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Manual

A screen for individual cognitive profiling and classification

MANUAL

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1 Introduction

1.1 SUMMARY

Following brain injury (stroke, head injury, carbon monoxide poisoning) people can experience a range of cognitive problems, in addition to any difficulties in motor function – this includes changes in language ability, in memory, in the ability to attend to their environment, to maintain concentration and to plan tasks, to plan and program action and problems in maths and money handling. These cognitive problems strongly influence how well people functionally recover after a brain injury, e.g., a stroke. Very often individuals are not routinely screened to detect these cognitive problems. BCoS is a new test instrument developed to screen individuals for cognitive problems, giving in about a 1-hour testing session a novel **cognitive profile** across a range of cognitive processes. BCoS has been validated against 'standard' neuropsychological tests used to measure similar cognitive functions within populations of brain injury survivors both in a sub-acute stage post lesion (<3 months) and in a chronic stage (at least 9 months post damage). The BCoS screen has also been used for prognostic modelling, assessed against measures of cognition and activities of everyday living for survivors in the chronic stage. Deficits in individuals have been assessed in relation to measures of the location of the brain lesion (using both CT and MRI scans), to provide information about lesion–symptom relations.

BCoS is designed to provide an overview of the cognitive profile of individuals with brain lesions from a variety of aetiologies, with the data assessed against either the age-profiled results from non-lesioned normal subjects or the data from our large population of stroke survivors.

1.2 BACKGROUND TO THE SCREEN

Two of the most obvious consequences of brain lesion are motor impairments and impairments in spoken language – these deficits being evident in

the everyday behaviour of individuals with damage to motor and language areas of the brain. Therapists working on physical and speech recovery in individuals are well served with tests that enable motor and language deficits to be documented. However, individuals with neurological damage can also be affected by a number of other problems that are less obvious in some respects, but nevertheless have serious consequences for recovery of function (and are often more serious than motor or speech impairments). For example, impairments in perception and in the ability to control and sustain attention (deficits in so-called 'executive attention') are both relatively common in stroke survivors (e.g., affecting over 50% of the individuals documented in the BCoS screening programme at Birmingham University and similar numbers in other studies; Donovon et al., 2008), and are associated with poor outcome (Donovon et al., 2008; Narasimhalu et al., 2009; Nys et al., 2006). Due to the prevalence of problems in attention, and the relations between these problems and outcome, it is important to develop measurement tools that can be applied in clinical settings and in relatively acute stages, in order to pick up on any problem. In addition, it is important to know the relations between individuals' problem in attention and their other cognitive abilities, since an impairment in attention can impact on other functions – for example, if there is poor sustained attention, then the ability to follow a set of instructions may be compromised, problems such as visual neglect may be worsened, and so forth. Hence deficits in attention need to be measured in relation to other cognitive abilities. This is the aim of **BCoS**. BCoS is designed to provide a **cognitive profile**, which will indicate whether an examinee has a clinical impairment (related to norms) in five primary domains of cognition:

- attention and executive function
- language
- memory
- number skills
- praxis and action.

1.3 THE BCOS PHILOSOPHY

BCoS is designed to meet the need to (i) provide a sensitive and informative analysis of the cognitive profile across a range of clinically important abilities, and to do this (ii) in a time-efficient manner and (iii) with maximal inclusion of examinees. The test domains have been chosen as those where significant problems will have a direct impact on everyday life – from neglecting one side of space (attention) through an inability to sequence

actions in everyday tasks (praxis and action) and to problems in money handling (number skills). To enable the screen to be sensitive and informative, time efficient and maximally inclusive, the tests have been constructed with four key **B_philosophies** in mind:

(a) B_Sensitive

The stimuli critical to each test are chosen to be relatively difficult within their domain. For example, the *reading tests* examining irregular words use low-frequency stimuli, the *picture naming* task draws on objects low in familiarity and name frequency, and so forth. This is done in order that the test should pick up a problem if one exists.

(b) B_Informative

Wherever possible, tests are designed to give direct information about the nature of the problem in relation to cognitive models in each domain. For instance, the *reading tests* assess the naming of irregular low-frequency words and nonwords, enabling diagnoses of surface and phonological dyslexia to be advanced (reflecting impairments in using lexical and non-lexical phonological processes in reading). In some cases this is not possible because it would require more protracted testing and violate philosophy (d) below. In such instances, a problem detected through BCoS should be used as the start-point for more detailed testing – an example would be to distinguish between problems in semantics and in name retrieval when there is a clinical problem in picture naming. In addition, tests are designed to try to rule out contributions from irrelevant factors that could otherwise impact on performance. For instance, in the measure of rule finding and concept switching, the examiner is instructed to leave out the result sheet for the examinee's previous choice, to reduce memory demands so that the test is weighted to the demands of rule finding and concept switching rather than working memory.

