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Cognitive Assessment Techniques

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Abstract

Brain is the most sophisticated part of the human body. We concentrate our research on how to enhance the abilities of a healthy brain. The science dealing with this concern is called cognitive science. In this paper, various techniques to assess the abilities of the brain are discussed. These assessments thus made by such techniques are then used for enhancement of a healthy brain.

1. Understanding Cognition

Cognition, in layman's language refers to thinking [1]. Thinking is mandatory at almost every slight aspect of daily routine be it playing monopoly or doing calculations but a thought takes many understated forms such as inferring sensory input and then subsequently guiding the physical actions. Thus, Cognition is the process by which the sensory input detected by the human brain is altered, concentrated, enlarged, kept, improved, and used. Cognition is essentially a mental process that comprises various capabilities of brain like attention of working memory, calculating, reasoning, problem solving, and decision making [2].

"Cognition" is a word that dates back to the 15th century and it meant 'thinking and awareness' [3]. Cognitive procedure came more into consideration more than twenty-three centuries ago, opening with Aristotle and his attention in the inner-workings of the mind and how they shake the human experience. Aristotle engrossed on cognitive areas relating to memory, perception, and mental imagery. The Greek philosopher found great prominence in guaranteeing that his studies were based on empirical proof; scientific information that is gathered through observation and careful experimentation [4].

2. Cognitive Assessment

Cognitive Assessment is a kind of technique to predict or assess the abilities be it logical or reasoning of a human brain. It involves the use of pencil and paper tasks or certain computerized batteries to assess a wide range of abilities like attention (how attentive the brain is while doing a task), memory (how efficiently the memory is working), reasoning capabilities, language skills and intellectual functioning. It is the process of determining a patient's cognitive strengths and weaknesses through qualitative (approach to tasks and observed behaviour) and quantitative (standardized and scaled measures) approaches. Test scores are then evaluated on the basis of data acquired after the test and expected level of performance for a given individual based upon their educational/occupational level and estimates of their intellectual functioning [5].

3. Cognitive Abilities

Cognitive Assessment is a kind of examination that is conducted to predict the mental abilities of a human being. While doing so many abilities of brain are taken into account.**H.J. Woodford and J. George** stated numerous cognitive abilities for the elderly in their research [6].Some of the key components to consider while assessing the cognitive abilities are as follows:

3.1 Attention

Attention is a process of focussing. There are various definitions of the term 'attention'. Attention is the cognitive process of selectively concentrating on one aspect of the environment while ignoring other things. Attention has also been mentioned as the distribution of processing resources. A number of tasks can be considered to measure this cognitive ability. A simple example can be mathematical problems which draw a lot of attention of a human brain. An individual can be asked to recall a number of digits after the digits are shown to him/her for a short duration of time. Attention is a basic requirement for being able to perform other elements of the cognitive assessment [7].

3.2 Memory

Memory can be considered as the ability to remember things. Memory makes us. If we couldn't remember the what's, who's, when's and where's of our daily lives, we'd never be able to manage. Memory can be long-term memory or short-term memory. Short-term memory is more dependent on an intact limbic system (mainly in the temporal lobes) than long-term remembrance, which is reliant on upon other cortical processes [8]. Various tests for assessing such memories are available. For example, the working memory of an individual can be evaluated by making him/her remember a bunch of images and then recalling it after a specified time span.

3.3 Visuospatial Skills

Visuospatial skills permit us to visually observe objects and the interactions among objects. These are the skills that allow us to identify a triangle, square, cube or pyramid. They let us to review our way across the city because we have a visual map in our reminiscence from the last time we completed the trip. They permit us to know that the car is closer to us and smaller than the building just after the car. They enable us to comprehend that the car we see two blocks away is actually about the similar size as the car that is just in front of us, even though it seems to be much smaller. Most of what we analyze visually would take many words to define yet we do it visually in a fraction of a second. Visuospatial skills comprise a wide diversity of individual abilities that differ from identifying complex intersecting angles and curves to knowing faces from the shape of eyes, noses, mouths and hair. Impairment of these abilities can have an overwhelming effect on even modest everyday functions that we take for decided.

