

Administration Manual

Disorders of Consciousness Scale-25

(DOCS-25)

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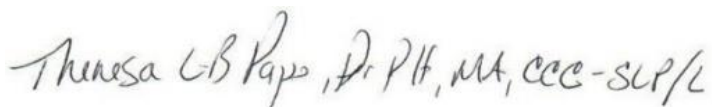
Dedication

The DOCS-25 test is dedicated to my sister Patricia Ann Bender (1957 – 2008), my brother Stephen Robert Bender (1965 – 1997) and my parents (Gloria Bender 1929– 2008; Frank J. Bender Jr. 1926 – 2018). Patty and Stephen were both survivors of severe brain injury and my parents were their lifelong caregivers. In college, Patty studied music, opera major, and I still remember her doing the dreaded vocal exercises in her bedroom (which was right next to mine). Patty was offered her first Broadway audition just before becoming seriously injured. While she never made it to that audition, I still listen to her angelic recordings while driving. In a complicated birth, Stephen suffered severe oxygen deprivation and I only heard him speak one time. As a young girl, I often read to him and during one of these story times he verbalized the word ‘cookie.’ This immediately provided the justification I needed to sneak him and myself several cookies, I think that they were chocolate chip. While he only spoke to me that one time, I often hear him speaking to me in my dreams. Patty and Stephen both lived a long life with chronic disabilities and are passed away before any of us were ready to say goodbye. I am forever grateful to them for letting me be a part of their lives. The paucity of specialty rehabilitation and my parents serving as primary caregivers over the course of their lifetime, inspire me to understand how to measure progression from a coma, detect treatment effects at the individual patient level and at the group level. They also drive my dedication to developing treatments for a patient population who still has limited treatment options.

I also dedicate this test to the over 200 severe brain injury survivors, and their loving caregivers, who participated in the early research that ultimately led to the DOCS-25. So many of their names and faces come to mind and everyone of these participants allowed us to meaningfully advance the science of measuring neurobehavioral function in survivors of severe brain injury. Even today, many of these caregivers are helping us understand what meaningful change means to them. Finally, I dedicate this test to the many therapists who also participated in this research as raters, which provided us with the data we needed to examine the impact of reader severity and leniency on measurement of neurobehavioral function.

I started developing the DOCS-25 while working on my doctoral degree, and ultimately finished the first version (V1) in 2001. The DOCS was originally titled the “Standardized Assessment of Consciousness” but I changed it to the DOCS in 2001. The second version, DOCS-23, came out in 2010 because it was based on a set of 23 test items. This third and final version, DOCS-25, is comprised of a final set of 25 test items. I had a lot of wonderful collaborators with whom I worked with on this test, and I am particularly grateful to: Ann Guernon, Sandra Lundgren, Michelle Peterson, Allen Heinemann, James Kelly, Trudy Mallinson and Jennifer Weaver.

On a final note, I want to thank all of the above family members, survivors, caregivers, health care providers and scientific collaborators. Your dedication to the science of improving the lives of persons with severe brain injury allows us to advance rehabilitation care for survivors of severe brain injury.



Theresa GB Papp, Dr. PH, MA, CCC-SLP/L

Prologue

ABOUT THE PRIMARY AUTHOR OF THE DOCS

Dr. Theresa Louise-Bender Pape is a Clinical Neuroscientist with the Veterans Administration (VA) Rehabilitation Research and Development (RR&D) Service and Research Professor at Northwestern University's Feinberg School of Medicine in the Department of Physical Medicine and Rehabilitation. Dr. Pape also works as a Clinical Research Associate at Marianjoy Rehabilitation Hospital.

Dr. Pape received her Master's in speech-language pathology from Western Michigan University in 1986. She implemented her speech-language skills by providing services to individuals with Traumatic Brain Injury (TBI) at the Rehabilitation Institute of Chicago. In 1999, she completed a pre-doctoral fellowship with the VA and also received a Doctor of Public Health (Dr. PH) from University of Illinois at Chicago. In 2001, Dr. Pape completed a post-doctoral fellowship at Northwestern University's Institute for Health Services Research and Policy Studies as part of an Advanced Rehabilitation Research Training Program sponsored by the National Institute on Disability and Rehabilitation Research (NIDRR) and was awarded a NIDRR Merit Switzer fellowship in 2000. Dr Pape also received three consecutive Career Development Awards (CDA) with the VA RR&D services; her first was related to rehabilitation measurement and outcomes in severe TBI. She received an Advanced CDA to study advanced neurosciences and neural plasticity subsequent to receiving a CDA Transition Award that enabled her to study neural plasticity in neurorehabilitation after TBI.

Dr. Pape's training in speech-language pathology and neuroscience cuts across traditional medical rehabilitation boundaries. Dr. Pape applies and synthesizes her clinical experiences and advanced training in neurosciences, neural plasticity, CNS repair mechanisms, measurement, outcomes, statistics, and research design to plan and test rehabilitation-focused interventions that promote neural plasticity adults recovering from severe TBI.

Motivated by the desire to provide more effective rehabilitation for adults in disordered states of consciousness, Dr. Pape recognized the need for an accurate, reliable, and responsive assessment tool to capture recovery of consciousness during the neurorehabilitation trials that she intended to conduct. The result of this discovery resulted in Disorders of Consciousness Scale (DOCS), first published in 2006.

Dr. Pape's research career started in rehabilitation measurement and outcomes because of the need to develop accurate measures of neurobehavioral functioning that can be obtained at the bedside. Dr. Pape determined that development of these measures was critical for the conduct of effectiveness research to examine therapeutic effectiveness at the behavioral level. Dr. Pape developed the DOCS as one step toward her career of developing medical rehabilitation interventions to shape and guide CNS repair to ultimately lead to functional recovery after severe TBI. In addition, Dr. Pape recognized that prognosis, rather than diagnosis, was a priority when developing the DOCS because families needed information regarding what is expected when responding to and coping with logistical, financial, personal and ethical issues that are associated with lifetime of severe impairments.

Dr. Pape's dedication to help persons and families recover from the devastating effects of severe TBI is reflected in perseverance to improve measurement and treatment for these individuals. This manual is dedicated to the families and loved ones with consciousness disorders that have been generous with their time and insights.

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Study Participants and Caregivers:

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Research Team Members:

This work would not have been possible without the dedication, hard work, and remarkable efforts of Ann Guernon, PhD, CCC-SLP. Dr. Guernon has collaborated with Dr. Pape since 1999, providing practical help with data collection, clinical insights, and irreplaceable moral support.

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The cooperation, collaboration, and continuous support from the contributions of the participating hospitals facilitated the implementation of this research. In addition, the rehabilitation practitioners in each hospital including speech-language pathologists, occupational therapists,

respiratory therapists and nurses whose pursuit of excellence contributed to the quality of data collection is highly appreciated. These hospitals include:

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Abbreviations Used in Manual:

BI – Brain Injury

CHART - Craig Handicap Assessment and Reporting Technique

CNS - Central Nervous System

CRS – Coma Recovery Scale

DIF - Differential Item Functioning

DOCS – Disorders of Consciousness Scale (earlier version)

DOCS-25 – Disorders of Consciousness Scale-25

eMCS – Emerging Minimally Conscious State

GCS – Glasgow Coma Scale

GR – Generalized Response

IP - Inpatient

LR – Localized Response

MCS - Minimally conscious state

NPV– Negative predictive Value

NR – No Response

PCA - Principal Component Analyses

PPV - Positive Predictive Value

SE - Standard Error

SMART - Sensory Modality Assessment and Rehabilitation Technique

TBI – Traumatic Brain Injury

UTI – Urinary Tract Infection

VS - Vegetative state

WHO – World Health Organization

WNSSP – Western Neuro Sensory Stimulation Profile

GLOSSARY OF TERMS

Coma: State of prolonged unconsciousness that a person cannot be awakened. A person in coma does not respond to painful stimuli, light or sound.

Consciousness: The state of being aware of oneself and external information

Disorders of Consciousness: Difficulty maintaining wakefulness and/or awareness of self and environment due to severe injury to the brain.

Logit: A unit of additive measurement. A log-odds unit that is well-defined within the context of a single homogenous test. It is used to express item difficulty on a linear scale that extends from negative infinity to positive infinity.

Minimally Conscious State: Condition of severely altered consciousness with minimal but definite, sustained and/or reproducible behavioral evidence of awareness of self or environment is demonstrated. There may be periods of communication or response to commands, but these periods are inconsistent.

Minimally Important Clinical Difference: Represents the smallest improvement considered worthwhile by a patient.

Vegetative State/Unresponsive Wakefulness Syndrome: Condition of severely altered consciousness with evident periods of sleep and wakefulness, but no signs of awareness. There may be periods of eye opening and sleep-wake intervals but no meaningful responses to stimulation.

Rasch Analysis: A unique approach to mathematical modeling. The Rasch model is used to measure attitudes or abilities. It shows the probability of an individual getting a correct response on a test item.

Chapter 1: Introduction to the DOCS-25

Description of Measure:

The Disorders of Consciousness Scale (DOCS-25) is a bedside assessment measuring neurobehavioral functioning during coma recovery of individuals. This bedside neurobehavioral evaluation was designed to detect changes in observable indicators of neurobehavioral functioning. It enables observers (clinicians, caregivers) to examine unconsciousness as a continuum of fluctuating levels of neurobehavioral integrity while detecting and distinguishing between true changes and random fluctuations. The DOCS-25 provides a clear description of neurobehavioral recovery including various levels of neurobehavioral integrity (coma, vegetative, minimally conscious) and the quality of behavioral responses to sensory test stimuli.

Purpose:

One of the most crucial and challenging tasks for clinicians providing medical care for survivors of severe brain injury (BI) is establishing a prognosis for long-term functional recovery. Clinicians and caregivers need an assessment that (1) can be completed at bedside, (2) is sensitive to subtle changes in neurobehavioral functioning, (3) produces a reliable and valid measure of neurobehavioral functioning in unconscious persons over time, and (4) can identify the factors that influence and predict recovery. Additionally, the DOCS-25 was designed to help clinicians provide early counseling to families and to guide and evaluate the effectiveness of medical and rehabilitation interventions.

Why Does DOCS-25 Scoring Reflect the Person's Best Performance?

The DOCS-25 is different from other bed-side assessments of neurobehavioral function for individuals with disorders of consciousness because it captures the person's 'best response' to sensory stimuli rather than their most consistent response. By scoring the person's best responses, we give them an opportunity to demonstrate their optimal capability. Administration procedures provide multiple opportunities to demonstrate behavioral responses to test stimuli (e.g., 'Is your name Jane?' and 'Tell me your name.') and provide multiple response modes (e.g., verbal, gestural, visual e.g., point at yes/no cards). The multiple stimuli and responses modes also help avoid confusing degree of consciousness with impairments of language, arousal, wakefulness, or awareness.

History & Development of the DOCS-25:

The development of the DOCS-25 was an iterative process with refinements and revisions based on ongoing data collection and the evolving state of science. The first version, the DOCS-23 was developed between 1991 and 1992 and was titled 'Standard Assessment of Consciousness', which was later renamed as 'DOCS' in 1995 (Pape, 1999). Between 1992 through 2001, pilot studies informed revisions to the assessment, including changes to the rating scale and test stimuli (Pape, 1999). The original 23 items were developed based on literature review by a group of rehabilitation practitioners, including occupational therapists, physical therapists, speech and language pathologists, and other professionals in the field (Pape, 1999). The DOCS-23 was critically reviewed by 8 of the 21 members of the Aspen Neurobehavioral Workgroup on the Vegetative and Minimally Conscious States which included the co-chairs for the group and one of the authors for the GCS (Pape, 1999, Pape, Heinemann, Kelly, Hurder & Lundgren, 2005)

The reliability, construct validity and predictive validity of the DOCS-23 (Pape, 1999) was examined among 44 rehabilitation practitioners with 95 mostly young (36 years old on average) males (85%) with closed head injuries (72%).