(c) B_Inclusive

The tests are designed to be as inclusive as possible for individuals with common problems after brain lesion, which can often impact on measures of cognition that are not meant to test that ability (and may even prevent individuals from being assessed). Most specifically, BCoS is 'neglect, aphasia and hemiplegia friendly', meaning that data can be collected that are not contaminated by these problems when they are irrelevant for the test. For example, to avoid irrelevant effects of neglect, stimuli are laid out using vertical rather than horizontal arrangements, and rules are given for cueing examinees to attend to stimuli when the tests are administered. To avoid irrelevant effects of aphasia, tasks use high-frequency short words that

individuals with aphasia are likely to be able to process, where possible stimuli are presented visually and verbally (avoiding problems in one modality), and forced-choice administrative procedures are employed to minimise deficit due to poor word finding. To avoid irrelevant effects of hemiplegia on the tests of praxis and action, examiners are allowed to support the performance of examinees in non-critical ways and testing can be conducted with the unaffected rather than the affected limb.

(d) B_Time Efficient

BCoS aims to provide a **broad but brief** analysis of cognition – sampling broadly across the five chosen domains at a level that is relatively shallow (and so time efficient), but sufficient either to directly identify a problem or to point to ways that the problem can be analysed further [philosophy (b)]. To maximise time efficiency, tasks are created so that, where possible, several measures can be derived from a single test. For example, the auditory attention test provides measures of selective attention, sustained attention and working memory. The rule finding and concept switching task indexes both of these functions. The memory task provides indices of encoding, retrieval blocking and forgetting/consolidation. In addition, many of the tests have 'stop' criteria, where the test is stopped if the examinee does not pass the first items, and their score overall is extrapolated from the initial failures. This reduces the numbers of failures made by examinees who have difficulty with particular tests while also reducing the administration time. The tests should also be administered in a set order to provide maximum clinically relevant information, and to accommodate the verbal and task memory items while reducing the interference of verbal tasks.

In addition to the benefits that accrue from the B_philosophies, BCoS has particular virtues.

- In about **1 hour** a **cognitive profile** is generated covering attention, language, memory, praxis and number processing. This gives novel information about co-occurring deficits, which, due to their combined action, can affect outcome. The cognitive profile also enables examiners to control for effects of co-occurring deficits when analysing data.
- BCoS gives measures of several **attentional and executive functions** (controlled, selective and sustained attention, working memory, rule finding and concept switching) not covered in many tests.
- BCoS measures **multi-step use of real objects** as well as tests of **praxis**, linking to problems in action planning and sequencing.

1.4 TRAINING, WEB SUPPORT

Alongside the BCoS test, we also provide:

- on a subscription basis associated training packages including DVD-based examples of test administration and scoring, and access to other updates for **continued professional development**.
- on a subscription basis automated **data-entry and scoring**, including the provision of a 'visual snapshot' of an examinee's cognitive profile, for use in clinical decision making and care management (Figure 1).
- on a free look-up service, adaptable pages for multiple choice answers to the Time and Space sections of the Orienting questions.

