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THE PSYCHOMETRIC STUDY OF BRIEF BEDSIDE REPEATABLE ASSESSMENT TEST (BBRAT)

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ABSTRACT
The study aimed to calculate the psychometric properties (validity and reliability) of Brief Bedside Repeatable Assessment Test (BBRAT) a sample of 40 individuals aged 29 to 40 years who did not suffer from any cognitive or executive function disorders. The results of the study showed that the of Brief Bedside Repeatable Assessment test possesses good psychometric properties (validity and reliability), Item 4 of the test is also very easy and needs modification.
KEYWORDS: Psychometric, Brief Bedside Repeatable Assessment Test (BBRAT)

1. INTRODUCTION

Our consciousness depends on the frontal lobe of the brain. It is the largest of the cerebral cortex's four paired lobes, right behind the forehead and under the frontal skull bones. The frontal lobe comprises two paired lobes: the left and right frontal cortex. Although the size and complexity of the frontal lobe differ between species, about one-third of the cerebral hemisphere is made up of the frontal lobe. The lateral sulcus separates the frontal lobe from the temporal lobe inferolaterally, and the central sulcus (Sylvian fissure) separates it from the parietal lobe posteriorly. The four primary gyri on the surface of the frontal lobe are the precentral, superior frontal, middle frontal, and inferior frontal gyri. It is larger and more developed in humans than any other organism [1].
The frontal lobe occupies one-third of the surface of the brain hemisphere. The frontal lobe cortex comprises primary and secondary motor areas and a region anterior to the premotor cortex, called the prefrontal cortex. The prefrontal cortex is related to higher function processing in humans, such as behavior, judgment, personality, responsibility, and social property [2].
Frontal lobes are delimited posteriorly by the deep fissure of the central sulcus which lies behind the precentral gyrus. The central sulcus resembles an elongated S shape visible on both hemispheres as a continuous serpentine fissure on the topography of the brain, separating the primary motor territory of the frontal lobes from the somatosensory parietal regions. Human frontal lobes are capacious and encompass an enormous surface area in the skull compared to other lobes, comprising about half of all cerebral territory [3].
Frontal lobe is the largest of all the four lobes and is separated posteriorly from the parietal lobe by the central sulcus and inferiorly from the temporal lobe by the Sylvian fissure [4].
Frontal lobe damage can produce a range of deficits from subtle to grossly overt. The complexity of the frontal lobe involvement in many tasks both directly and indirectly means that their effect cannot only run the gamut from noticeable only to those who knew the patient well, to obvious to everyone in the environment but can also include functions which have an impact on other cognitive areas. For example, impairment in frontal lobes can produce simple, sustained and complex voluntary attention deficits which in turn have a discernable impact on seemingly unrelated tasks as object naming, copying a geometric figure or holding a conversation with out becoming tangential or circumloquacious [5].
Cognitive disorders are often initially characterized by impairments in executive function, which encompasses higher-order processes such as attention, decision-making, and working memory [6], Executive function encompasses three core components: inhibitory control, working memory, and cognitive flexibility, each playing distinct yet interconnected roles [7].
Assessing frontal lobe function and thus being able to identify a dysexecutive syndrome are helpful for the diagnosis and prognosis of brain diseases such as frontotemporal dementias and for evaluation of the severity of brain injuries. It can also help to identify vascular dementias and parkinsonian disorders, particularly progressive supranuclear palsy (PSP), in which the presence of frontal lobe dysfunction supports, the diagnosis It may also be useful for differentiating between degenerative disorders involving subcortical structures and for evaluating the progression of these disorders over time. The functions of the frontal lobes are difficult to assess clinically. There is no test that reliably identifies a dysexecutive syndrome. In practice, extensive neuropsychological batteries are needed to assess the frontal lobe processes. Given the modular functional organization of the frontal lobes, searching for a possible dysexecutive syndrome requires timeconsuming tests exploring functions associated with different frontal areas. Therefore, there is a need for a brief tool exploring different domains of executive function that are impaired in several neurologic diseases [8].