In 2014, the DOCS-23 was updated to extend its ability to describe changes in performance across a broader range of neurobehavioral function in order to better understand recovery. Prospective observational data were collected from 1996 through 2010 in order to update the assessment's psychometric properties and clinical utility. This study added new items and removed some existing

items, resulting in the DOCS-25 (Pape, Mallinson, & Guernon, 2014). A total of 174 participants who experienced a severe brain injury of traumatic, anoxic, or hemorrhagic cause participated in this study. (Pape, Mallinson, & Guernon, 2014)

Components of the DOCS-25:

The DOCS-25 consists of 25 sensory stimuli (items) that are administered by observers (clinicians or caregivers) to persons in disordered states of consciousness. The DOCS -25 test kit consists of a manual, a rating form, testing items, and pocket reference cards to support administration at the bedside.

Baseline observations of the person's response to their environment are completed prior to administering the test items. Observers administer the items (e.g., sensations, commands), observe the individual's behavioral responses and rate behavioral responses to the items (i.e., responses deviating from baseline) according to a 3-point rating scale (0 = No response, 1 = Generalized Response, 2 = Localized Response).

Time to Administer the DOCS-25:

The amount of time required to administer the DOCS-25 may vary based on the purpose of the assessment, although for most individuals it can be completed in 40-60 minutes. It is recommended that all 25 items be administered at baseline. For ongoing daily evaluation, it may be sufficient to administer only items that are aligned with the individual's current level of performance [See Chapter 5 for Interpretation].

Who Should Administer and Score DOCS items and Interpret DOCS-25 results:

The administration of test stimuli and observation of responses can be conducted by rehabilitation practitioners or caregivers. In clinical settings, DOCS-25 should be interpreted by rehabilitation clinicians (e.g., neuropsychologists, nurses, occupational therapists, physical therapists, psychologists, and speech language pathologists) after completing the training program.

Training:

The training requirements to administer the DOCS-25 in the clinical setting include reviewing this manual and viewing the scoring video. To learn more about interpretation of responses and scoring procedures, you can receive more information using the link below:

https://arch.library.northwestern.edu/concern/generic_works/qf85nb41q?locale=en

Chapter 2: Theoretical Basis of DOCS-25

Recovery in disorders of consciousness following severe brain injury is characterized by changes in neurobehavioral function (NBF). It is hypothesized that these changes in NBF reflect development of more complex connections among different regions of the brain. Persons with a severe brain injury who have lost consciousness for more than 24 hours may be appropriate for a DOCS-25 assessment. Severity of the brain injury is classified as mild, moderate or severe using an assessment such as the Glasgow Coma Scale (GCS).

Four Foundational Concepts in Administering & Scoring the DOCS-25

1. Establish baseline observations against which the responses elicited by test stimuli can be compared
 - The baseline observational protocol uses a systematic checklist to assess the person's movements, gestures, and fascial expressions without test stimuli.
 - This helps assessors distinguish between a person's true response to a test stimulus and random responses to ongoing environmental stimuli or their current physical state.
2. Maintain testing readiness throughout the assessment
 - The assessor continuously monitors if the person is ready to receive the next stimuli. If testing readiness is disrupted, for example the person's eyes close, the assessor can use readiness options to re-establish testing readiness.
3. Create optimal assessment conditions
 - The environment should be as free of extraneous noises, bright lights, and smells as possible and should have a comfortable ambient temperature so that test stimuli are not "competing" with other stimuli from the room.
 - Position the person so they are most comfortable and so they are able respond with parts of the body they have most control over e.g., head, eyes, fingers, toes.
4. Assessment procedures should leverage the assessor's best judgment
 - Assessors will use their knowledge of the person to optimize the opportunity for him or her to provide their best response. For example, the assessor may use scents that they know the person enjoys, or may choose a meaningful object for the person to follow with their eyes.
 - Assessors should also be aware that other conditions such as difficulty speaking (aphasia), difficulty planning movements (apraxia), vision problems, or poor sense of touch may influence the person's ability to respond to test stimuli. Awareness of these issues is important because they may make the person appear to be less conscious than they really are.

Sensory Domains:

The stimuli items of the DOCS-25 are organized into four sensory domains: Auditory Language, Gustation/Olfaction, Visual, and Somatosensory.

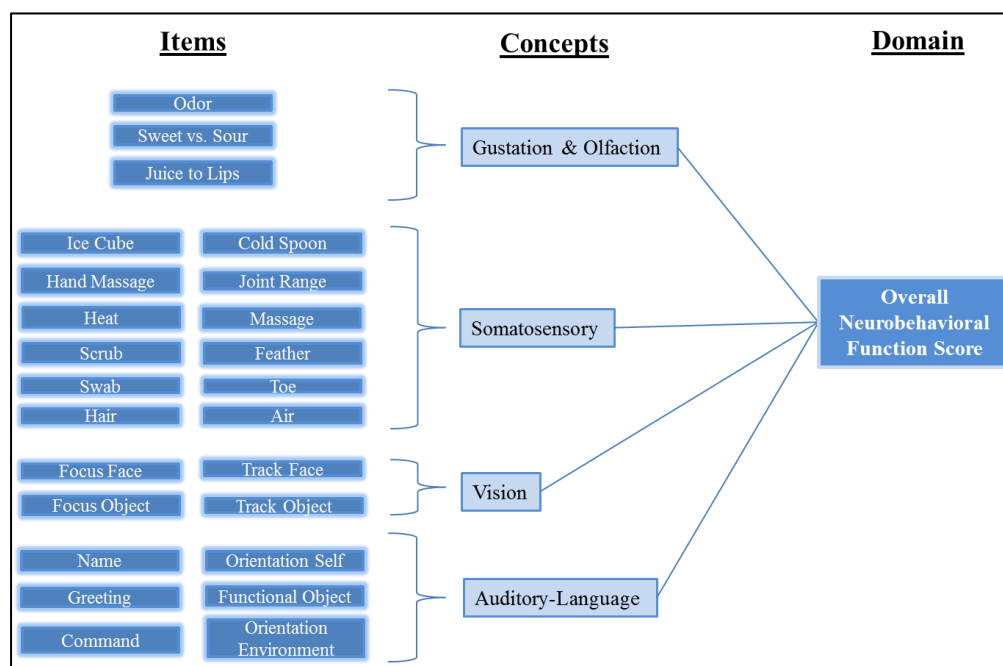
Auditory Language: Auditory responsiveness is based on a continuum from general awareness of language, to localizing auditory sources (knowing where the sound comes from), to behavioral responses to sound (such as turning towards the sound), to responding to increasingly complex information (such as responding to their name being called or following a simple command). The person is asked to follow commands that are tailored to their physical abilities.

Gustation/Olfaction: The stimuli indicate if the person has volitional control over salivation and swallowing. Once the person can control salivation and swallowing, they can be referred for additional assessment of swallowing abilities and eating by mouth. Since taste is one means of increasing salivation, (which is needed for swallowing) introducing a tasty liquid into the person's mouth would increase salivation, which in turn, would facilitate swallowing. The olfactory system (sense of smell) assists digestion, facilitates recollections, and gives emotional substance to the environment.

Visual: Visual function can be challenging to assess in person's with disorders of consciousness. However, visual function is frequently used to draw conclusions about re-emergence into consciousness. A lack of response to visual stimuli could indicate the person is in a vegetative state or a visual impairment (e.g., cortical blindness). A certain degree of visual discrimination can be indicative of a minimally conscious state.

Somatosensory: Heightened awareness of tactile (touch) sensation and/or tactile defensiveness is often observed following a severe TBI. Firm touch may be more soothing to these individuals compared to light touch. Until more definitive research is available DOCS-25 uses light touch as one of the tactile stimuli. Other stimuli include warm and cool temperatures and vibration.

Figure 2.1 Conceptual model of DOCS-25 items, sensory systems and neurobehavioral function.



Chapter 3: How to Build the DOCS Testing KIT

Creating a DOCS Kit:

To administer and score the DOCS, a test kit needs to be created. This DOCS test kit can be compiled by any individual for approximately \$50.00 - \$75.00 (US Dollars) and the items for this test can be purchased through various sources such as your local store and via internet. Items required for the DOCS-25 testing are provided below to assist clinicians to purchase supplies, considering those individuals that reside in areas that are outside the urban settings in the United States. Some items should be disposed of after every use. These are indicated in the right hand column. Some items may be used with the same patient on multiple time but should not be shared across patients. These are also indicated in the right-hand column. This manual does not endorse any brand, store or website. Below is a list of items needed to create a DOCS test kit (Table 3.1).

Table 3.1 Items for the DOCS Kit

Items	Description	Places Where You Can Purchase these Items	Suggested Disposal/ Infection Control Practices after use?*
1. MiniVibrator	Any small, portable vibrator	Any health care equipment store	Disinfect between uses
2. Flavor Extracts	Suggested flavors: vanilla, mint, orange, banana (only 2 are needed per administration)	Any grocery store	Store for 12 months or Best by date
3. Red block	About 1" square	Any toy store or department store selling children's toys	Disinfect between uses
4. Pressurized air	Standard size can.	Any office supply store, computer supply store.	Disinfect between uses
5. Feather	Approximately 3-5 inches long. Dispose of each feather after use. Follow the infection control procedures at your facility.	Any grocery, department or party store.	Do not share across persons
6. Kitchen scrubs	Yellow sponge on one side and green coarse surface on the other side. Cut each sponge into 1x1 inch squares, disposing of each square after using it. Follow the infection control procedures at your facility.	Any grocery or department store.	Do not share across persons
7. Alcohol prep swabs	1 needed per administration.	Any pharmacy or First Aid section of a department store.	Dispose after single use
8. Metal spoon	Purchase several inexpensive teaspoon sized metal spoons; use one spoon per person. Follow the infection control procedures at your facility.	Any grocery store or online	Do not share across persons

9. Cotton tipped applicators	At least 6 applicators are needed for one administration of the DOCS.	Available on most person units or inpatient facilities. They can also be purchased at your local pharmacy.	Dispose applicators after single
10. Photographs of people familiar to the person	We ask the families to supply photographs of people familiar to the person (i.e., faces not places). Familiar means that the person knew the person for at least 1 year prior to the date of injury.	Need to ask family for these in advance of testing.	Do not share across persons
11. Yellow Tennis Ball		Department stores or specialty sporting goods stores.	Do not share across persons
12. Hand-held mirror	Approximately 4 x 6 inches, not magnifying	Department stores or specialty sporting goods stores.	Disinfect between uses
13. Sugar	Approximately ½ teaspoon of white sugar crystals in sealed packets	Available at grocery stores.	Dispose after single use
14. Lemon(ade) flavored drink mix powder	Must be sour, not overly sweet. Ensure the powder does not contain a sweetener.	Found at any grocery store.	Dispose after single use
15. Gel Hand warmer	Single use or reusable gel-filled handwarmer. Activated prior to beginning evaluation to ensure sufficient warmth. Reusable pack. Follow the infection control procedures at your facility.	Can be found online or at any sporting goods store.	Dispose after single use
16. Ice chips	About ¼ cup in a small container.	N/A	Dispose after single use
17. Juice/ soda/ familiar flavored liquid	About 1 tablespoon of a familiar, pleasurable liquid in a small container.	Any grocery store.	Dispose after single use
18. Toothbrush	Person's own or new toothbrush. Follow the infection control procedures at your facility to clean between uses.	Any grocery store	Do not share across persons
19. Laminated Yes/No Cards	Two cards, approximately 4x5.5 inches, one with YES, one with NO	We provide template that you may print on card and laminate (Appendix A).	Disinfect between uses
20. Do not disturb sign	Laminated card with words "Do Not Disturb."	Make your own or purchase at office supply store (See Appendix A)	Disinfect between uses
21. Fingertip pulse oximeter	Unit clips onto person's finger to measure oxygen levels in the blood in their finger tip.	Found at any medical supply company.	Disinfect between uses

22. Bite block	Dental bite blocks (or mouth props) help keep a person's mouth and jaw open. Recommend using a new one per person and keeping extra one in your kit.	Available online or at pharmacies	Do not share across persons
23. Towel and/or wash cloth	Standard sized wash cloth	Found at department stores and online	Do not share across persons

* Adhere to facility specific guidelines for disinfecting and reusing test materials.

