Tactile Working Memory Scale: An Assessment Tool for Learners with Congenital DeafBlindness



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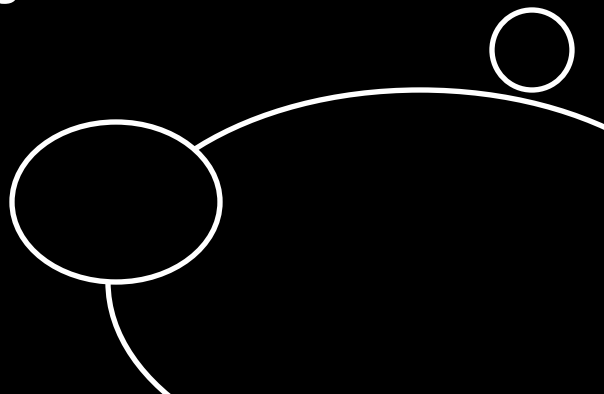
What is Working Memory?

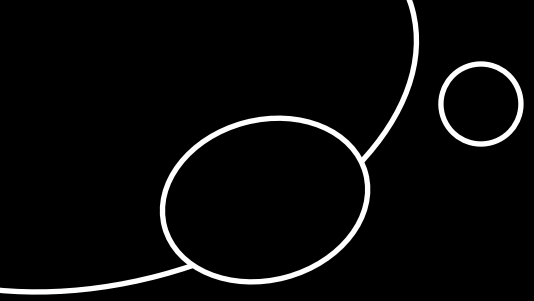


- The ability to keep something in mind for a limited amount of time is a central function in cognition.

- Working memory has been described as a complex cognitive mechanism used to temporarily store and process information (Miyake & Shah, 1999).

- Working memory is critical for making sense of anything that unfolds over time, for that always requires holding in mind what happened earlier and relating that to what comes later (Diamond, 2013).





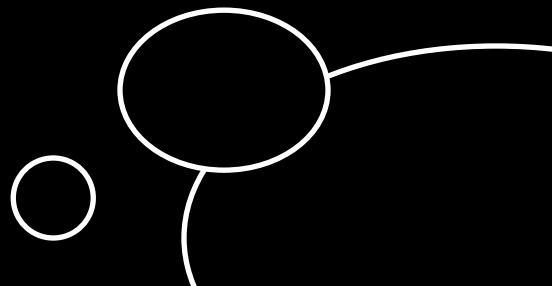
Working memory can be flexibly used to support a variety of tasks performed in daily life and is widely thought to be one of the most important mental faculties, critical for cognitive abilities such as planning, problem solving, understanding complex topics and learning new things.

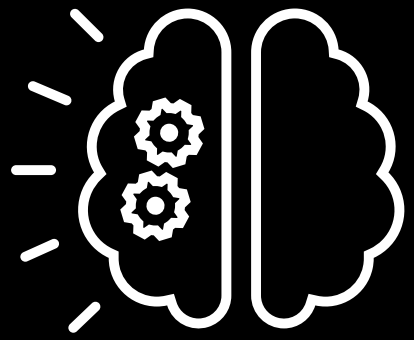
Working memory is our ability to store and process new as well as previously obtained information, which aids in processes such as reasoning, comprehension, learning, and memory updating (Sandhu, 2002). It also has been proposed to play a critical role in communication (Rudner & Signoret, 2016).

Four separate working memory components

1. A central executive/attention controller that focuses, switches, and divides attention and links long-term and working memory
2. A visuospatial sketchpad that holds visual and spatial information
3. A phonological loop that holds speech-based and other acoustic information
4. An episodic buffer that forms an interface among working memory components and binds information from subsystems and long-term memory

-Baddeley (2003)





Working Memory & Language

- Scientific studies have shown strong links between working memory and vocabulary acquisition (Gathercole & Alloway, 2008), learning a new language (Bosman & Janssen, 2017), linguistic processing (Archibald, 2017) and speech perception (Heine & Slone, 2019).

- Working memory is critical for language comprehension because it serves as a temporary holding area for incoming and outgoing information, as well as a storage space for linguistic information during immediate processing (Baddeley, 2007).

Working Memory & Sign Language



- Working memory also plays a significant role in sign language (Wilson & Fox, 2007). Sign language working memory appears to have an impact on deaf signers' signed language proficiency (Boutla, et. al., 2004).