2. The Brief Bedside Repeatable Assessment Test (BBRAT)

The Brief Bedside Repeatable Assessment Test (BBRAT) is a neuropsychological screener designed specifically for brief repeatable assessment. This abbreviated measure is intended to provide a snapshot of a patient's sensory, motor and neurocognitive functioning, at both global and domain-specific levels. Individual test items have been adapted from empirically supported, standardized measures. When given in its entirety, the BBRAT takes approximately 40 min to administer, including 10–15 min for the cranial nerve exam and approximately 25-min for cognitive testing, which includes a 10-min delay for memory. Importantly, for clinicians who administer the memory portion, they are encouraged to use nonverbal tasks between immediate and delayed recall trials to mitigate task interference.

The Brief Bedside Repeatable Assessment Test (BBRAT) is designed as a bedside measure that can be administered as individual subtests or in its entirety, depending on the presenting concern. This measure is intended to screen multiple subdomains within aspects of cognition, including motor functioning, arousal/attention, language, memory, visuospatial abilities and abstraction/reasoning/judgement. Time to administer is variable, depending on the areas of functioning being assessed [9].

2.1 orientation

1. Administration:
(a) "Tell me the [date, month, year, day] today."
(b) "Tell me the name of [building, city] we are currently in."
(i) The patient should provide the exact name of hospital/clinic to receive credit.
2. Scoring:
(a) 6 correct responses = Oriented
(b) 1–5 correct responses = "Some Disorientation"
(c) 0 correct responses = "Fully Disoriented"

Gross awareness/attention

1. Observation:
(a) Observations should be used to answer if the patient orients when someone enters the environment, if they are capable of answering direct questions, and if they can hold a conversation.

.Working memory

1. Digits forward
(a) Administration:
(i) Read the number sequence at a rate of one digit per second.
(ii) "I am going to say some numbers, and when I'm through, I want you to repeat these numbers back to me in the same order that I say them."
(iii) Administration should cease following any errors.
(b) Scoring:
(i) Patients receive a check if they provide accurate numbers in order.
2. Digits backward
(a) Administration:
(i) Read the number sequence at a rate of one digit per second.
(ii) "Now I am going to say some more numbers, only this time when I'm finished, I want you to repeat these numbers backwards."
(b) Scoring
(i) Patients receive a check if they provide accurate numbers in order.

3. Serial 7's

1. Administration:
(a) "For this task, I want you to start with the number 100. I then want you to subtract 7 from that, and continue to subtract 7, until I tell you to stop."
2. Scoring
(a) Record the number of responses that correctly subtract 7.
(b) If the individual provides an incorrect response, but then correctly subtracts 7 from that response, this would be considered on incorrect response and one correct response. For example, if the patient says "93 - 7 = 87" instead of "86," the next correct response would be "80" instead of "79."

4. Sustained attention/vigilance

1. Administration
(a) Read letters at a rate of one per second
(b) Record when patient omits a hand tap "A" or taps on the wrong letter.
2. Scoring
(a) See Administration form

2.2 Memory

1. *Remote memory* (a) Administration:

(i) "Can you tell me, who is currently the president of the United States?"
(ii) Next, ask them, "Can you name 4 United States Presidents since 1961?"
(b) Scoring
(i) See Administration form
2. *Verbal memory*
(a) Administration:
(i) Read each word at a rate of one per second.
(ii) Do not correct the patient if they provide an incorrect word.
(iii) There is a 10-min delay between Trial 3 and Delay Trial
During the delay trial, attempt to fill
(iv) After you administer the Delay Trial, administer Cued Recall
See Cued Recall instructions below
(v) After you administer Cued Recall, administer Recognition
See Recognition instructions below
(b) Instructions to patient
(i) *Trial 1*: "For this next test, I am going to read you a list of words, and when I'm through, I want you to tell me as many words as you can remember. You do not have to tell me the words in the same order, just tell me as many as you can remember, in any order."
(ii) *Trial 2*: "I am going to read these same words again. Again, when I finish, I want you to tell me as many words as you can, in any order, even if you said them before."
(iii) *Trial 3*: "I am going to read this same list, one more time. Again, when I finish, I want you to tell me as many words as you can, in any order, even if you said them before."
After they finish providing responses for Trial 3, say, "Now, I want you to try to remember these words because I am going to ask you to repeat them again in a few minutes."
(iv) *Delay trial*: "Do you remember that list of words that I read to you earlier? I want you to tell me as many words as you can remember, in any order."

