and psychiatric illness [10,8] as well as shifts in state. It however appears to be independent of ethnic and cultural factors [10]. John [9] has proposed that when all qEEG measures fall within the central portion of the normal curve, the information content in this state be considered to form a ‘zero’ or ‘baseline’. Although the resting EEG is recorded during a “passive” state, the “zero” or ‘baseline’ does not imply the absence of mental activity or concurrent information processing. Indeed, it is probably not possible for an awake and alert human participant to simply do “nothing”. Unfortunately, it is not easy to control for the mental state of a participant during such passive conditions. For this reason many laboratories prefer to engaging participants’ attention in some sort of a task, thus exercising at least some control over the extent of mental activity. In the applied and clinical settings, participants may however be unwilling or unable to fully participate in such active tasks. Although the passive task is unable to experimentally control of the extent of cognitive activity, the influence of temporal fluctuation of the power spectrum has been quantified by including it as a source of variation in qEEG [10]. This explicitly compensates for momentary fluctuations.

* Corresponding author.
E-mail addresses: jogon001@uni-duesseldorf.de, jagonzalez_hernandez@yahoo.es (J.A. González-Hernández).

0304-3940/$ – see front matter © 2005 Elsevier Ireland Ltd. All rights reserved.
doi:10.1016/j.neulet.2005.08.027

Hemodynamic imaging techniques such as those employed in fMRI and or PET also often rely on a resting baseline condition. In block-design studies, the baseline data of the hemodynamic activity of the brain collected is then subtracted from that collected during an experimental condition. Similarly, in many EEG block-design studies, resting brain activity collected during a passive condition is often compared to brain activity collected during an experimental condition. The assumption in each case is that brain activation is identical in the two conditions except for the additional activity that is elicited by the experimental condition. The subtractive method removes the common, baseline activity leaving only activity that can be explained by the experimental manipulation. Interpreting relative differences across and within studies can however be ambiguous. This is because differences can emerge because of the assumed differences in the experimental condition but also because of unassumed differences in baseline conditions. As an example, in two studies [4,5] based on qEEG/VARETA measurements to examine cognitive activity in schizophrenic patients and control participants, multi-channel EEG was collected during a passive, resting condition ('baseline') and during a cognitive task. Large resting qEEG/VARETA differences were expected between the normal mental activity of the controls and the disorganized cognition of the schizophrenic patients. In actual fact, resting condition differences were not statistically significant. At first sight, this lack of difference can be interpreted as that the pre-task resting condition is truly at 'rest' and can be used as reference or 'baseline'. However, this may also reflex an 'active' state beyond the baseline condition derived from common processes that take place during the period prior to the task. In this case, similar inter-individual brain responses may be undetectable. Manipulation of the task may prove the existence of this 'active' state but does not solve the problem about a reference or a 'truly' baseline condition able to standardize these studies. The present study will address this problem by comparing the pre-task resting electrical activity of healthy volunteers to the 3D normative Cuban digital resting EEG database [1]. This group has previous non-task related resting activity within normal values according to this Cuban norm. Variable-resolution Brain Electromagnetic Tomography (VARETA) will be employed to model the sources that accounts for variations in the power spectrum across the scalp. The normative (Z) statistical parametric mapping (SPM) quantify the change in state allowing to detect the common, baseline activity as well as the significant activity that can not be explained by the baseline condition alone.

Ten healthy subjects volunteered to participate in this study. The demographic characteristics of the group, as well as the descriptions of the recording session and cognitive tasks have been described elsewhere [4,5]. In brief, healthy volunteers (mean age 28.5 years, S.D. 3.1 years) had at least 13 years of education. None had a personal or family history (first degree) of psychiatric or neurological diseases, or alcohol abuse. None of the controls were taking medication. Additionally, all of them had previous qEEG/VARETA measurement by resting condition within the normative values. The Ethics Committee of the Institution approved the study.

Both the standard waking eyes open and eyes closed procedures were studied in separate conditions. As is usual in clinical EEG recording, participants were encouraged to maintain 'mental rest'. The beginning of the recording session was visually determined through inspection of the electrical activity and coincided with an absence of artifact and neurophysiological evidence of relaxation. The subjects were informed about the upcoming task before the EEG recordings. The EEG in both the eyes open and closed conditions was recorded continuously over a 3 min period prior the cognitive tasks used: Wisconsin Card Sorting Test. Despite the task, recording conditions were within the standard clinical guidelines, which are the same for the Cuban normative database [2,19], but differ from this, in the total time recorded and the posture of the subjects during this resting state. The previous non-task related resting EEG were registered in the same posture like in this study.

Nineteen Ag/AgCl cup electrodes were placed over frontal (Fp1, Fp2, Fz, F3, F4, F7, F8), central-temporal (Cz, C3, C4, T7, T8) parietal-temporal (Pz, P3, P4, P7, P8) and occipital (O1, O2) sites, using the modified International 10/20 Placement System. The reference was linked earlobes. All electrode impedances were kept at 5 kΩ. The EEG signals were recorded with the Medicid-4 (Neuronic, SA) digital data acquisition system. Filter band pass was 0.39–19 Hz. A 60 Hz notch filter was also used. The EEG data were digitized at a 200 Hz sampling rate. The data were stored on hard disk for subsequent off-line analyses. After visual editing to exclude artefacts, an average of 24 epochs for the eyes closed and 19 epochs for the eyes open conditions were selected. The difference in the number of epochs between conditions was because of the larger occurrence of artifact in the eyes open condition. Each epoch consisted of a 2.56 s EEG sweep. These procedures meet exactly the requirements to manipulate the EEG segments for the comparison with the Cuban normative digital database.

Time domain EEG epochs were transformed to the frequency domain by means of the Fast Fourier Transform (FFT). At each electrode site, the complex covariance matrix (or the cross-spectra) was calculated from 0.39 to 19 Hz using 0.39 Hz bin intervals. To obtain the inverse solution, manipulation of the cross-spectra matrix was performed using the VARETA procedure [1,20,21]. VARETA computes the full cross-spectral matrix and is a member of a class of minimum algorithms used to obtain solutions to the inverse problem in electroencephalography. It provides an estimate of the intra-cranial brain source current densities that underlie the spectral power recorded across the different electrode scalp sites. Unlike many source localisation procedures, VARETA makes no assumptions about the number or location of the sources within the brain, thus overcoming the non-uniqueness of the inverse problem. To do so, VARETA assumes a spatially smooth distribution of current density and that activity in these smooth sources must be synchronized. This method employs a discrete spline distributed inverse solution, which computes scalp electrode positions in accordance with a probabilistic MRI atlas [2]. A neuroanatomical mask constrains the number of source solutions to be located within gray matter comprising 3563 voxels. VARETA superimposes the computed sources on slices obtained from this averaged brain

Download English Version:

https://daneshyari.com/en/article/9428861

Download Persian Version:

https://daneshyari.com/article/9428861

Daneshyari.com