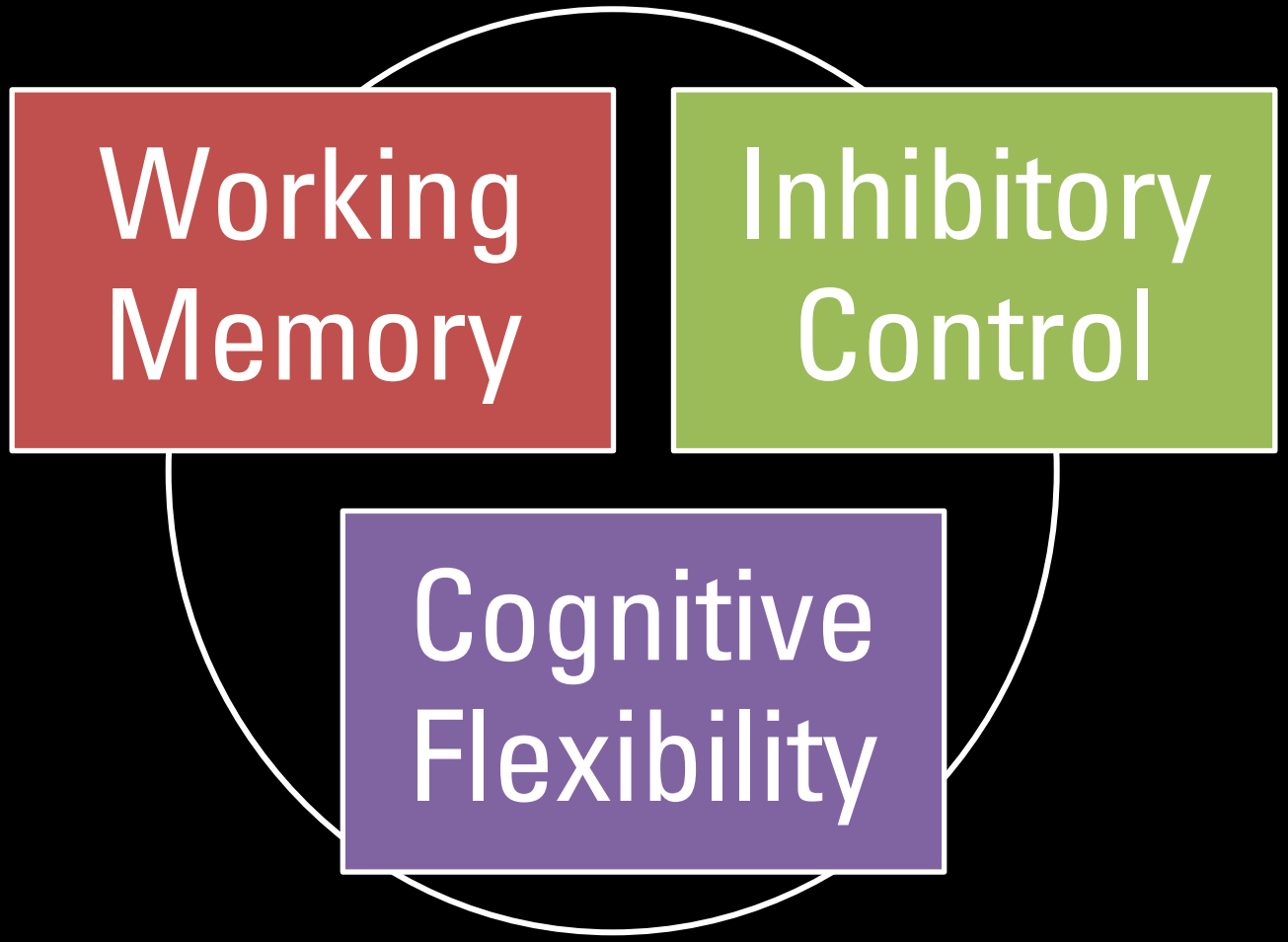
- Wilson and Emmorey (2003) proposed a sign-based phonological loop in deaf signers, which comprises of two components: a phonological store that retains information using sign-based phonological codes (e.g., handshape, orientation, location, and movement), and a manual articulatory rehearsal mechanism that refreshes information in the phonological store.