3.4 Frontal/Executive Function

Executive function is a term for the higher cerebral functions, mostly resulting from the frontal lobes, but also connecting subcortical connections with the basal ganglia and thalamus. They contain components such as abstract thought, development and decision. They are required to complete composite jobs. There is a wide range of procedures available to the clinician to assess frontal lobe functions. They include the trail-making tests. In the simplest form, this includes joining a sequence of numbers dispersed across a page, in the correct order (e.g. 1!2!3 . . .).

4. Cognitive Assessment Techniques

As stated earlier, Cognitive Assessment Techniques are used to evaluate the mental abilities of the human brain. In this type of assessment, the subject will be asked to complete a series of tasks that require cognitive skills. Exams may be broken up into several different components to test things like reasoning, understanding language, and so forth. Each section is scored separately, and the results can be compared with those of other people who have taken the test to see where someone falls on a scale of cognitive performance. There are various ways of performing this process of evaluation. These methods may use a mere paper and pencil test or cognitive assessment batteries like Psychology Experiment Building Language (PEBL). Cognitive assessment can be classified as:

(i) Task Oriented Assessment
(ii) Physiological Assessment

4.1 Task oriented Assessment

The subject is asked to complete a series of tasks like logical puzzles, matching numbers, etc. that necessitate the involvement of cognitive skills. For performing such type of cognitive assessment there are certain test batteries. Some of them are described as follows:

4.1.1The Prevention and Early Intervention Program for Psychoses (PEPP) Cognitive Assessment Battery

The PEPP battery states numerous tests for assessing various cognitive abilities [9]. The list of tests administered to each patient includes the following:

- **National Adult Reading Test (NART):**This test gives an estimate of premorbid IQ. Premorbid Intelligence of an individual refers to the estimate of person's intellectual functioning preceding to

recognized or supposed onset of brain disease or dysfunction. More usually, this word is used to label a process in neuropsychological assessments in which an individuals' level of neuropsychological functioning that existed former to the onset of known or suspected neurological dysfunction is determined. The NART was developed by Hazel Nelson in the 1980s in Britain and published in 1982 [10].

- **Wechsler Adult Intelligence Scale:** The WAIS is used to measure intelligence in adults and older adolescents [11]. The third edition (WAIS-III) delivers Verbal and Performance IQ scores and a Processing Speed Index. Currently this scale is in its fourth form. The test WAIS-IV consists of 10 core subtests and five additional subtests, with the 10 core subtests having the Full Scale IQ. In the new WAIS-IV, the verbal/performance subscales from prior versions were detached and replaced by the index scores. The General Ability Index (GAI) was encompassed, which consists of the Similarities, Vocabulary and Information subtests from the Verbal Comprehension Index and the Matrix Reasoning, Block Design and Visual Puzzles subtests from the Perceptual Reasoning Index. The GAI is clinically valuable because it can be used as a quantity of cognitive abilities that are less susceptible to deficiencies of processing and working memory.

- **Wechsler Memory Scale:** The third edition (WMS-III) offers indexes of instantaneous and deferred auditory and visual memory, and working memory. The Wechsler Memory Scale (WMS) is a neuropsychological test intended to measure dissimilar memory functions in a person. Anyone from ages 16 to 90 is qualified to take this test. The current version of this test is the fourth edition: WMS-IV.

- **Wisconsin Card Sorting Test (WCST):**It is the measure of executive functioning of the brain. The Wisconsin Card Sorting Test (WCST) is a neuropsychological test of "set-shifting", i.e. the ability to display flexibility in the face of changing agendas of establishment. The WCST was inscribed by David A. Grant and Esta A. Berg. Initially, a number of stimulus cards are offered to the participant. The participant is told to match the cards, but not how to match. The original WCST used paper cards and was done with the experimenter on one side of the desk facing the participant on the other [12].

- **Stroop Test:**It is the measure of divided attention, mental elasticity, handling speed. This test is made on the Stroop Effect. In psychology, the Stroop Effect is demo of interference in the reaction time of a task. When the name of a color (e.g., "blue," "green," or "red") is published in a color not signified by the name (e.g., the word "red" published in blue ink instead of red ink), specifying the color of the word takes longer and is more disposed to errors than when the color of the ink matches the name of the color. The effect was first printed by John Ridley Stroop [13].