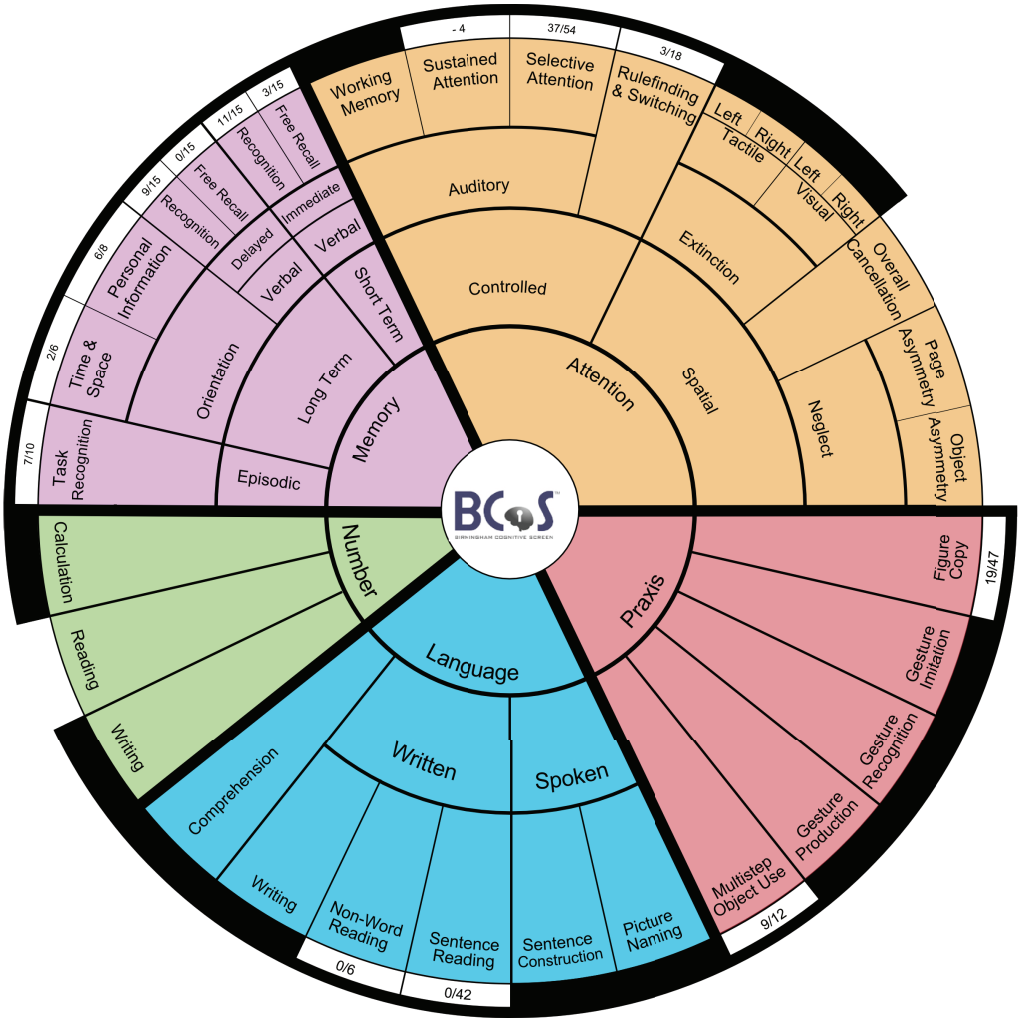

Figure 1 Example snapshot 'cognitive profile' for an examinee, showing the five major domains of cognition addressed by BCoS (Attention, Language, Memory, Number, Praxis), with their associated sub-domains (long-term, short-term and episodic memory, etc.) and specific tests associated with those sub-domains (reading, writing, etc.). The classification is indicated by the outside band. White = impaired; black = spared (control level of performance); missing segment = not tested.

In order to make optimal use of BCoS, including gaining hands-on experience in time-efficient test administration and scoring, we recommend that practitioners undergo **BCoS training**. Details of **training, continued professional development and automated data-entry and scoring** are provided at www.cognitionmatters.org.uk.

1.5 BCOS DOMAINS

BCoS is designed to provide a set of 'broad but shallow' measures covering: (i) attention and executive functions, (ii) language, (iii) memory, (iv) number skills and (v) praxis and action. The tests more specifically examine:

Cognitive domains	Sub-domains
Attention and executive functions	Spatial attention, controlled attention
Language	Spoken, written
Memory	General orientation in space and time, episodic memory
Number skills	
Praxis and action	

BCoS tests were designed to assess different aspects of cognitive models for each domain. The measures of **Attention and Executive Function** assess (i) the allocation of attention in different spatial coordinates (**egocentric** and **allocentric** space) and (ii) the control of attention. The latter indexes the ability to select targets not distractors (**selective attention**), to sustain attention over trials (**sustained attention**) and to hold task goals while processing other information (**working memory**). There is prior evidence that these different aspects of attention can be separated. **Executive functions** are defined here as the ability to find rules in a sequence of stimuli and to switch mental set, when a rule changes.

The **Language** tasks cover **Spoken** and **Written** language processes. Tests of **spoken language** tap object recognition and name retrieval (picture naming) along with semantic and syntactic processing for speech production. Tests of **written language** evaluate both lexical and non-lexical reading processes (sentence and nonword reading respectively) and writing (words and nonwords).

The **Memory** tests examine current autobiographical memory (orienting to time and place), longer-term verbal recall and recognition and recognition for items not explicitly memorised (task recognition).

The **Number Skills** tasks tap the ability to read and write numbers and prices, plus also the ability to make different calculations.

The measures of **Praxis** demand visuo-spatial construction (complex figure copy), everyday multi-step action (multi-step object use), and gesture production, recognition and imitation. These last tasks assess input and output coding of known and novel gestures (input tasks: recognition, imitation; output tasks: production, imitation), to evaluate both direct/lexical and indirect/non-lexical processes in gesturing.