Use of DOCS KIT:

It is recommended that you keep all the test stimuli/items in a small box that can be purchased at any variety store. The items in the DOCS test kit (i.e., the stimuli) should **only** be used for testing and not for therapy. It is recommended that the toolbox be labeled as the **“DOCS TEST KIT”** and instruct others to NOT use it in therapy. We add this second label **“DO NOT USE IN THERAPY”** to remind the others to only use the kit for evaluation.

Chapter 4 –Administration & Scoring

Organization of the DOCS-25:

The DOCS-25 consists of a baseline observation protocol, a three-point rating scale, test stimuli (items), and testing readiness protocol. The items in each subscale are arranged below in hierarchical order from easier to respond to through harder to respond to.

The 25 items are grouped into 4 categories based on the type of stimuli

1. Auditory-Language

- a. Social Greeting**
- b. Command**
- c. Name**
- d. Orientation to Self**
- e. Orientation to Environment**
- f. Toothbrush**

2. Gustation/Olfaction

- a. Juice to Lips & Tongue**
- b. Odor**
- c. Masseter Massage**
- d. Sweet/Sour Taste**

3. Visual

- a. Static Familiar Face**
- b. Static Object**
- c. Moving Familiar**
- d. Moving Object**

4. Somatosensory

- a. Cold Spoon**
- b. Vibration to Toe**
- c. Cube to Toe**
- d. Feather**
- e. Joint Range of Motion**
- f. Air**
- g. Hand Massage**
- h. Heat**
- i. Scrub to Arm**
- j. Swab to Toe**
- k. Hair**

When to administer the DOCS-25:

The assessor's best judgement should be used to administer the assessment when it is most optimal for the person (e.g., morning, afternoon, before a meal). Re-evaluations are recommended to be conducted using a clinical and/or caregiver judgment based on the person's unique circumstances (DoC Practice Guidelines, Giacino et al, 2018).

Before each administration:

Check that all items in the list above are available. Gather up and prepare the ice chips and small amount of juice; prepare the flavor extracts by dipping a cotton-tipped applicator into the extract bottle, activate the heat packs, put sugar crystals and lemonade crystals on paper towel (clearly label which is which and do not mix the powders).

Once all materials are prepared, proceed to creating an optimal testing environment for the person in DoC. The following guidelines provide recommendations for minimizing environmental distractions and positioning the person in the most optimal position for responding to the test stimuli.

Creating Optimal Assessment Conditions**Environment:**

It is extremely important to create an optimal environment prior to the administration of DOCS-25 items. To optimize the testing environment, consider the following recommendations:

- Post a "Do Not Disturb" sign outside of the assessment environment
- Notify nursing personnel and/or caregivers to avoid any unnecessary interruptions
- Close the door to reduce hallway noise
- Try to eliminate or reduce any unpredictable noise (e.g., TV, radio, intercom, phone)
- Lower bright lights (e.g., close or partially close blinds if sunlight is exceptionally bright)

Person Positioning:

It is important for the person in DoC to be in the most comfortable position to support assessment readiness. Optimizing the persons' position before assessing and ensuring they maintain that position during the assessment will help to identify true behavioral responses to the items. Optimal positioning can assist with breaking up spastic patterns and inhibiting extensor tone. Administration of items should be paused, and the person should be re-positioned to the optimal position, whenever necessary.

General Guidelines:

- Remove splints and restraints if permitted
- Stop testing and re-position the person throughout the assessment as needed
- After repositioning, wait 20-30 seconds before administering test stimuli

Laying on back on bed or mat:

- Elevate head of bed between 45 and 90 degrees
- If reclined, ensure person's head is positioned so they can see ahead

Sitting on side of mat or bed:

- Feet should be flat on the floor
- Knees should be level with hips
- Supported to sit up straight
- Head should be held upright
- Arms should be bent comfortably at elbow

Sitting in a chair or wheelchair:

- Feet should be placed on the footrests of the wheelchair when possible
- Head and trunk should be upright and supported to maintain midline position as needed
- Arms should be on the arm rests or resting on a lap tray or pillow if needed

Hygiene and Safety Precautions

- Wash your hands before and after administering the DOCS.
- Follow any contact precautions that are in place for specific individuals.

- Use personal protective equipment such as gloves, gown, mask and eye shield as appropriate for the individual and the setting the DOCS is being administered in.
- Follow facility procedures for sterilizing/cleaning reusable objects and equipment.
- Dispose of used materials such as swabs, sugar packets at the completion of the testing session.

Baseline Observations

A period of observation is utilized to establish a behavioral baseline against which responses to test stimuli can be compared. Place the pulse oximeter on the person's finger.

The baseline observation is critical to accurate measurement during the administration of the DOCS-25. The baseline observation should last for approximately 2-5 minutes and should be conducted under optimal testing conditions for the person. The clinician should note any responses that are observed during the baseline observation. After completion of the baseline observations, the testing conditions for the environment and the person should be re-evaluated. Once the baseline observation is complete, consider how you will distinguish responses from baseline behavior. For instance, if the person is not opening their eyes, how will you evaluate responses to visual stimuli?

Testing Readiness and Engagement

Testing readiness is a general state of readiness to respond which is observed and measured behaviorally during the baseline observation and throughout the administration of the DOCS-25 items. [Testing](#) During the Baseline Observation, consider the three questions below. These questions will enable the clinician to consider the quality of the responses exhibited by the person being evaluated. At the end of the test, you will be asked to consider if the person was able to maintain a state of readiness to respond to stimuli. This will help you to assess the patient's level of arousal and alertness.

1. Is double vision (third nerve palsy) or inability to lift eyelids (ptosis) suspected?
 - Consider this if patient appears unable to open one or both eyes
2. Is cortical blindness suspected? Might this person have a visual problem that cannot be detected because they cannot communicate?
 - Persons with occipital lobe damage may experience cortical blindness
3. Does the person require additional stimulation to remain engaged in testing procedures?
 - During the evaluation, consider the following methods of improving levels of arousal if the person is having difficulty maintaining a state of readiness to respond to stimuli
 - **Auditory Stimuli:** Call the person's name in an attempt to re-engage them in the assessment
 - **Tactile/Deep Pressure Stimuli:** Provide deep pressure or rubbing stimuli to the person's arms, legs or face in an attempt to re-engage them in the assessment. Consider warm or cold tactile stimulation using a washcloth.
 - **Passive Movement Stimuli:** Provide some passive movement to the person, such as rocking or rolling from side to side in an attempt to re-engage them in the assessment. Consider moving the head of the bed up and down slightly if in a hospital bed. Changing the position of the person from lying down to sitting. Sitting at the edge of the bed may also help to re-engage in testing readiness behavior.

General Administration Instructions:

- Baseline observation procedures must be completed prior to administering test stimuli.
- During baseline observation, identify the best response mode for the person to respond to auditory language information (i.e. visual gaze, head nods, gestural thumbs up/down, pointing to yes/no cards)
- Speak clearly, don't shout
- The first test item is always the social greeting item.
- After social greeting, we recommend doing gustation/olfaction, somatosensory, visual, auditory-language items.
- The items in each subscale are presented in order of difficulty from easiest to hardest.
- For each sensory domain, start with easier items and continue with harder items – administer all items if possible
- Each test stimulus is applied for 3-5 seconds unless specifically indicated.
- Following administration of auditory-language items, allow up to one minute for a response.
- Following administration of somatosensory, gustation/olfaction and visual items, responses should be expected immediately following the stimulation.
- Administer the item as many times as needed to obtain the best response
- When appropriate, present each sensation on both the right and left sides.
- Stand outside of the person's view except when giving auditory commands.
- Score the item as soon as you determine the person's best response. Do not wait to score until all items have been administered.

Scoring Items:

All DOCS-25 items are scored on a 3-point rating scale. The best behavioral response observed for each item is scored : 0 (No Response), 1 (Generalized Response), 2 (Localized Response).

The DOCS-25 rating scale distinguishes between localized and generalized responses and between generalized responses and no response. The assessor uses their best judgment and knowledge of the person to assign a score.

- A localized response is a response that is directly related to the stimulus provided
- The behavior appears to be in response to the stimuli and not reflexive activity
- The behavior appears to be in response to the stimuli and not general behavior observed at baseline

Table 4 Provides examples of localized and generalized responses for each sensory domain.

Table 4: Rating Scale Descriptions and Examples

Response Type	Score	Descriptor	Gustation/Olfaction	Somatosensory	Visual	Auditory-Language
No Response	0	<ul style="list-style-type: none"> No active movement or vocalization in response to stimuli Response does not differ from baseline observation 				
Generalized Response	1	<ul style="list-style-type: none"> Response is not contextually related to test stimuli Response is different from baseline behavior Examples include: reflexive movement; changes in respiration; changes in tone (increased/decreased); muscle tensing or other movements unrelated to the area stimulated; unrelated vocalizations; blinking; deviation in blood oxygen levels; deviation in heart rate; eye opening 	<ul style="list-style-type: none"> Suckling Jaw movement Chomping or chewing motion Muscle tensing or other movements unrelated to the area stimulated Change in oxygen saturation level Change in heart rate 	<ul style="list-style-type: none"> Decorticate posturing Abnormal flexion Eye opening Increased respiration Decreased tone or increased tone Muscle tensing or other movements unrelated to the area simulated Blinking Deviation of oxygen saturation from baseline range Deviation of heart rate from baseline Increased flexion/extension 	<ul style="list-style-type: none"> Eye Opening Increased respiration Decreased tone Oral Motor Movements Muscle tensing or other movements unrelated to the area stimulated Unrelated vocalizations Blinking 	<ul style="list-style-type: none"> Eye opening Increased respiration (breathing) Decreased or increased tone in arms, legs, or trunk Muscle tensing or other movements unrelated to the area stimulated Unrelated vocalizations Blinking Deviation in oxygen saturation level from baseline Deviation in heart rate from baseline
Localized Response	2	<ul style="list-style-type: none"> Response is contextually related to test stimuli Response is different from baseline behavior The response reflects an ability to regulate incoming sensory information and control their behavioral responses to the sensory input Examples of Localized Responses: orienting or localizing movements toward sound; vocalization or response indicating the person's comprehension of a greeting. 	<ul style="list-style-type: none"> Purposeful oral motor movements, such as licking lips or lip compression Purposeful tongue pumping or movement Swallowing within 15-20 seconds of stimulation Person swipes at the examiner's hand, as an attempt to inhibit input Appropriate changes in facial expression Vocalization related to stimuli (e.g., "mmm" or "ahhh") 	<ul style="list-style-type: none"> Person swipes at the assessor's hand as an attempt to inhibit input Person assists or resists movement or activity during passive movement stimulation Orienting movement of the body part stimulated Moving body part stimulated Vocalizations in response indicating localization to the stimulus 	<ul style="list-style-type: none"> Subject swipes at the assessor's hand, as an attempt to inhibit input Related vocalization (e.g., "ohhhhh") Facial movements Head turning Squinting Eye Closing (for blink test items) Eyelid fluttering (for blink test items) Visual orientation toward object 	<ul style="list-style-type: none"> Purposeful movements directly in response to stimuli being administered Moving body part that subject was told to move

Starting the Test:

Verbal Instruction prior to administering the first test stimuli:

**(“Person’s first name) listen carefully to each thing we/ I ask you to do.” (PAUSE)
“Try to respond.” (PAUSE) “This will allow us/me to help you.”**

Auditory-Language Subscale

Required Materials:

Toothbrush

Yes/No Cards - for eye gaze or pointing responses

General Auditory Administration Guidelines:

- For the social greeting item don’t allow more than 30 seconds for a response for a response and wait 30-60 seconds before administering another item.
- For the command, orientation and toothbrush items, allow up to one minute for a response and wait 30-60 seconds before administering another item.
- Note the commands and the orientation questions used on the score sheet.