- **Trail Making Test (Parts A and B):**It is the measure of attention and visual-motor sequencing. Both parts of the Trail Making Test involve of 25 circles dispersed over a sheet of paper. In Part A, the circles are numbered 1 – 25, and the subject should draw lines to attach the numbers in ascending order. In Part B, the circles comprise both numbers (1 – 13) and letters (A – L); as in Part A, the subject draws lines to join the circles in a rising pattern, but with the extra task of alternating between the numbers and letters (i.e., 1-A-2-B-3-C, etc.). The subject should be coached to join the circles as rapidly as possible, without lifting the pen or pencil from the paper. Note the time of patient as he or she attaches the "trail." If the subject makes an error, point it out immediately and allow the patient to correct it. Errors affect the subject's score only in that the correction of errors is comprised in the achievement time for the task. It is needless to continue the test if the subject has not accomplished both parts after five minutes have passed.

- **Oral and Written Word Fluency:**It measures of executive functioning. A number of words are set to the subject and his/her articulacy is checked both verbally and while inscription.

- **Prospective Memory Screening Test:**It is the measure of preparation and recollection for future tasks. Prospective memory is a form of memory that includes memorising to accomplish a scheduled action or intention at the suitable time [14]. Prospective memory tasks can be used in a variable ways to

measure prospective memory. These tasks can be shadowed by questionnaires about prospective memory.

- **Paced Auditory Serial Addition Task:**It is the measure of continued and raced processing. It is used to evaluate capacity and rate of information dispensation and continued and divided attention [15]. The subjects are publicised a number every 3 seconds and are queried to add the number they just caught with the number they caught before. This is a stimulating task that includes attention, working memory and arithmetic capabilities.

- **Continuous Performance Task:**It is the measure of sustained attention/focus and treating speed. It is also called the quantitative behaviour test. Subjects are available with a repetitive, uninteresting task and must uphold their emphasis over a period of time in order to reply to targets or constrain response to foils. Test may use symbols, numbers or sounds but the idea of task is same. Although the tests may differ in terms of length and type of stimulus used, the basic nature of the tests remains the same. Clients are offered with a boring, "tedious" task and must maintain their emphasis over a period of time in order to answer to marks or inhibit response to foils. Tests may use numbers, symbols or sounds, but the basic task has the same concept.

- **Neo Personality Inventory:**It is a measure of personality characters. This was intended to deliver a general description of normal personality applicable to clinical, therapy and educational circumstances. It consists of 240 personality substances and a validity item. All items were designed to be easily read and understood.

- **Cognitive Failures Questionnaire:**It is a self-report measure of cognitive abilities. The questions are about minor faults which everybody makes from time to time, but some of which happen more often than others. The questions are like 'Do you read something and find you haven't been thinking about it and must read it again?'

4.1.2 The Psychology Experiment Building Language (PEBL)

PEBL offers a simple programming language tailor-made for creating and conducting many standard experiments [16]. These experimentations are used for performing cognitive assessment. Some of these tests are described below:

- **Digit Span Test**

  The digit span test or memory test is the lengthiest list of items that a person can duplicate back in correct order instantaneously after presentation on 50% of all trials. It is also a constituent of cognitive ability tests. In Digit Span, the subject will see a series of digits presented in a box at the top of the screen and the task will be to remember these numbers in sequence. After a short period of time, the numbers will disappear and the subject will key in his response. The digit strings will rise in length with each trial and the subject will continue the task until he/she makes a mistake.

- **Go/No-Go Test**

  In general go/no go testing discusses a pass/fail test principle using two boundary circumstances. The test is approved only when the Go circumstance is met and also the No go circumstance fails. This test was advanced to assess response inhibition in a rapid computerized assessment format. Subjects learn to distinguish between two response substitutes. Subjects are asked to reply and pick the correct choice. On some judgements, however, one of the incentives is colored red, which is a signal not to respond at all ("no-go" trial). The frequency of "go" stimuli relative to "no-go" stimuli is 80%, which maintains a bias and tendency to respond on every trial. Key dependent measures include both reaction times for all "go" responses, and error frequencies, the most important of which are "false alarm" errors (i.e., a response to a "no-go" stimulus). The test adapts to the subject's rate of performance, maintaining a maximum pace of administration.