(iii) If the individual writes a word or a non-coherent group of words, this should be considered incomplete.
(v) *Cued recall*: "I'd like you to tell me how many words from the list I read to you are [animals, colors, utensils]."
(vi) *Recognition*: "I am going to read some more words to you and after I read each one, I want you to tell me if that word was on the list I read to you earlier. Was [recognition word] on the list?"
After "Fish" can just read the word listed without asking if it was on the list.
For example, "Was Spoon on the list? Was Fish on the list? Home? Pig?" etc.
(c) Scoring
(i) Record a "✓" next to each word that was recalled during their respective trials.
(ii) Total the number correct at the bottom of each trial.
(iii) When scoring the recognition trial, correct responses, phonemic errors and semantic errors are indicated based on their fonts (e.g., correct responses are bolded, phonemic errors are italicized, and semantic errors are in normal print).
(d) Interpretations
(i) Initial learning trials should be recorded, though level of potential impairment will be reflected during recall and recognition trials. It is anticipated that most patients will recall up to at least one less than their highest learning trial.

For example, if a patient's best learning trial is four words, they should be able to freely recall at least three of those four words on the delay trial.
(ii) Similarly, individuals are expected to perform equally well or better on cued recall and recognition trials. Patients who recall fewer than one minus their highest learning trial would suggest some degree of impairment.
Equal or greater than their highest learning trial = WNL
1 fewer than their highest learning trial = Mild impairment
> 1 fewer than their highest learning trial = Moderate impairment
(iii) Although phonemic and semantic errors may improve clinical impressions, a quantitative interpretation of error frequency is not expected.

2.3 Visuospatial
1. *Prior to administering the visuospatial tasks, fold the paper on the dotted line, to ensure the patient is unable to see questions from the Memory section.
2. *Visual Cancellation of A's* (a) Administration:
(i) Hand the patient a pen/pencil and say, "Here, you are going to see some letters. I want you to cross out all of the "A's" in this area without missing any. Go ahead."
(b) Scoring:
(i) Frequency of omission and commission errors should be summed.
(ii) Qualitative interpretations should be made based on the sum of total errors.

3. *Visual closure recognition*
(a) Administration:
(i) Hand the patient a pen/pencil, point to the visual closure recognition area and say, "Here are some figures that have been separated. I want you to put them together in your mind and tell me the names of each figure."
(ii) Record responses verbatim on the lines provided under each figure.
(b) Scoring:
(i) Acceptable responses for each figure include:
Figure 1: square; rectangle; quadrilateral
Figure 2: heart
Figure 3: arrow
(ii) If an individual provides an incorrect response on an earlier item, but provides a correct response on a later item, qualitative interpreted should be made based on the patient's highest correct response.
Example 1: If an incorrect response is made for Figure 1, but correct responses are provided for Figures 2 and 3, the overall performance should be interpreted as within normal limits.
Example 2: If incorrect responses are provided for Figures 1 and 3 and a correct response is provided for Figure 2, this should be interpreted as mildly impaired.
. Line bisection (a) Administration:
(i) Hand the patient a pen/pencil, point to the line bisection area, and say, "Look at these lines. I'd like you to use your pen/pencil to draw a vertical line through the middle of each of the horizontal lines in this box."
(b) Scoring:
(i) Total the frequency of "Off-Center" lines, which include all lines that deviate more than 6 mm from the center of a horizontal line.
(ii) Right-left bias is calculated by totaling the directional bias of each off-center line.
(iii) Multiple off-center lines with consistent directional biases should be considered impaired.
5. *Rampart copy*
(a) Administration
(i) Hand the patient a pen/pencil, point to the image of the ramparts, and say, "I want you to copy this entire design in the space provided below."
(b) Scoring
(i) Total the frequency of perseverative, omission and commission errors.
(ii) A perseverative error should be counted each time a shape is repeated in the drawing sequence.
(iii) Overall performance on this task is considered impaired if any errors occur.
6. *Pentagons*
(a) Administration
(i) Hand the patient a pen/pencil, point to the image of the pentagons, and say, "I want you to copy this design exactly in the space provided next to it."
(b) Scoring
(i) To receive full credit, the drawing must include: 1) two pentagons with sides that are mostly equal in length and 2) the two pentagons should overlap one another, with less than one full side overlapping the other figure.
7. *Clock drawing*
(a) Administration:
(i) Hand the patient a pen/pencil, point to the image of the clock drawing area, and say, "I would like you to draw a clock and set the time to 11:10."
(b) Scoring
(i) Patient can receive 1 point for each of the three criteria:
1. ***Contour:*** The clock needs to be drawn as a circle with minimal distortion.
Numbers: Clock numbers 1–12 need to be included and in their correct locations. Patients can receive credit if the numbers are accurately placed outside of the clock's perimeter.
3. ***Hands:*** Two hands must be included to receive credit. There must be an hour hand that is clearly shorter than the other and the two hands must originate from the center of the clock.