Test Stimuli and Administration Procedures:

ITEM: Social Greeting (This should always be the first stimulus administered)

SAY/DO: “Hi, I’m (say your name). How is it going?”

LOOK FOR:

- Localized responses such as: Orienting or localization movements toward the sound of their name or vocalization or response indicating subjects’ comprehension of greeting
- Generalized responses such as: general movements of head or limbs, eye opening or closing, or any other movements or behaviors that were not seen during the baseline observation period.

ITEM: Follow Command 1 and Follow Command 2

SAY/DO: State a simple, one step command for the person to follow such as: “Wave your hand”

- Ensure the command is something the person is physically able to do
- Avoid extra language in the command such as “Now I want you to wave your hand” or “Can you wave your hand?”
- Repeat the first command as often as needed (until you conclude you have elicited the best response)
- Then give second command following the same steps described above.

LOOK FOR:

- Localized responses such as: executing the command that was provided
- Generalized responses such as: general movement of the body part involved in the command, general movement of other body parts, any behavior/movement that was not seen during the baseline observation.

ITEM: Name

SAY/DO: Stand 3-6 feet away from the person in various locations *and call out the person's name (first name or last name or nickname)*

- When repeating the name vary the inflection and loudness with each repetition
- Call the name from different locations making sure to attempt on the right and left side. Attempt to stand out of the person's direct vision.

LOOK FOR:

- Localized responses such as turning head toward the sound of the name being called, making eye contact with the person calling the name or verbalizing and appropriate reaction to their name being called such as, "Hello" or "What?"
- Generalized responses such as: general movement of body parts, any behavior/movement that was not seen during the baseline observation.

ITEM: Orientation to Self

SAY/DO: Stand in front of the person. Ask the person one or more of these questions:

- *What is your name?*
- *Is your name [use opposite gender first name]?*
- *Is your name [use real first name]?*

LOOK FOR:

- Localized responses such as: the person *must respond accurately to both their name and the gender opposite name* for a localized response
- Generalized responses such as: *a correct response to one question and an incorrect response to the other questions*, general movement of the body part involved in the command, general movement of other body parts, any behavior/movement that was not seen during the baseline observation.

ITEM: Orientation to Environment

SAY/DO: Stand in front of the person. Ask the person one or more of these questions or similar simple, environmental questions:

- *Is [Name of familiar/known person] in the room?*
- *Who is in the room?*
- *Are the lights on?*

LOOK FOR:

- Localized responses such as: the person *must respond accurately to the question* for a localized response
- Generalized responses such as: *an attempt to respond to the question that is incorrect*, general movement of the body part involved in the command, general movement of other body parts, any behavior/movement that was not seen during the baseline observation.
-

ITEM: Toothbrush

SAY/DO: Stand in front of the person. Hold toothbrush within 18 inches of the person's face and say: "*This is a toothbrush.*" Place toothbrush in person's hand. Then say: "*Brush your teeth.*"

- Put the toothbrush in the person's dominant (writing) hand when possible
- If necessary, you may support the person's elbow to assist with arm movement
- Observe for arm or hand movement and appropriate mouth movements.

LOOK FOR:

Localized responses such as: bringing the toothbrush to the mouth. The person does not have to get the toothbrush to or in their mouth. If the person is attempting to bring the toothbrush to mouth and is appropriately moving mouth in response to toothbrush this should be considered a localized response

- Generalized responses such as: general movement of body parts or any behavior/movement that was not seen during the baseline observation.

Gustation/Olfaction Subscale

Required Materials:

Juice
Sugar packet
Powdered lemonade packet
Flavor extracts (i.e. vanilla, mint, banana, orange)
Cotton tip applicator
Gloves
Towels
One bite block

General Gustation/Olfaction Administration Guidelines:

- Check with the Speech-Language Pathologist prior to placing anything beyond the teeth
- When administering the odor items to individuals with a tracheostomy tube confirm with appropriate medical personnel that the tracheostomy tube may be momentarily occluded (with cuffed tracheostomy tubes, the cuff must be deflated prior to attempting any occlusion trials)
- If the person is unable to tolerate tracheostomy tube occlusion for the odor items, check for upper airway movement through the nasal cavity with a small feather. Hold the feather ½” to 1” below the nostrils to see if the feather moves. If the feather moves, then present each stimulus at this distance for 5-10 seconds. If the feather does not move, do NOT administer odor.
- Each stimulus should be presented for 3-5 seconds
- Wait 15-20 seconds for a response and wait at least 30 seconds before administering another test item

Test Stimuli and Administration Procedures:

ITEM: Juice to Lips

SAY/DO: Dip a swab applicator in the liquid, stand in front of the person, say “I’m going to put a little bit of juice/soda on your lips”, and apply a small amount of liquid to the lower lip and gums.

- Before putting anything in the person’s mouth, tell them what you are going to do, and the setting or time of day he/she would experience this taste
- Examples (e.g., “Here is a taste of orange juice, we drink it for breakfast” or “Here is Mountain Dew, it’s your favorite”). If person is able to open mouth and does not have a significant bite reflex, attempt to provide taste stimulation to the top of the tongue with the swab applicator.

LOOK FOR:

- Localized responses such as: licking the lips, swallowing in response to the taste, facial expression that indicates a recognition of the taste, person swipes at therapist’s hand in an attempt to inhibit the input
- Generalized responses such as: non-purposeful mouth movement, movements of the body unrelated to the area stimulated such as movement of foot, deviation in heart rate or oxygen saturation levels.



ITEM: Odors 1 and 2

SAY/DO: Dip the applicator in the flavored extract, hold beneath nostrils, and say *“This is (describe the flavor), it smells like xxxx”* for example, *“This is vanilla, it smells like cookies”*.

- Place the applicator 1/2" to 1" below the nostrils. Tell the person to take a deep breath.
- If person has a tracheotomy tube and there is medical clearance to occlude the tube, then occlude the tracheotomy tube for 3-5 seconds while applicator is beneath the nostrils
- Repeat procedure again for Odor 2 using a different extract – do not use the same odor that was used for Odor 1.

- If the person demonstrates a localized response to odor 1 then odor 2 does not have to be administered.

LOOK FOR:

- Localized responses such as: facial expression indicating recognition of the odor, a swallow, meaningful movement of the tongue and lips, person swipes at therapist's hand in an attempt to inhibit the input.
- Generalized responses such as: non-purposeful mouth movement, movements of the body unrelated to the area stimulated such as movement of foot, deviation in heart rate or oxygen saturation levels.



ITEM: Contrasting Sweet and Sour

SAY/DO: Dip applicator in sugar and apply to lips and tongue

- Wait 30 seconds then apply a small amount of lemon-flavored drink powder on lips and tongue.
- Scoring for this item is determined by the contrast in responses for sweet and sour.

LOOK FOR:

- Localized Response (2) = Facial expression or other indication of a difference in the tastes.
- Generalized Response (1) = swallow, licking of lips, tongue movement after both presentations.

Visual Subscale

Required Materials:

- Picture of a person familiar to the subject (known person at least one year prior to injury)
- Mirror
- Two 3-dimensional objects (tennis ball or blocks are provided in the DOCS kit description)

Administration Guidelines:

- If eye opening isn't achieved or re-established, **do not** administer the visual items. Attempt to administer at another time within 24 hours.
- If unilateral or bilateral ptosis is suspected, then eyelids should be propped open with finger tips. Make sure to provide opportunities to blink while holding the eyes open. Also provide 5-10 seconds for the person to adjust to eye opening prior to administering visual stimuli.
- Consider administering the visual items first, immediately after the social greeting item, if there is a concern that the person will not maintain eye opening for the entire evaluation session.
- Persons with dysconjugate/divergent gaze (i.e., non-symmetrical eye movement, the eyes are looking in 2 different directions) should be assessed with one eye patched or covered (please consult with your physician and/or members of your rehabilitation team such as the occupational therapist for guidance if needed).
- Present each test item as many times as necessary to determine the person's best response.
- Wait 30-60 seconds before administering another test stimulus.
- Head should be midline and supported, eliminate or reduce neck extension.
- Score each test item after determining the person's best response. Do **not** wait to score.

Test Stimuli and Administration Procedures

Prior to presenting each test stimuli, the person should be provided with information about the test procedure. Tell the person that you want him/her to look at the objects (e.g., "Joe look at the ball" or "Joe watch the ball" or "Joe keep your eyes on the ball").

ITEM: Focus on Familiar Face

SAY/DO: Stand in front of person, hold a picture of a familiar person or place the mirror in front of the person approximately 18" from the face for 5-10 seconds in all of the visual fields listed below.

- Upper Visual Field
- Middle Visual Field
- Lower Visual Field
- Left Visual Field
- Right Visual Field
- If the person does not score a "2" focusing on familiar face photo in at least one of the visual fields, use the mirror and have the person focus on themselves via mirror. If a familiar person is present during the DOCS administration, they may place their actual face 18" from the person in each visual field listed below.

LOOK FOR:

- Localized responses such as: visual focus maintained on the face for at least 2 seconds in one or more of the visual fields.
- Generalized responses such as: eye opening, blinking, head turning, facial movements, general movement of body parts or any behavior/movement that was not seen during the baseline observation.

ITEM: Focus on Object

SAY/DO: Hold a 3-dimensional object in the visual fields listed below, approximately 18" from the face for 5-10 seconds in all of the visual fields listed below.

- Upper visual field
- Middle visual field
- Lower visual field
- Left visual field
- Right visual field
- If the person does not score a “2” focusing on familiar face photo in at least one of the visual fields, use the mirror and have the person focus on themselves via mirror. If a familiar person is present during the DOCS administration, they may place their actual face 18” from the person in each visual field listed below.

LOOK FOR:

- Localized responses such as: visual focus maintained on the object for at least 2 seconds in one or more of the visual fields.
- Generalized responses such as: eye opening, blinking, head turning, facial movements, general movement of body parts or any behavior/movement that was not seen during the baseline observation.