- **Matrix Rotation Test**

  The test describes how the mind distinguishes objects in the environment. The subject is shown a square matrix with a design and he/she is tutored to remember that pattern and then a second matrix

appears. He/she is now taught to associate both the patterns in his/her mind. If the pattern is rotated 90 degrees (either left or right), the subject has to press the left shift key on the keyboard otherwise the right shift key has to be pressed.

- **Muller-Iyer Test**
  The Muller-Iyer Test is an optical illusion consisting of a conventional arrow. The Arrow has two arrow heads and it seems as two arrows. The subject has to compare which arrow has longer length and the corresponding key has to be pressed. The lines appear to be same and that is why it is called an illusion test.

- **Spatial Cueing Test**
  The test includes 50 trials. It is required to respond to a stimulus dimension, overshadowed by spatial location. At the beginning of each trial, a fixation cross appears, accompanied by a left arrow ([<+]), a right arrow ([+>]) or both ([<+>]). The stimulus 'X' will appear after a short time span either to the left or right of the fixation area. The arrow will usually tell you where the stimulus will appear (75% of the time the stimulus will appear in the direction of the arrow). The subject's goal is to fixate 'X' without moving the eyes and pressing key 'A' as soon as he/she sees the stimulus.

4.1.3 Bhatia's Battery for Performance Test of Intelligence

This is another kind of cognitive battery consisting of many tests to measure the cognitive abilities. **Poonam Dhaka** et. al. used this battery to evaluate the impact of light-sound stimulation on intelligence in teenagers [17]. Some of these tests are described below:

- **Koh's Block Design Test**
  This test contains of 10 designs from the unique 17 designs from the Koh's test. The time for first five designs is 2 minutes and for the lasting five the time is 3 minutes. The card with a variability of colored designs are shown to the test taker and he/she is asked to replicate them using a set of colored blocks. The presentation is based not just on the accuracy of the drawings but also on the examiner's observation of behaviour during the test, comprising such factors as attention level, self-criticism, and adaptive behaviour.

- **Alexander Pass-along Test**
  All the designs of the unique test are comprised in this test and consist of certain blocks of red and blue color. The subject has to organise the blocks according to the card shown to him/her. The first four of these have to be completed in 2 minutes and the rest of the four have to be accomplished in 3 minutes.

- **Pattern Drawing Test**
  This test comprises of eight patterns of increasing difficulty from first to eighth. In this test, the subject has to make the figures as shown in the card without repeating on lines and without lifting the pencil. The time for the first four cards is 2 minutes and for the rest four cards it is 3 minutes.

- **Immediate Memory Test**
  This test has a close relation with mental growth or general intellect. It begins with two letters and then growths accordingly. Firstly the investigator tells out the word and then the subject. There are three substitute sets of letters. If failure is logged in the first set, try the second and the third substitute sets. If failure is noted in all the three substitutions the failure is noted and the task is stopped. The same stages are to be followed in reversed sounds.

- **Picture Construction Test**
  This test entails of five graded subjects. In these sub-tests there are number of pieces and the subjects have to put the pieces together to form the picture. The time for first two pictures is 2 minutes and the rest of the three pictures in 3 minutes. Individual management of this test takes less than one hour. Maximum 95 marks can be obtained in the complete test. Maximum marks for 1^{st}, 2^{nd}, 3^{rd}, 4^{th} and 5^{th} test are 25, 20, 20, 15, and 15 respectively.

4.1.4 Neurocognitive Test Battery

This is another way for performing cognitive assessment [18]. The tests of neurocognitive test battery are explained as follows:

- **Letter Cancellation Test**
  This test concentrates on visual scanning, response speed and sustained attention. A series of English letters are presented to the subject, and he/she is instructed to cancel out specific letters. The score is the time taken by subject to actually perform this task. In addition, the numbers of different errors (omissions and commissions) done by the subject are also counted.