2.4 Language
. Simple/complex/discourse (a) Administration: "I'm going to ask you some questions and I want you to tell me the answer."
(b) Scoring: Record a "✓" for correct responses and "X" for incorrect responses.
2. *Command*
(a) Administration: "I am going to give you some commands. I'd like you to do what I say, and then relax."
(b) Scoring: Record a "✓" for correct responses and "X" for incorrect responses.
(i) If the patient correctly points to the floor and ceiling during the final trial, but does so in an incorrect order, this is considered incorrect.
3. *Repetition*

(a) Administration: "I am going to say a word or phrase, and I want you to repeat what I say. Say …"
(b) Scoring: Record a "✓" for correct responses and "X" for incorrect responses.
4. *Naming*
(a) Administration:
(i) Choose one of the three lists provided on the sheet to follow (e.g., Shirt, Sleeve, Collar, Cuff).
(ii) "I am going to point to some objects, and I want you to tell me what I am pointing to."
(b) Scoring: Record a "✓" for correct responses and "X" for incorrect responses.
5. *Reading*
(a) Administration
(i) Fold the BBRAT form where it says "Reading" before presenting to the patient.
(ii) "I want you to read this aloud and do what it says."
(b) Scoring
(i) If the patient either reads the statement aloud but does not raise their hand or raises their hand but does not read the statement aloud, it should be recorded as "Incomplete."
. Writing
(a) Administration
(i) Fold the BBRAT form where it says "Writing" before presenting to the patient.
(ii) Ask the patient to write their full name in the "Name" box
If they are unable to do this, discontinue.
(iii) If they can write their name, ask them to write any sentence.
If they cannot think of something to write about, ask them to write about how they are feeling.
(b) Scoring
(i) Individuals should receive full credit if they accurately write their full name following an initial request or prompting. If they only write their first or last name even after being prompted, this should be considered incomplete.
(ii) If the individual writes a sensible, full sentence, including a subject and a verb, they should receive full credit.
Full credit may still be provided even if punctuation is incorrect.
(iii) If the individual writes a word or a non-coherent group of words, this should be considered incomplete.

2.5 Abstraction/reasoning/judgement
. Convergent & divergent reasoning (a) Administration
(i) Questions can be repeated if requested.
(ii) If a patient provides multiple answers, ask them to select their best answer.
(b) Scoring
(i) Convergent reasoning
While not all possible responses could be included on the BBRAT form, additional abstract responses should receive full credit, while concrete responses should be considered as indicating mild impairment.
(ii) Divergent reasoning
Responses unique to those provided on the BBRAT form indicating distinct, categorical differences, should receive full credit.
2. *Sequencing* (a) Simple
(i) Administration
Ask the patient to, "Count from 1 to 25."
Ask the patient to, "Count backwards from 10."
Follow-up attempts may be made on these tasks if requested by the examiner/examinee.
(ii) Scoring
Tasks should be completed without error.
Examinees should receive full credit if they complete the task successfully, even if this is accomplished on follow-up attempts.
(b) Complex
(i) Administration
Read each number or number/letter combination at a rate of one per second.
Say, "For this task, I am going to begin a pattern and, when I stop, I want you to say the next two sequences of the pattern."
(ii) Scoring
Record a "✓" for correct responses and record incorrect responses verbatim.
3. Judgement (a) Administration
(i) Questions can be repeated if requested.
(ii) Responses should be directly recorded on the BBRAT form.
(iii) Say to the patient, "I am going to ask you some questions and I want you to answer each question as best you can."
(b) Scoring
(i) Criteria for interpreting responses can be found on the BBRAT form [9].