ITEM: Tracking Familiar Face (Horizontal and Vertical)

SAY/DO: Stand in front of the person and present a picture of a familiar person or hold the mirror for the person to see themselves in the left visual field and slowly move the picture to the right, across midline. Next, present the picture in the right field moving the object to the left across midline. Repeat this item beginning in the middle visual field and moving upward to the upper visual field and then down to the lower visual field at midline. Tell the person to “Keep your eyes on [insert name]”.

- If the subject does not score a “2” tracking familiar face photo, use the mirror, and have the subject track themselves via mirror.
- If the person demonstrates an ocular-motor restriction (i.e. field cut) and in the judgment of the assessor prohibits crossing of midline for tracking, then if the person demonstrates tracking in at least one visual field (right or left), a score a “2” should be recorded.
- The distinction between ocular-motor and attention impairment is at the discretion of the assessor. If a familiar person is present during the DOCS administration, they may place their actual face 18” from the person to evaluate horizontal tracking as described above.

LOOK FOR:

- Localized responses to this item requires maintained tracking of the picture/mirror for at least 45 degrees.
- Generalized responses such as: fleeting tracking of less than 45 degrees, eye opening, visual focus on the picture/mirror, head turning, facial movements, general movement

of body parts or any behavior/movement that was not seen during the baseline observation.

ITEM: Tracking Objects (Horizontal and Vertical)

SAY/DO: Stand in front of the person and present a 3-dimensional object middle visual field and slowly move the object to the left. Repeat this presenting the object in the middle visual field and moving to the right. Repeat this using the 3-dimensional object but now begin in the middle visual field and slowly move the object upward. Next, present a 3-dimensional object in the middle visual field and slowly move the object downward.

- If the person demonstrates an ocular-motor restriction (i.e. field cut) and in the judgment of the assessor prohibits crossing of midline for tracking, then if the person demonstrates tracking in at least one visual field (right or left), a score a “2” should be recorded.
- If the clinician suspects attention impairment is prohibiting person from crossing midline then a score of “1” should be recorded. The distinction between ocular-motor and attention impairment is at the discretion of the assessor.

LOOK FOR:

- Localized responses to this item requires maintained tracking of the object for at least 45 degrees.
- Generalized responses such as: fleeting tracking of less than 45 degrees, eye opening, visual focus on the picture/mirror, head turning, facial movements, general movement of body parts or any behavior/movement that was not seen during the baseline observation.

Somatosensory Subscale

Required Materials

Mini vibrator
Feather
Can of pressurized air
Kitchen scouring pad
Ice cubes or ice chips
Alcohol swab
Hand or Foot Warmer

Administration Guidelines:

- Present test item as many times as necessary to determine the person's best response
- Wait 10-15 seconds for a response and wait 30 seconds before administering another test item.
- Person's head should be at midline and supported. Eliminate or reduce neck extension when moving the person.
- Prior to presenting the test stimuli the person should be provided with information about the test stimuli.
- The subject may attempt to inhibit input or may demonstrate decreased or increased tone in the joint/limb being ranged.

Test Stimuli and Administration Procedures:

ITEM: Cold Spoon

SAY/DO: Stand in front of person and place cold metal spoon on lower lip for 5 seconds.

- The pressure placed on the spoon should resemble the same pressure you would place on your lips when eating ice cream.
- Observe person for a response for 5 – 10 seconds.

LOOK FOR:

- Localized responses such as: moving the lips/tongue around the spoon, attempting to swallow or fully executing a swallow.
- Generalized responses such as: non-purposeful tongue pumping or munching behaviors not seen at baseline, general movement of body parts or any behavior/movement that was not seen during the baseline observation.

ITEM: Vibration to big toe or heel:

SAY/DO: Apply vibrator to pad of big toe or heel for 2-3 seconds

- Be sure to provide gentle pressure with the vibrator tip to the toe.

- Observe person for a response for 5 – 10 seconds.

LOOK FOR:

- Localized responses such as: immediate lifting of the toe, wiggling of toes or movement of foot to avoid the stimulation.
- Generalized responses such as: any behavior/movement that was not seen during the baseline observation.



ITEM: Ice Cube

SAY/DO: Stand at the foot of the bed or near the foot if not in bed, using light pressure, hold the ice cube on the right big toe or heel just until the ice starts to melt.

- Repeat this on the left side if no localized response.



LOOK FOR:

- Localized responses such as: immediate removal of the toe/foot in response to the cold.
- Generalized responses such as: general movement of body parts or any behavior/movement that was not seen during the baseline observation.

ITEM: Feather

SAY/DO: Gently sweep the feather across the face over the nose and on the cheeks.



LOOK FOR:

- Localized responses such as: shaking the head or closing the eyes to avoid the stimulation; reaching with hands to remove the feather from the face.
- Generalized responses such as: general movement of body parts or any behavior/movement that was not seen during the baseline observation that are not meaningful in response to the feather across the face.

ITEM: Joint Range of Motion

SAY/DO: Choose one arm or leg and provide passive range of motion

- Support above the joint and move the joint with your other hand at medium speed within the person's available range of motion for 3 or 4 repetitions.
- Note any limits in range of motion on the response rating form – be aware of general limitations
- Do not range to the extent of pain, past resistance, or beyond normal expectations for joint range of motion.
- If the person does not get a score of 2, then range the other side or a different limb
- If required, ask your local occupational or physical therapist to demonstrate proper range of motion technique

LOOK FOR:

- Localized responses such as: withdrawing or actively resisting the movement (caution to distinguish from involuntary changes in muscle tone), reaching with hands to remove the stimuli.
- Generalized responses such as: increase or decrease in muscle tone, general movement of body parts or any behavior/movement that was not seen during the baseline observation that are not meaningful in response to the joint range of motion.

ITEM: Masseter Massage

SAY/DO: Use fingertips to provide firm pressure slowly downward along the masseter (upper jaw) muscle to the corner of lips

- Repeat this motion 3 – 5 times in a row and then observe for response.

LOOK FOR:

- Localized responses such as: movement of the lips, tongue or jaw and/or a swallow response within 10 seconds of the stimulation.
- Generalized responses such as: automatic munching behavior (vertical movement of the jaw up and down) that was not observed during baseline observation or general movement of other body parts or any behavior/movement that was not seen during the baseline observation

ITEM: Air

SAY/DO: Using the can of pressurized air, direct stream of air as close as possible to center of back of neck.

- If necessary, position person's head and then wait 20 seconds before applying the stream of air.
- Response to this stimulus should be immediate.



LOOK FOR:

- Localized responses such as: an immediate startle response to the air stream or some purposeful behavior to avoid the air or remove the air (hand reaching up, upper body movement away).
- Generalized responses such as: general movement of body parts or any behavior/movement that was not seen during the baseline observation and is not directly related to the stimuli.

ITEM: Hand Massage

SAY/DO: Using fingertips, apply firm pressure down the inside surface of the right arm from the shoulder to the wrist. Repeat on left arm if no localized response.

- Make sure to provide firm pressure and not pinching the arm to induce pain.
- Observe person for a response for 5 – 10 seconds.

**LOOK FOR:**

- Localized responses such as: movement of the arm that is being massaged, attempts to push the massage away.
- Generalized responses such as: general movement of body parts or any behavior/movement that was not seen during the baseline observation and is not directly related to the stimuli.

ITEM: Heat

SAY/DO: Place a hand warmer in palm for 15 to 20 seconds.

- Remove the hand warmer from the packaging at the beginning of the testing period to allow for activation of the heat.
- Hand warmer may be placed in either hand, preferably in the palm. If the person cannot close fingers around the hand warmer, tester should hold the hand warmer in the palm lightly.
- If the person is not able to open the hands to have the hand warmer placed in the palm, apply the hand warmer to the top of the hand and make a note on the testing form.
- Observe person for a response for 5 – 10 seconds.

LOOK FOR:

- Localized responses such as: manipulation of the hand warmer, facial expression/vocalization that indicates pleasure.
- Generalized responses such as: general movement of body parts or any behavior/movement that was not seen during the baseline observation and is not directly related to the stimuli.

ITEM: Scrub

SAY/DO: Using the kitchen scouring pad, firmly apply a back and forth movement with firm pressure over the back of arm, top of forearm, and mid-thigh areas on one side of the body (exposed areas). Choose the side based on injury location, likelihood of sensory issues and/or dominant side of body. Stimulate the side of the body that will likely respond best to this stimulation (i.e. absence of suspected sensory or orthopedic issues).

- Repeat procedure on the other side of the body if no localized response.
- Observe person for a response for 5 – 10 seconds.



LOOK FOR:

- Localized responses such as: movement of the body part being stimulated.
- Generalized responses such as: general movement of body parts or any behavior/movement that was not seen during the baseline observation and is not directly related to the stimuli.

ITEM: Swab/ big toe or heel

SAY/DO: Using an alcohol prep wipe, swipe the big toe or heel without your fingers touching the person's skin on one side. Choose the side based on injury location and suspected sensory issues that may impede response.

- Repeat procedure on the other side of the body if no localized response.
- Observe person for a response for 5 – 10 seconds.



LOOK FOR:

- Localized responses such as: movement of the toe being stimulated.
- Generalized responses such as: general movement of body parts or any behavior/movement that was not seen during the baseline observation and is not directly related to the stimuli.

ITEM: Hair

SAY/DO: Without contacting the skin, lightly move the hair in the direction opposite to that of the hair growth pattern (e.g., eyebrows, beard, arms). Recommend using the eyebrows.

- Repeat procedure on the opposite side if no localized response.
- Observe person for a response for 5 – 10 seconds.

LOOK FOR:

- Localized responses such as: movement of head (or other body part stimulated) in avoidance.
- Generalized responses such as: general movement of body parts or any behavior/movement that was not seen during the baseline observation and is not directly related to the stimuli

Maintenance of Testing Readiness: After all the DOCS items have been administered, consider the need for providing stimuli to maintain the person's engagement with the testing. The Testing Readiness observation allows for clinical tracking to determine the optimal time to administer the DOCS evaluation. Observations of the maintenance of testing readiness may also be used to document improvements/changes in levels of arousal and awareness that may not be captured by the DOCS-25 scores.

OBSERVATION OF TESTING READINESS:

Did the person require stimulation (auditory stimuli, tactile/deep pressure or passive rolling/rocking) throughout the evaluation to maintain a state of testing readiness?

YES or NO

If the person required stimulation to remain engaged in the testing, which type(s) of stimulation were provide (select all that apply)?

- ☐ Auditory Stimuli
- ☐ Tactile/Deep Pressure Stimuli
- ☐ Passive Rolling/Rocking Stimuli
- ☐ Other Stimuli

Was the stimulation required for maintaining testing readiness the same as the previous testing session? (select one descriptor)

- ☐ More Stimulation Required
- ☐ Stimulation Required Was About the Same
- ☐ Less Stimulation Required

Scoring

Tables are provided in Appendix A to facilitate the scoring of each item. The tables provide a scoring method for individual testing sessions or to monitor scores across several testing sessions. Finally, we present the Keyform, which is used to track the person's performance over time. Each rating of an item within a subscale is presented along a hierarchy indicating levels of consciousness.

Chapter 5: Interpretation of DOCS-25

Transforming Raw Scores

Raw scores are the numbers assigned to each DOCS-25 item. Raw scores may be summed to find total raw scores for each sensory domain, or for all 25 items. Never sum total raw scores if some items were not administered or scored.