- **Trail Making Test**
  Part A: This test assesses visuo-motor speed and attention. The subject is taught to draw a straight line to connect 25 successive circles. The score is the time taken by the subject to complete the task.
  Part B: In addition to visuo-motor speed and attention, it necessitates the patient to shift strategy and hence, is a sensitive measure of executive function as well. In this the subject is taught to connect 25 numbered and lettered circles by alternating between the two sequences. The score is the total time taken by the patient to complete the task.

- **Ruff Figural Fluency Test**
  This test assesses on the non-verbal fluency of a subject, which is an indirect measure of subject's capability to form a strategy to complete a given task. The subject is offered with a sheet of paper on which 40 boxes are present. The objective is to draw unlike patterns in these boxes by joining dots existing in these boxes in a stated period of time. The score is based on total number of dissimilar patterns, and number of perseverations. The revolutions were also noted in this test along with Patterns and Perseverations as Rotations are considered to be the hallmark in the strategic approach.

- **Digit Span**
  Digits Forward:measuresinstant verbal memory span. In the test, subjects must repeat back sequences of digits of increasing length read out by the examiner.
  The score is maximum number of digits that the patient can recall.

  Digits Backward: In addition to auditory attention and short-term absorbentcapability this test also assesses the ability to operate information in the verbal working memory (and hence is sensitive measure of executive function). The subject has to replicate the sequences of numbers of growing digit length in inverse order to what was said by the examiner. The score is the maximum number of such digits that the patient is able to inverse.

4.1.5 Cognitive Drug Research (CDR) Computerized Assessment System

The CDR system includes a number of measures that are precise to specificfeatures of attention, working memory and long-term memory [19]. The battery comprises of the following tests:

- **Word Presentation**: A series of 15 words is offeredconsecutively for one second each with an inter-stimulus pause of one second. The words are anamalgam of one two and three syllables.

- **Immediate Word Recall**: The computer demonstration counts down sixty seconds during which participants inscribe down as many of the words from the list as possible. Recall is scored for number of correct words, and errors (words that are not presented in the list).

- **Picture Presentation**: Twenty photographs are offered, with a stimulus duration of 2 s each, and inter stimuli interval of 1 second.

- **Simple Reaction Time**: The word Yes is shown in the centre of the screen. The participant has to press the Yes button as speedily as possible. There are 50 trials and the inter trial interval varies randomly between 1 and 2.5 s. The reaction time is recorded in milliseconds.

- **Digit Vigilance**: A number is showed constantly to the right of the screen. A series of 240 digits is offered one at a time in the centre at a rate of 80 per minute; 45 match the constantly displayed digit. The participant has to press the Yes button as quickly as possible every time the digit in the center matches the one constantly displayed. Accuracy of response (%), reaction time (ms), and number of false alarms are recorded.

- **Choice Reaction Time**: Either the word Yes or the word No is presented in the center of the screen. The participant has to press the Yes or No button as appropriate and as quickly as possible. There are 30 trials (25 "Yes" and 2 "No") and the intertrial interval varies randomly between 1 and 2.5 s. Accuracy (%) and reaction time (ms) are recorded.

- **Spatial Working Memory**: A schematic picture of a house is presented for 5 s. The house has nine windows in a 3 × 3 pattern, 4 of which are illuminated. A series of 36 presentations of the same house in which just one window is illuminated follow, and the participant has to respond Yes if the window was one of the four lit in the original presentation, or No if it was not. Sixteen of the stimuli require a Yes response and 20 a No response. Reaction time and accuracy are recorded and a sensitivity index calculated.

- **Memory Scanning**: Five digits are presented singly at the rate of one every second for the participant to remember. A series of thirty digits is then presented. For each, the participant must press Yes or No according to whether the digit is thought to be one of the five presented initially. Fifteen stimuli require a Yes response and 15 a No response. This is repeated three times using a different 5 digits on each occasion. Reaction time is recorded and a sensitivity index calculated.

- **Delayed Word Recall**: The computer counts down 60 s during which time participants free recall as many of the words from the list as possible. Recall is scored for number of correct words; and errors (words not presented in the list).