3. Participants

We administered a Brief Bedside Repeatable Assessment Test (BBRAT) to 40 individuals aged 29 to 40 years who did not suffer from any co-morbidities or disorders at the executive function level or cognitive processes, With the aim of measuring the psychometric properties of the test.

4. Calculating the psychometric properties of Brief Bedside Repeatable Assessment Test (BBRAT)

The test consisted of 5 items and was administered to 40 individuals using a two-point answer system: 0 for incorrect answers and 1 for correct answers. To calculate the psychometric properties of the test, we followed these steps:

4.1. Reliability: was calculated using the Kuder-Richardson coefficient of (KR-20), which is the most appropriate and accurate type when the test items are measured in a binary way, for example, yes or no. 0/1 This coefficient aims to measure internal consistency, i.e., the coherence and homogeneity of the items, in measuring test reliability.

4.1.1 The result (0.78) indicates that 78% of the variance in individual scores is due to genuine differences in their abilities at the executive function level of the test. Only 22% is attributed to random errors in scales with few items. Since the test contains five items, a value above (0.70) is an excellent indicator of the instrument's reliability.

4.1.2. The standard error of measurement (0.58) indicates that the dispersion of individuals' scores around their true scores is very small, less than one point, giving high reliability to the results upon repeated administration.

The following table shows the results obtained:

Table 1: Reliability of Brief Bedside Repeatable Assessment Test (BBRAT)

Psychometric index	Value	Targeted reliability type	Psychometric Interpretation
The Kuder-Richardson coefficient of (KR-20)	0.78	Internal consistency	Very good and suitable for making research decisions.
The standard error of measurement (SEM)	0.58	Accuracy and stability of the observed score	Low, reflecting high test accuracy

4.2. Validity: We relied on construct validity, represented by the internal consistency of the items. This validity is calculated by verifying the correlation of each item with the total test score, while excluding the item itself to avoid statistical inflation.

4.2.1. Difficulty and Discrimination Indices for Items: Interpretation of the results for items 1, 2, 3, and 5: Items 1, 2, 3, and 5 showed excellent difficulty and discrimination indices. A balanced difficulty index of around (0.50) ensures that the item accurately measures individual differences. A discrimination index above (0.30) confirms its validity, Individuals who achieved a high overall score were the same ones who answered these items correctly.

Item four exhibited a psychometric flaw with a difficulty index of (0.85), indicating it was too easy. 85% of the sample answered it, resulting in a decrease in its discriminatory validity to (0.25), This means it does not effectively differentiate between strong and weak executive functions, necessitating its modification.

The following table shows the results obtained:

Table 2: Validity of item Brief Bedside Repeatable Assessment Test (BBRAT)

Item Number	Difficulty Index (P)	Discrimination Coefficient (D)	Type of validity: Internal consistency	Psychometric decision
Item1	0.75	0.45	True correlation with overall score	Keep it unchanged.
Item 2	0.60	0.50	True correlation with overall score	Keep it unchanged.
Item 3	0.40	0.35	True correlation with overall score	Keep it unchanged.
Item 4	0.85	0.25	Weak correlation with the overall score	It needs review and modification.
Item 5	0.55	0.40	True correlation with overall score	Keep it unchanged.

6. CONCLUSION

Modern neuropsychological studies confirm that traumatic brain injuries, at all levels, cause significant impairments in executive functions, particularly in working memory, executive attention, cognitive flexibility, and the ability to plan and make decisions. This directly impacts the professional and social performance and functional independence of those affected. Recent research has also shown that assessing this impairment cannot rely solely on traditional cognitive tests. Instead, it requires an integrated approach that includes specialized neuropsychological testing, realistic behavioral assessments, and long-term functional performance indicators. Current findings indicate that the severity of the brain injury, the duration of unconsciousness, and age factors are associated with the degree of executive deficit. Artificial intelligence techniques and modern predictive models are emerging as promising tools for improving the accuracy of assessment and predicting functional recovery [10]. Furthermore, scientific evidence confirms that early intervention and cognitive rehabilitation contribute to reducing the long-term effects of executive deficits and improving the chances of returning to normal professional and social life for those with brain injuries.

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