Raw scores are easy to calculate but can be misleading because the difference in neurobehavioral function between, say a 0 (no response) and a 1 (generalized response) on an item may not be (and probably isn't) the same as the difference in function between a 1 and a 2 (localized response). In addition, items (sensory stimuli) provide different levels of challenge. For example, we know that gustation/olfaction items are some of the first stimuli to which someone in severe disorders of consciousness will respond while responding to their name being called occurs once they have progressed a little. This means that a 2 on the "Juice to Lips" item represents a different amount of neurobehavioral function than a 2 on "Name". So simply adding these numbers up would not provide accurate information about a person's true amount of neurobehavioral function.

Rasch Measurement Analysis is a way of converting raw scores to linear, equal interval units, and gets us around the challenges in comparing raw scores described above. The tables below provide an easy look-up to convert DOCS-25 raw scores to Rasch units on a 0-100 scale. Details of the research studies that produced these tables can be found in the reference list.

There are three ways to administer and score the DOCS-25 items: i) all 25 items; ii) all items in a single Sensory Domain; iii) find the best response based on the "just right challenge." Each of these approaches is described below.

Administer and Score All 25 DOCS-25 Items

Using this approach, administer and score all the items using the methods described in Chapter 4. Record the scores on the scoresheet and use the tables provided in the Appendix to convert Total Raw Scores to Rasch units. **You must have a score for all 25 items to use this table.** Never use this table to convert Total Raw Scores to Rasch units if you have missing responses.

In clinical practice, it is not always possible to collect scores for each item and may not always be necessary. If you plan to use an approach that does not involve using all 25 items, we strongly recommend you establish a good baseline by performing the full DOCS-25 three times at the beginning of care, over the course of 1-2 days. After that, you may administer a subset of items using one of the two approaches described below.

Administer and Score All Items in a Single Sensory Domain

Using this approach, administer and score all items in a single sensory domain using the methods described in Chapter 4. Record the scores on the score sheet(s) provided in Appendix A and use Tables 5.2a-d provided in Appendix B to convert the corresponding single Sensory Domain Raw Scores to Rasch Units. **You must score all the items in a single Sensory Domain to use these tables.** Never use these tables to convert a single Sensory Domain Raw Score to Rasch units if you have missing responses.

Finding the Best Response Based on the Just Right Challenge

This approach of finding the “just right challenge” has been used in both developmental assessments and in other assessments of neurobehavioral function. In this approach, you either start at a point that you know the person will be able to respond and administer successively more challenging items until they are no longer able to respond, or you administer a challenging item you are fairly sure they will not be able to respond to and then administer successively easier items until they are providing response consistent with earlier assessments.

Since the goal of the DOCS-25 is to find the person’s best behavioral response, we recommend beginning to administer items that are around where the person was responding the last time they were assessed and continuing to administer more challenging items until they are no longer able to respond. We currently do not know if these two approaches produce the same results.

Use Table 5.3 provided in Appendix B to find the Rasch unit value associated with the rating scale score for the most challenging item you administered. This will be the person’s Best Response measure.

Using and Comparing DOCS-25 Rasch Measures Based on Different Administration Procedures

We strongly recommend completing 3 baseline administrations of the DOCS-25 in order to be confident in your evaluation of the person’s initial level of neurobehavioral function. Persons in disordered states of consciousness may fluctuate in their level of neurobehavioral function over the course of the day or across days, especially in the first few days and weeks after injury. While completing three full DOCS-25 does not eliminate this challenge, it will help the team be more confident in the results and a baseline from which to judge progress.

The full DOCS-25 and the two abbreviated versions, each provide slightly different, but comparable information. The Rasch Unit measure provides information on the person’s “average” neurobehavioral function across all 25 items. The single Sensory Domain Rasch Unit measure provides information on the person’s “average” neurobehavioral measure in that Sensory Domain. The Just Right Challenge approach will provide a Rasch unit measure that indicates the person’s best neurobehavioral response that day. In general, you should expect that the Just Right Challenge approach will produce the highest Rasch unit measure, the Sensory Domain Subscale will probably produce a slightly lower Rasch unit measure, and the overall DOCS-25 will probably produce the lowest Rasch unit measure. This is because the “All Items” measures averages across items that the person could respond to and those that they could not.

Tracking Change in DOCS-25 Rasch Unit Measures Over Time

When using one of the two abbreviated versions, calculate the equivalent approach from the full baseline measures. These steps are described below.

For the Single Sensory Domain: From the first full DOCS-25, use the scores for a single Sensory Domain of interest to calculate a raw score and find the corresponding Rasch unit measure from Table 5.2a-d provided in Appendix B. Repeat for the second and third full DOCS-25 completed at baseline. Sum these three Rasch unit measures and divide the result by 3 to find the average single Sensory Domain Rasch measure. Compare the subsequent single Sensory Domain measures you administer to this average baseline measure. You can plot these measures on the graph template provided in the Appendix.

For the Just Right Challenge: From the first full DOCS-25, identify the highest response achieved using Table 5.3 provided in Appendix B to find the highest rating scale step measure. Repeat for the second and third full DOCS-25 completed at baseline. Sum these three Rasch unit measures and divide by 3 to find the average “just right challenge” Rasch unit measure. Compare subsequent “just right challenge” measures you administer to this average baseline measure. You can plot these measures on the graph template provided in the Appendix.

Keyform Nomogram

If you have used one of the abbreviated versions of scoring the DOCS-25, you can find the location of the items on the Keyform. This will show you where a person’s best response is, relative to other items. Figure 5.1 below shows how to read a Keyform.

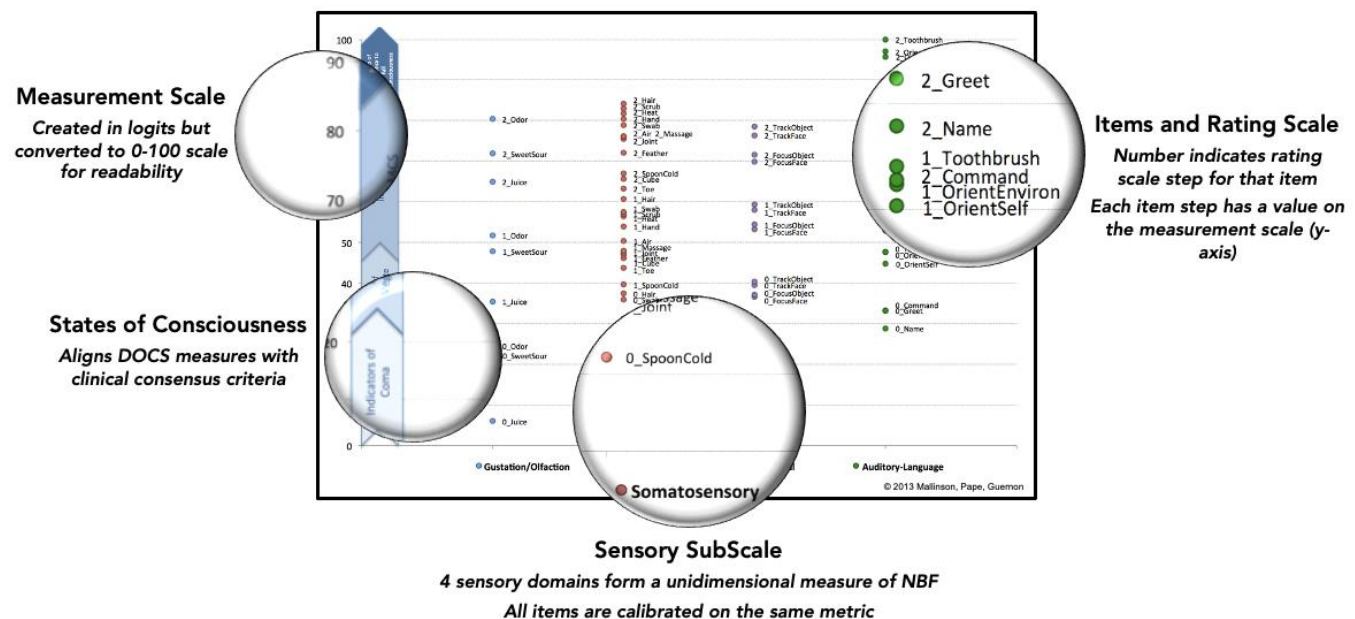
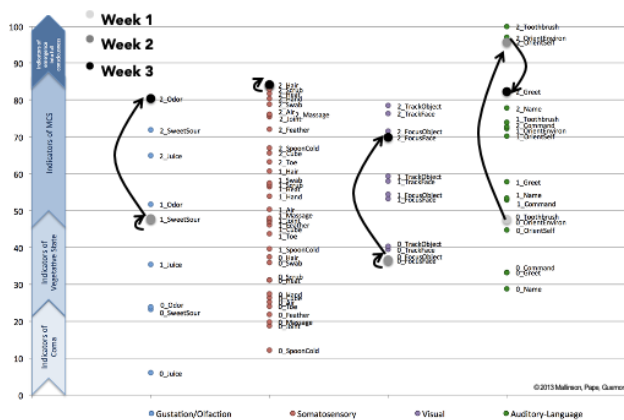


Figure 5.1. Taken from Mallinson, Pape and Guernon. The DOCS Keyform: Clinically Meaningful Tracking of Neurobehavioral Function in Patients with Severe Brain Injury. Poster 97. Archives of Physical Medicine and Rehabilitation 94. 10 (2013): e44-e45.

Participant 78: Variable Progress Across Sensory Domains

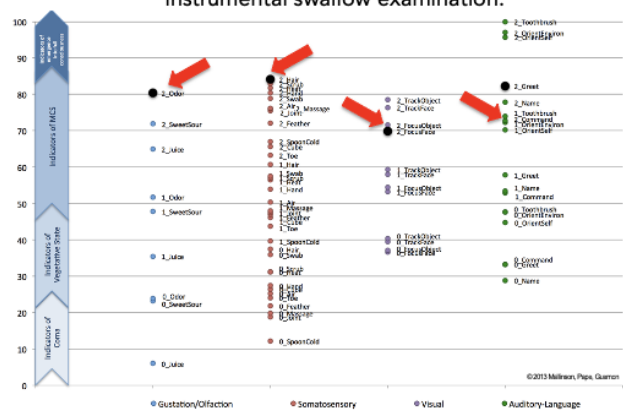
Figure 1 is a line graph showing the evolution of the 100 most frequent words in the 1000-word phase of the MacArthur Communication Development Inventory (MCDI) for 10 children. The Y-axis represents the 'Index of Frequency' from 0 to 90. The X-axis represents 'Index of Semantic Category' with five categories: Gustative/Olfaction, Somatosensory, Visual, Auditory-Language, and Auditory-Language. The graph shows two lines: a dashed line for Week 1 and a solid line for Week 3. The lines generally trend upwards from left to right, indicating that words in more semantically complex categories are used more frequently. The graph also shows the emergence of new words over time, with some words appearing in Week 1 and others appearing in Week 3.

Although NBF is consistent with MCS over the first 3 weeks, this participant makes progress in each sensory domain. However, the rate of progress varies considerably by domain.



Participant 78: Finding the Just-Right Challenge

By week 3, this patient has swallowing, tactile awareness, some visual focusing, can follow a simple command. Therapy focus on consistency of swallow response, consider completing an instrumental swallow examination.



