Potential Elements for Development of a Versatile Cognitive Function Screening Tool

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ABSTRACT: *Cognitive function screening tools are so useful in detection of cognitive impairment resulted from both neurodegenerative, non-neurodegenerative, neurodevelopmental and non-neurodevelopmental disorders. Moreover, it is also used as cognitive aptitude tests or general cognitive ability tests in non-clinical settings such as in various recruitment processes. However, most of the cognitive function screening tools (CFST) available now is highly subjective and don't encompass a wide range of cognitive biomarkers and also don't apply a wide range of cognitive reagents. Whether cognitive function screening tools are pen-paper basedor digital, these essential elements have to be taken into consideration to ensure versatility, efficacy and accuracy of cognitive function screening tools. The same principle can be applied in development of cognitive function training tools (CFTT) that can potentially provide effective cognitive rehabilitation. A dual-functional model has been proposed and demonstrated that can potentially be used in pre-clinical and non-clinical settings.*
KEYWORDS: neurodegenerative, cognitive biomarkers, cognitive reagents, cognitive impairment

INTRODUCTION

Cognitive function screening tools(CFST)[1] are widely available in both pen-paper based[2] and digital formats. Cognitive function training tools (CFTT) are also available in earlier mentioned formats and both CFST and CFTT are being used pre-clinically[3] and non-clinically. There are similarities among the contents of CFST and CFTT and in both case a wide range of cognitive biomarkers[4]can potentially be encompassed and a wide range of cognitive reagents can potentially be applied. The aim and scope of this article is to explore the essential elements that must be utilized to develop a versatile cognitive function screening tool.

Design and Methods:

Cognitive biomarkers are basically the cognitive domains and cognitive reagents are basically the cognitive tasks [3,8]. When individuals perform a cognitive task, the domains get involved thus detection of any impairment can be traced.

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1.1Cognitive biomarkers:

The cognitive domains along with their sub-domains can potentially be termed as cognitive biomarkers.There are 2 types of cognitive domains:

1.Encoding domain: "Thinking" is the Encoding Domain. It encodes 6 cognitive domains.

2.Encoded domains: These cognitive domains are encoded by the encoding domain "thinking". These are as follows:

1.Perception

2.Attention

3.Memory: It has 3 sub-domains:

A)Short term memory

B)Long term memory

C) Working memory

4.Learning abilities: It has 2 sub-domains:

   A) Ability to follow instructions

   B) Ability to implement learned concepts

5.Decision making abilities: It has 4 sub-domains:

A) Reasoning

B) Abstraction

C) Categorization

D) Analysis

6.Language abilities

1.2 Cognitive reagents:

These are basically cognitive tasks that can be listed as follows -

1.Numerical/Alphabetical attention tasks

2.Word/image recall

3.Comparison/differentiation

4.Generalization

5.Numerical reasoning

6.Verbal reasoning

7.Shape/object recognition

8.General quantitative reasoning

9.Time/place orientation

10.Concept description/Spatial reasoning/Visuospatial function

11.Pattern recognition

Sample of a proposed dual-functional model:

If properly developed encompassing a wide range of cognitive biomarkers[5]and reagents, a dual-functional model[6]can be developed that can potentially serve the purposes as screening and training tools[6,15]. Sample of such a model has been demonstrated as follows:

Section -1:Time allocated:10 Minutes

A)Purpose: Code checking test for assessment of visual perception, attention and executive function:

1.Which of the answers below is an alternative to the code 492?