- **Word Recognition**: The 15 words initially presented for the word recall are presented again in random order interspersed with 15 new words. The participant presses Yes or No each time to signal whether or not the word was from the original list. Reaction time and accuracy are recorded and a sensitivity index calculated.

- **Picture Recognition**: The 20 pictures presented earlier are shown again in random order interspersed with 20 similar new ones. The participant signals recognition by pressing the Yes or No button as appropriate. Reaction time and accuracy are recorded and a sensitivity index calculated.

4.2 Physiological Assessment

The physiological parameters like ElectroEncephaloGraphy (EEG), ElectroCardioGraphy (ECG), Galvanic Skin Resistance (GSR), Heart Rate (HR), etc. are taken into account for the purpose of performing cognitive assessment experimentation. Cognitive assessment can also be done by acquisition of cognitive signals. These parameters relate to various cognitive abilities that are to be assessed and enhanced. EEG is conventionally used to detect pathlogicalconditions like epilepsy [20-24], but nowadays it is also beimg used to detect and quantify emotions [25-29]. EEG is record of neural activity, and it is acquired in a non-invasive manner by placing electrodes over the subject [8]. The signal of EEG is conditioned by de-noising and features are extracted from frequency bands of different ranges like alpha, beta, theta, delta and gamma [21, 22, 25]. For emotional detection or for diagnosing any pathological condition like epilepsy, the features extracted from EEG frequency bands are given to a related classifier, that may be rule based, nearest neighbour classifiers, or more advance technique like SVM [30].

How is Cognitive Enhancement different from Training

To answer this question, consider, for instance, a football player who practices daily for 6 hours to increase his performance on field. The player thus undergoes through a task which is related to his game. As he practices daily, his performance on the field gets better or enhanced. Scientifically, if some physiological parameters, say,

EEG are checked before and after training and it is observed that some features of EEG, for instance, alpha power and beta power increase/decrease after the player has practised for long, then it can be stated that the player has been trained well. On the contrary, if the same player is exposed to an unrelated task, i.e., having no relation to his game, daily for some time, and enhancement is observed on the field then it is called cognitive enhancement. This unrelated task can be identified by observing the features of the physiological parameters. The unrelated task for training should be chosen in such a way that the same parameters in that should increase/decrease as of the field game. Hence, suppose EEG rhythms of the player are recorded while he plays football and these rhythms are then analysed to give certain value of some predefined bands of EEG – alpha, beta, theta, delta and gamma. These signals are then again analysed after the player undergoes through the unrelated task. If it is observed that the same parameters which were considered earlier now increase or decrease, then it is said that the player has undergone cognitive enhancement.

A classical example of cognitive enhancement is making soldiers play hard in playground thereby improving their performance in the battlefield. Apart from building physical stamina during field practice, the neuromuscular coordination, the response time, visuo-spatial attention, etc. are some of the cognitive abilities that enhance. The cognitive abilities are much needed in battlefield. No wonder it is said that "the more you sweat in peace, the less you bleed in war". Hence proving that the best soldiers are made in playgrounds. Also, recently it has been reported that gamers make good surgeons. Gaming can help increase hand-eye coordination, which strengthens surgical skills.

The following discussion relates various parameters of physiological EEG signals to various cognitive abilities:

4.2.1 EEG features for Emotions

Ian H. Gotlib, CharanRanganath and J. Peter Rosenfeld made their research on physiological activities in the prefrontal region of brain to relate depression and cognitive functioning [31]. They evaluated the asymmetry in prefrontal region using power in the alpha band. According to the research, left frontal hypoactivation is related to depression. In study 1, they computed Davidson's formulations by observing differences in frontal EEG alpha asymmetry among currently depressed, previously depressed, and never depressed subjects. As expected, currently and previously depressed subjects showed left frontal hypoactivation relative to never depressed controls. In study 2, relations among the frontal EEG asymmetry were computed in response to negative mood induction procedure, attentional processing.

Dan Nie et. al. recognised emotions while the subjects watched movies related to positive and negative emotions [32]. EEG signals were acquired during the procedure. The feature of EEG taken into account for positive and negative emotions is energy of various bands- alpha, beta, theta, delta and gamma. As per the research, the energies of delta and gamma does not affect emotions. It is also observed that energy for positive emotions increases and for that of negative emotions it decreases.