Interpreting the Amount of change

Indices of change are provided for persons who are improving, those not changing or declining, and for all persons who participated in the research study (Mallinson, Pape and Guernon, 2016). The minimal detectable change, based on 95% confidence intervals (MDC_{95}), tells us the amount of change that is greater than chance. The minimally clinically important difference (MCID) tells us how much change was

made by persons in DoC who participated in a research study. MCID is calculated two different methods: using an anchor-based and a distribution-based approach. For the anchor-based approach, we determined that persons who made 2 units of change on the Glasgow Coma Scale in two weeks made about 8-9 units of change on the DOCS-25. The distribution-based approach, calculates the amount of change based on the distribution of the people in the research study, referred to as the standard deviation. We identified the Rasch units associated with small, moderate, and large differences the DOCS-25 in the research study (0.20, 0.33, and 0.50 SD, respectively). Table 5.4 in Appendix B provides the change in Rasch units using these different approaches.

It is important to remember that there is no right answer to the question, how much change is enough? Change greater than 5 Rasch units means we can be sure the change is a real change and not just measurement error. Changes greater than 7 or 8 units are very large compared to other persons with DoC. Which index of change you use depends on your purpose and the question you are trying to answer.

Conditional Minimally Detectable Change (cMDC)

The indices of responsiveness presented above were based on looking at change in people participating in a research study and “averaging” across all those people. But research has shown that these indices can vary depending on whether someone has high, medium, or low levels of neurobehavioral function. A new approach to determining if an observed change in DOC-25 Rasch unit measures is important involved calculating a person-specific MDC. Table 5.5 provided in Appendix B can be used to find the MDC specific to an individual.

How to use the cMDC Look-up Table

To if the difference between two DOCS-25 measures is greater than the cMDC, find the first DOCS-25 Total Raw Score in the light green column; then find the next DOCS-25 Total Raw Score in the light blue row. Locate the cell where the row and column intersect. Cells above the shaded area indicate change greater than measurement error. Cells below the shaded area indicate decline greater than measurement



error. Cells in the grey area mean this change could be random variation or measurement error.

Figure 5.3. Total raw scores for the DOCS-25 administered to one person over a two-week period.

Figure 5.3 shows the scores for a person assessed over a two-week period. The person’s first DOCS-25 is 22 and their next DOCS-25, on Day 3 is 28. Looking at table 5.5, we see these scores intersect above the grey region meaning this person has improved more than we would expect by chance or measurement

error. This amount of change reflects real improvement in neurobehavioral function. The next time this person is assessed (Day 8) they score 32. This time, locate the raw score of 28 (Day 3) in the light green column and their new score of 32 in the light blue column. Even though this is only a 4 raw score point change, these scores intersect above the grey area, meaning that this change is also greater than would be expected by chance or measurement error. On Day 10, this person is received a score of 29; we find at their Day 8 score of 28 in the light green column and their new score of 29 in the light blue row. This time, these scores intersect in the grey region, meaning this change could have occurred by chance or measurement error. At day 12 and again at Day 15, the person also receives lower scores. These changes, from Day 10 to Day 12 and from Day 12 to Day 15, each lies in the grey region, indicating each of these changes could have occurred by chance. However, if we compare their score from Day 8 (32) to Day 15 (26) we see that this is a real decline in neurobehavioral function that might indicate the need for a change in treatment, medication, or further investigation is required.

Chapter 6: DOCS-25 Research

Staying Current with the DOCS-25

As literature continues to report on the reliability and validity of the DOCS-25, please stay up to date by reviewing the instrument summary on the Rehabilitation Measures Database:

<https://www.sralab.org/rehabilitation-measures/disorders-consciousness-scale>

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Appendix A

Score Forms

Disorders of Consciousness Scale-25 Scoring Grid: Arranged in Order on Short and Long Form

Test Item	No Response (NR)	Generalized Response (GR)	Localized Response (LR)
1. Name Called	0	1	2
2. Follow 1 Step Command	0	1	2
3. Social Greeting	0	1	2
4. Orientation to Self	0	1	2
5. Orientation to Environment	0	1	2
6. Toothbrush	0	1	2
Auditory Language Score			
7. Juice to Lips & Tongue	0	1	2
8. Sweet/Sour Taste	0	1	2
9. Odor	0	1	2
Gustatory/Olfactory Score			
10. Focus on Face	0	1	2
11. Focus on Object	0	1	2
12. Tracking Face	0	1	2
13. Tracking Object	0	1	2
Visual Score			
14. Cold Spoon	0	1	2
15. Joint Range of Motion	0	1	2
16. Masseter Massage	0	1	2
17. Feather	0	1	2
18. Vibrator to Toe	0	1	2
19. Air	0	1	2
20. Cube to Toe	0	1	2
21. Hand Massage	0	1	2
22. Heat	0	1	2
23. Scrub to Arm	0	1	2
24. Swab to Toe	0	1	2
25. Hair	0	1	2
Somatosensory Score			
TOTAL RAW SCORE			

Disorders of Consciousness Scale-25 Scoring Grid: By Time Points

Test Item	Time 1 Date: Best Response (0, 1, or 2)	Time 2 Date: Best Response (0, 1, or 2)	Time 3 Date: Best Response (0, 1, or 2)	Time 4 Date: Best Response (0, 1, or 2)
1. Name Called				
2. Follow 1 Step Command				
3. Social Greeting				
4. Orientation to Self				
5. Orientation to Environment				
6. Toothbrush				
AUDITORY LANGUAGE SCORE				
7. Juice to Lips and Tongue				
8. Sweet and Sour Taste				
9. Odor				
GUSTATORY OLFACTORY SCORE				
10. Focus on Face				
11. Focus on Object				
12. Tracking Face				
13. Tracking Object				
VISUAL SCORE				
14. Cold Spoon				
15. Joint Range of Motion				
16. Masseter Massage				
17. Feather				
18. Vibration to Toe				
19. Air				
20. Cube to Toe				
21. Hand Massage				
22. Heat				
23. Scrub				
24. Swab to Toe				
25. Hair				
SOMATOSENSORY SCORE				
TOTAL RAW SCORE (0-50)				
TOTAL MEASURE (0-100)				

APPENDIX B

SCORE CONVERSION TABLES

Table 5.1 DOCS-25 Score to Measure Table

RAW SCORE	TRANSFORMED MEASURE	S.E.
0	0	>10.85
1	-1	>10.85
2	6.74	10.85
3	12.99	8.88
4	17.45	7.72
5	20.94	6.93
6	23.82	6.36
7	26.28	5.93
8	28.44	5.58
9	30.37	5.3
10	32.13	5.07
11	33.74	4.88
12	35.25	4.72
13	36.66	4.59
14	38	4.47
15	39.28	4.37
16	40.5	4.28
17	41.68	4.21
18	42.82	4.15
19	43.93	4.1
20	45.01	4.06
21	46.08	4.02
22	47.13	4
23	48.17	3.98
24	49.2	3.97
25	50.23	3.97
26	51.26	3.97
27	52.29	3.98
28	53.33	4
29	54.39	4.03
30	55.46	4.07
31	56.55	4.11

32	57.66	4.16
33	58.81	4.23
34	60	4.3
35	61.23	4.39
36	62.52	4.49
37	63.87	4.61
38	65.3	4.75
39	66.82	4.91
40	68.46	5.1
41	70.23	5.33
42	72.18	5.6
43	74.35	5.94
44	76.82	6.36
45	79.69	6.92
46	83.15	7.68
47	87.55	8.81
48	93.69	10.75
49	-99	>10.75
50	-100	>10.75

Table 5.2 (a-d) DOCS-25 Item-Step Calibrations

a. Gustatory/Olfactory

Item Name	Raw Score	Item-Step Calibration
Juice	0	6.0
Sweet	0	23.2
Sour		
Odor	0	23.8
Juice	1	35.5
Sweet	1	47.8
Sour		
Odor	1	51.8
Juice	2	65.0
Sweet	2	71.9
Sour		
Odor	2	80.4

b. Somatosensory

Item Name	Raw Score	Item-Step Calibration
SpoonCold	0	12.2
Joint	0	18.8
Massage	0	19.9
Feather	0	21.9
Toe	0	24.1
Air	0	25.3
Cube	0	26.4
Hand	0	27.4
Heat	0	31.2
Scrub	0	31.2
Swab	0	35.9
Hair	0	37.4
SpoonCold	1	39.6
Toe	1	43.7
Cube	1	46.0
Feather	1	47.0
Joint	1	47.5
Massage	1	47.9
Air	1	50.4
Hand	1	53.9
Heat	1	56.5
Scrub	1	57.1
Swab	1	57.4
Hair	1	60.8
Toe	2	63.3
Cube	2	65.7
SpoonCold	2	67.1
Feather	2	72.1
Air	2	75.4
Massage	2	75.9
Joint	2	76.1
Swab	2	78.9
Hand	2	80.5
Heat	2	81.7
Scrub	2	82.9

Hair	2	84.1
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c. Visual

Item Name	Raw Score	Item-Step Calibration
FocusFace	0	36.6
FocusObject	0	37.1
TrackFace	0	39.5
TrackObject	0	40.3
FocusFace	1	53.2
FocusObject	1	54.4
TrackFace	1	58.0
TrackObject	1	59.4
FocusFace	2	69.9
FocusObject	2	71.6
TrackFace	2	76.4
TrackObject	2	78.5

d. Auditory Language

Item Name	Raw Score	Item-Step Calibration
Name	0	28.9
Command	0	33.2
Greet	0	33.3
OrientSelf	0	44.8
OrientEnviron	0	47.7
Toothbrush	0	47.7
Command	1	53.0
Name	1	53.3
Greet	1	57.8
OrientSelf	1	70.3
OrientEnviron	1	72.3
Command	2	72.7
Toothbrush	2	74.0
Name	2	77.8
Greet	2	82.3
OrientSelf	2	95.7
OrientEnviron	2	97.0
Toothbrush	2	100.0

Table 5.3 Best Response Scores

Item Name	Raw Score	Item-Step Calibration
Juice	0	6.0
SpoonCold	0	12.2
Joint	0	18.8
Massage	0	19.9
Feather	0	21.9
SweetSour	0	23.2
Odor	0	23.8
Toe	0	24.1
Air	0	25.3
Cube	0	26.4
Hand	0	27.4
Name	0	28.9
Heat	0	31.2
Scrub	0	31.2
Command	0	33.2
Greet	0	33.3
Juice	1	35.5
Swab	0	35.9
FocusFace	0	36.6
FocusObject	0	37.1
Hair	0	37.4
TrackFace	0	39.5
SpoonCold	1	39.6
TrackObject	0	40.3
Toe	1	43.7
OrientSelf	0	44.8
Cube	1	46.0
Feather	1	47.0
Joint	1	47.5
OrientEnviron	0	47.7
Toothbrush	0	47.7
SweetSour	1	47.8

Massage	1	47.9
Air	1	50.4
Odor	1	51.8
Command	1	53.0
FocusFace	1	53.2
Name	1	53.3
Hand	1	53.9
FocusObject	1	54.4
Heat	1	56.5
Scrub	1	57.1
Swab	1	57.4
Greet	1	57.8
TrackFace	1	58.0
TrackObject	1	59.4
Hair	1	60.8
Toe	2	63.3
Juice	2	65.0
Cube	2	65.7
SpoonCold	2	67.1
FocusFace	2	69.9
OrientSelf	1	70.3
FocusObject	2	71.6
SweetSour	2	71.9
Feather	2	72.1
OrientEnviron	1	72.3
Command	2	72.7
Toothbrush	1	74.0
Air	2	75.4
Massage	2	75.9
Joint	2	76.1
TrackFace	2	76.4
Name	2	77.8
TrackObject	2	78.5
Swab	2	78.9
Odor	2	80.4
Hand	2	80.5
Heat	2	81.7
Greet	2	82.3
Scrub	2	82.9
Hair	2	84.1
OrientSelf	2	95.7
OrientEnviron	2	97.0