4	9	2
♣	♦	♠
C	S	F

A)C9♦

B)49S

C)♠CF

D)C9♠

B)Purpose: Quantification task for evaluation of quantitative reasoning:

2. Diana has 2 brothers namely Martin and Lewis. Martin is 10 and Lewis is 14 years of age respectively. What's the average age of Diana's brothers?(try to remember Martin's and Lewis' age as you may need it in later sections)

A)14

B)12

C)16

D)18

C)Purpose: Categorization task for assessment of abstraction:

3. Which one of the following words is most closely related to the set of words "(Zebra, Elephant)"?(try to remember the set of words as you may need it in later sections)

A) Vehicle

B) Instrument

C) Flower

D) Animal

D)Purpose: Reverse spelling task for evaluation of quality of concentration and working memory:

4. Which one of the following is the backward representation of the word "MANGO"?(try to remember the word as you may need it in later sections)

A)ONGAM

B)OGNAM

C)OAGNM

D)ONAGM

E)Purpose: Quantification task for evaluation of quantitative reasoning and working memory

5. How many 10 cents make $4?(try to remember the amount of cents and dollars as you may need it in later sections)

A)200

B)400

C)20

D)40

F)Purpose: Abstraction task for evaluation of span of attention

6. Which of the following letters are common in both of the following sets of letters?

"CMEHFRP" And "EVTNPDF"

A)G,P

B)T,M

C)H,D

D)E,F

G)Purpose: Time identification task for evaluation of visuospatial executive function and quality of concentration

7.The short arm of a clock is pointing at 11 and the longer arm is pointing at 12. So, what's the time?

A)11:12

B)12:11

C)11:00

D)12:55

H)Purpose: Visual search task for evaluation of span of attention and quality of concentration

8. Which one of the following digit can be found 4 times in the number below?

238563279251240

A) 8

B) 3

C) 2

D) 5

I)Purpose: Numerical reasoning task for assessment of cognitive perception, attention, general quantitative reasoning, pattern recognition, inductive thinking and analytical abilities:

9. Which of the following numbers can be used to fill up the blank spaces in the sequence below?

5,15,_,35,45,55,_,75,85,95

A)16,56

B)34,74

C)25,65

D)None of the above

J)Purpose: Digital-Letter substitution task for evaluation of span of attention and working memory

10. If, O=9, B=6, E=7, L=3, D=5, U=2. Then the word "DOUBLE" can be written as which one of the followings?(try to remember the word as you may need it in later sections)

A)592763

B)592736

C)592637

D)592367

Section -2:Time allocated: 5 Minutes

K)Purpose: Word and number recall tasks for evaluation of short term memory:

11.Which one of the following code was mentioned in one of the previous questions in section-1?

A)738

B)739

C)736

D)735

12.What's Lewis' age?

A)17

B)10

C)14

D)12

13.What was the amount mentioned in one of the previous questions in section-1?

A)$3

B)$4

C)$6

D)$8

14.Which one of the following words was mentioned in one of the previous questions in section-1?

A) Giraffe

B) Zebra

C)Horse

D) Camel

15.Name of which one of the following fruits was mentioned in one of the previous questions in section-1?

A) MELON

B) MANGO

C) LEMON

D) PAPAYA

Scoring system:

Score distribution:

+1 for each right answer

0 for no/wrong answer

+2 if formal education is less than or equals to 12 years

+1 for each additional 10 years span if age is 65 or above

Score interpretation:

15 and above – 10 = NO cognitive impairment

9-6= Mild cognitive impairment

5-3= Moderate cognitive impairment

2-0= Very Severe cognitive impairment

Discussion

Several variants of such model [7,8,9,10] can be developed as both pen-paper based and digital versions that can potentially support the progressive nature of neurodegenerative conditions, the longitudinal nature of clinical trials focusing on development of experimental drugs that can potentially be used to treat neurodegenerative conditions and gradual nature of cognitive training programs[11,12]. A single cognitive task potentially expose multiple cognitive domains as there are correlations regarding function of cognitive domains. Such as, working memory and attention along with the sub-domains namely quality of concentration and span of attention functions simultaneously, thanks to the neural networks of the brain. Artifacts such as formal education and age can be eliminated by precise structuring of the scoring system that acts as a quantificative scale to provide potentially accurate report about individuals' cognitive status. Even though the proposed model may seem promising, proper validation studies are required to prove it's efficacy, versatility, accuracy and dual-functionality.

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