Irene Winkler et. al. classified emotions as positive and negative using asymmetry index [33]. The researchers presented some pictures to the subjects acquiring the EEG signals simultaneously and finally analysed signals using 'frontal EEG asymmetry'. It is also suggested that left frontal activity indicates positive emotions while right frontal activity is related to negative emotions. The degree of activation is inferred from the spectral power in alpha band, with lower values in alpha power being associated higher degree of activity.

4.2.2 EEG features for Attention

AndrzejWróbelfocussed on the beta activity to study visual attention [34]. The researcher stated that in the cat, cortico-geniculate feedback has a potentiation mechanism having beta frequency which activates thalamic cells and this may lower the threshold for visual information transmission. The study also showed that enhanced beta activity is observed during attentive visual behaviour. Beta bursting activity spreads to all investigated visual centers, including the lateral posterior and pulvinar complex and higher cortical areas.

S.P. Kelly et. al. computed EEG alpha power in a sustained attention task [35]. Alpha activity in various regions of brains were computed during the attention task. It was observed that in two of three subjects average power in the alpha band was related to stimulus presentation. This pointed towards short-term attentional processes. Thus, the alpha power is expected to decrease while engaged in an attention task.

KridsakonYaomaneeet. al. presented a research to find appropriate locations of brain for detecting EEG signals during attention tasks [36]. Three experiments were constructed for this purpose. All 3 experiments made the examiners focus on the specific task to stimulate attention. The locations found for detecting Alpha wave were AF3 and F7. The suggested locations for detecting Beta wave were FC6 and F8. It was also shown that Alpha wave in the relaxation state was higher than Alpha wave in the attention state and Beta wave in the attention state was higher than Beta wave in the relaxation state.

4.2.3 EEG features for Working Memory

Allison Bell analysed the theta waveforms of EEG signal during a working memory task [37]. The research considered a hypothesis- does eye closure increase theta wave amplitude and performance level during a working memory task. The EEG data analysis indicates no significant correlation between increased theta wave amplitude and eyes opened and eyes closed tasks.

Joshua Jacobs et. al. studied that memory retrieval and decision making in correlation with theta activity [38]. During retrieval, power of left-parietal theta oscillations increased in relation to how well atestitemwasremembered,andthetaincentralregionscorrelatedwithdecisionmaking.The study also showedhowtheseoscillatorydynamicscomplementedevent-relatedpotentials.

Ole Jensen and Claudia D. Tescheshowed that frontal theta activity in humans increases in a working memory task [39]. The research showed brain oscillations in the theta band are involved in tasks related to working memory. The activity in the theta band increased with the number of items retained in working memory. The results suggested that theta oscillations generated in frontal brain regions play a significant role in working memory tasks.

Features of another physiological parameters can also be considered:

CAI Jing et. al. recognized emotions considering features of ECG. The automatic location of P-QRS-T wave was performed by use of discrete wavelet transform (DWT). The researchers stated that it is feasible to recognize emotions with the features of ECG [40].

Tanu Sharmaet. al. studied emotions taking features of many physiological parameters like ECG, HRV, GSR, etc. While experiencing the emotion, there are also physiological changes taking place in the human body, like variations in the heart rate (ECG/HRV), blood volume pulse(BVP), breathing rate(BR), brain waves (EEG), skin conductance(GSR),temperature and muscle tension. It was concluded that GSR represents the emotional state of the person [41].

5. Conclusion

The overall discussion concludes to the fact that Cognitive Assessment is a technique that can assess mental abilities. Cognitive assessment is a formal assessment of an individual's abilities in a range of areas, such as verbal and non-verbal skills, memory and speed of processing. The subject is asked to do a number of tasks. Some are like puzzles, others require them to answer questions or remember certain things.Cognitive assessment can also be done by taking physiological signals under consideration like EEG, ECG, GSR, HR, etc. For instance, each band of EEG corresponds to a property of human brain. These bands can thus be used to assess various cognitive abilities of an individual.

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