Toothbrush 2 100.0

Table 5.4 Indices of Responsiveness for the DOCS-25 based on all participants, non-improvers and improvers

DOCS status	MDC95	Clinically Important Difference	
		0.20/0.33/0.50 SD	Anchor-based
Nonimprovers (n=35)	5.3	N/A	N/A
Improvers (n=57)	5.5	N/A	N/A
All participants (n=92)	5.6	2.6/4.4/6.6	8.6

Table 5.5 cMDC Look-Up Table

Raw Score		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50		
Rasch Measure	SE	21.1	25.5	31.9	35.6	37.6	39.0	39.7	40.3	40.9	41.5	42.0	42.5	43.0	43.6	44.3	45.1	46.0	47.0	47.8	48.4	48.8	49.1	49.4	49.7	50.0	50.4	50.7	51.1	51.6	52.1	52.7	53.2	53.6	54.0	54.3	54.7	55.1	55.5	55.8	56.2	56.6	57.1	57.6	58.5	60.6	63.7	65.7	68.5	72.8	76.3	78.3		
	2.2	4.2	3.2	1.4	1.4	1.0	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.8	0.9	0.9	1.0	1.0	0.9	0.7	0.6	0.6	0.5	0.5	0.6	0.6	0.6	0.7	0.7	0.8	0.8	0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.7	0.7	0.8	1.1	2.0	1.5	1.4	2.1	2.6	1.6	2.1		
0	21.1	2.2	8.8	7.4	5.0	5.0	4.3	4.1	4.1	4.1	4.0	4.0	4.0	4.1	4.2	4.3	4.4	4.4	4.2	4.0	3.9	3.8	3.8	3.8	3.8	3.9	3.9	4.0	4.1	4.1	3.9	3.9	3.8	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	4.0	4.1	4.5	5.8	5.1	5.0	5.9	6.6	5.2	5.9			
1	25.5	4.2	8.8	10.2	7.8	7.8	7.1	6.9	6.9	6.9	6.8	6.8	6.8	6.9	7.0	7.1	7.2	7.2	7.0	6.8	6.7	6.6	6.6	6.6	6.6	6.6	6.7	6.7	6.8	6.9	6.9	6.7	6.7	6.6	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.8	6.9	7.3	8.6	7.9	7.8	8.7	9.4	8.0	8.7		
2	31.9	3.2	7.4	10.2	6.3	6.3	5.7	5.4	5.4	5.5	5.4	5.3	5.3	5.4	5.5	5.6	5.7	5.7	5.5	5.3	5.2	5.1	5.1	5.1	5.1	5.2	5.2	5.3	5.4	5.4	5.3	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.3	5.5	5.8	7.2	6.5	6.3	7.2	7.9	6.5	7.2			
3	35.6	1.4	5.0	7.8	6.3	3.9	3.9	3.3	3.0	3.0	3.1	3.0	2.9	2.9	3.0	3.1	3.2	3.3	3.3	3.2	3.0	2.8	2.8	2.7	2.7	2.8	2.8	2.8	2.9	3.0	3.0	2.9	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.9	3.0	3.1	3.4	4.8	4.1	3.9	4.8	5.5	4.2	4.8		
4	37.6	1.4	5.0	7.8	6.3	3.9	3.3	3.0	3.0	3.0	3.0	2.9	2.9	3.0	3.1	3.2	3.3	3.3	3.3	3.1	2.9	2.8	2.7	2.7	2.7	2.7	2.8	2.8	2.9	3.0	3.0	2.9	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.9	2.9	3.1	3.4	4.8	4.1	3.9	4.8	5.5	4.1	4.8		
5	39.0	1.0	4.3	7.1	5.7	3.3	3.3	2.4	2.4	2.4	2.4	2.4	2.3	2.3	2.4	2.5	2.6	2.7	2.6	2.5	2.3	2.2	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.2	2.3	2.4	2.4	2.2	2.2	2.1	2.1	2.2	2.2	2.2	2.2	2.2	2.2	2.3	2.4	2.8	4.1	3.4	3.3	4.2	4.9	3.5	4.2	
6	39.7	0.8	4.1	6.9	5.4	3.0	3.0	2.4	2.1	2.1	2.1	2.0	2.0	2.1	2.2	2.3	2.4	2.4	2.4	2.2	2.0	1.9	1.8	1.8	1.8	1.8	1.9	1.9	2.0	2.0	2.1	2.1	2.0	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	2.0	2.2	2.5	3.9	3.2	3.0	3.9	4.6	3.2	3.9		
7	40.3	0.8	4.1	6.9	5.4	3.0	3.0	2.4	2.1	2.1	2.1	2.0	2.0	2.1	2.2	2.3	2.4	2.4	2.4	2.2	2.0	1.9	1.8	1.8	1.8	1.8	1.8	1.9	1.9	2.0	2.0	2.1	2.1	2.0	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	2.0	2.1	2.5	3.8	3.1	3.0	3.9	4.6	3.2	3.9		
8	40.9	0.8	4.1	6.9	5.5	3.1	3.0	2.4	2.1	2.1	2.1	2.0	2.0	2.1	2.2	2.3	2.4	2.4	2.4	2.3	2.1	1.9	1.9	1.8	1.8	1.8	1.9	1.9	2.0	2.1	2.2	2.1	2.0	2.0	1.9	1.9	1.9	1.9	1.9	1.9	2.0	2.1	2.2	2.6	3.9	3.2	3.0	3.9	4.6	3.3	3.9			
9	41.5	0.8	4.1	6.9	5.4	3.0	3.0	2.4	2.1	2.1	2.1	2.0	2.0	2.1	2.2	2.3	2.4	2.4	2.4	2.2	2.0	1.9	1.8	1.8	1.8	1.8	1.9	1.9	2.0	2.0	2.1	2.1	2.0	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	2.0	2.1	2.2	2.5	3.9	3.2	3.0	3.9	4.6	3.2	3.9		
10	42.0	0.7	4.0	6.8	5.3	2.9	2.9	2.3	2.0	2.0	2.0	2.1	2.0	1.9	2.0	2.1	2.2	2.3	2.3	2.3	2.1	1.9	1.8	1.7	1.7	1.7	1.7	1.8	1.8	1.9	2.0	2.0	1.9	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.9	1.9	2.1	2.4	3.8	3.1	2.9	3.8	4.5	3.1	3.8		
11	42.5	0.7	4.0	6.8	5.3	2.9	2.9	2.3	2.0	2.0	2.0	2.0	1.9	2.0	2.1	2.2	2.2	2.3	2.3	2.3	2.1	1.9	1.8	1.7	1.7	1.7	1.7	1.8	1.8	1.9	2.0	2.0	1.9	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.9	2.1	2.4	3.7	3.0	2.9	3.8	4.5	3.1	3.8		
12	43.0	0.7	4.0	6.8	5.4	3.0	3.0	2.3	2.1	2.1	2.1	2.1	2.0	2.0	2.1	2.2	2.3	2.4	2.3	2.2	2.0	1.9	1.8	1.8	1.8	1.8	1.8	1.9	2.0	2.1	2.1	1.9	1.8	1.8	1.8	1.8	1.8	1.8	1.9	1.9	1.9	1.9	1.9	2.0	2.1	2.5	3.8	3.1	3.0	3.9	4.6	3.2	3.9	
13	43.6	0.8	4.1	6.9	5.5	3.1	3.1	2.4	2.2	2.2	2.2	2.2	2.1	2.1	2.1	2.2	2.3	2.4	2.5	2.5	2.3	2.1	2.0	1.9	1.9	1.9	1.9	2.0	2.1	2.2	2.2	2.1	2.0	1.9	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.1	2.2	2.6	3.9	3.2	3.1	4.0	4.7	3.3	4.0		
14	44.3	0.9	4.2	7.0	5.6	3.2	3.2	2.5	2.3	2.3	2.3	2.3	2.2	2.2	2.3	2.5	2.6	2.6	2.6	2.4	2.2	2.1	2.0	2.0	2.0	2.0	2.0	2.1	2.2	2.3	2.3	2.1	2.1	2.0	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.2	2.7	4.0	3.3	3.2	4.1	4.8	3.4	4.1
15	45.1	0.9	4.3	7.1	5.7	3.3	3.3	2.6	2.4	2.3	2.4	2.4	2.3	2.2	2.3	2.4	2.5	2.6	2.6	2.5	2.3	2.1	2.1	2.1	2.1	2.1	2.1	2.2	2.3	2.4	2.4	2.3	2.2	2.2	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.2	2.7	4.0	3.3	3.2	4.2	4.9	3.5	4.2	
16	46.0	1.0	4.4	7.2	5.7	3.3	3.3	2.7	2.4	2.4	2.4	2.4	2.3	2.3	2.4	2.5	2.6	2.6	2.7	2.5	2.3	2.2	2.1	2.1	2.1	2.1	2.1	2.2	2.3	2.4	2.4	2.3	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.3	2.5	2.8	4.1	3.5	3.3	4.2	4.9	3.5	4.2	
17	47.0	1.0	4.4	7.2	5.7	3.3	3.3	2.6	2.4	2.4	2.4	2.4	2.3	2.3	2.3	2.5	2.6	2.6	2.7	2.5	2.3	2.2	2.1	2.1	2.1	2.1	2.1	2.2	2.3	2.4	2.4	2.3	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.3	2.4	2.8	4.1	3.4	3.3	4.2	4.9	3.5	4.2
18	47.8	0.9	4.2	7.0	5.5	3.2	3.1	2.5	2.2	2.2	2.3	2.2	2.1	2.1	2.2	2.3	2.4	2.5	2.5	2.5	2.2	2.0	1.9	1.9	1.9	1.9	2.0	2.0	2.1	2.2	2.2	2.2	2.1	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.1	2.3	2.6	4.0	3.4	3.1	4.0	4.7	3.4	4.0	
19	48.4	0.7	4.0	6.8	5.3	3.0	2.9	2.3	2.0	2.0	2.1	2.0	1.9	1.9	2.0	2.1	2.2	2.3	2.3	2.2	2.0	1.8	1.7	1.7	1.7	1.7	1.8	1.8	1.9	2.0	2.1	2.0	1.9	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.9	2.0	2.1	2.4	3.8	3.1	2.9	3.8	4.5	3.2	3.8		
20	48.8	0.6	3.9	6.7	5.2	2.8	2.8	2.2	1.9	1.9	1.9	1.9	1.8	1.9	2.0	2.1	2.1	2.2	2.2	2.0	1.8	1.6	1.6	1.6	1.6	1.6	1.6	1.7	1.8	1.9	1.8	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.8	2.0	2.3	3.6	3.0	2.8	3.7	4.4	3.0	3.7
21	49.1	0.6	3.8	6.6	5.1	2.8	2.7	2.1	1.8	1.8	1.8	1.7	1.7	1.8	1.9	2.0	2.1	2.1	2.1	2.0	1.8	1.6	1.5	1.5	1.5	1.5	1.6	1.6	1.7	1.8	1.8	1.7	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.7	1.9	2.2	3.6	2.9	2.7	3.6	4.3	3.0	3.6
22	49.4	0.5	3.8	6.6	5.1	2.7	2.7	2.1	1.8	1.8	1.8	1.7	1.7	1.8	1.9	2.0	2.1	2.1																																				