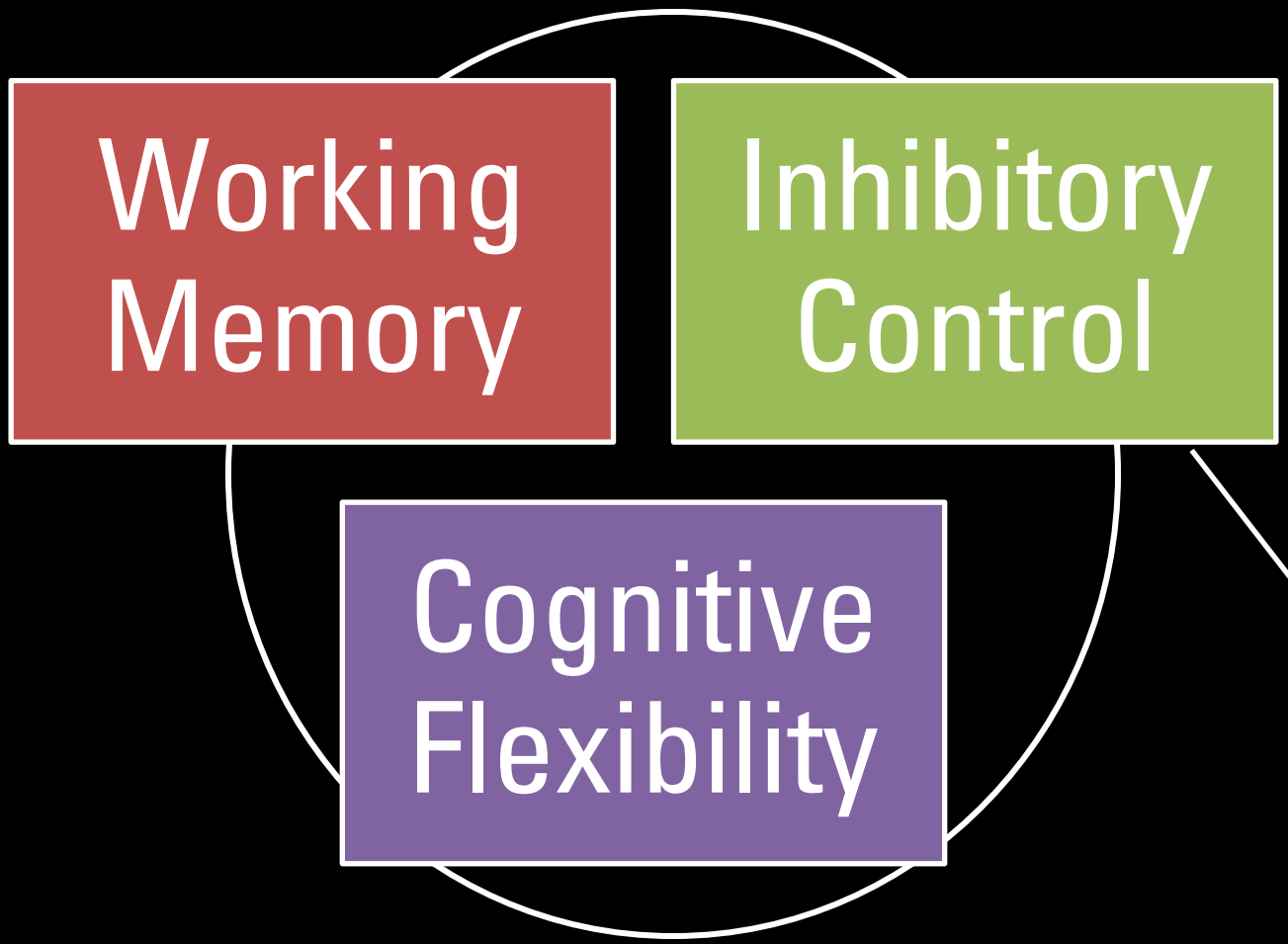
What are Executive Functions?

The concept of executive functions is defined as a set of mental control skills that are necessary for monitoring behaviors that facilitate the attainment of chosen goals, where working memory is a core component (Nicholas, 2005).

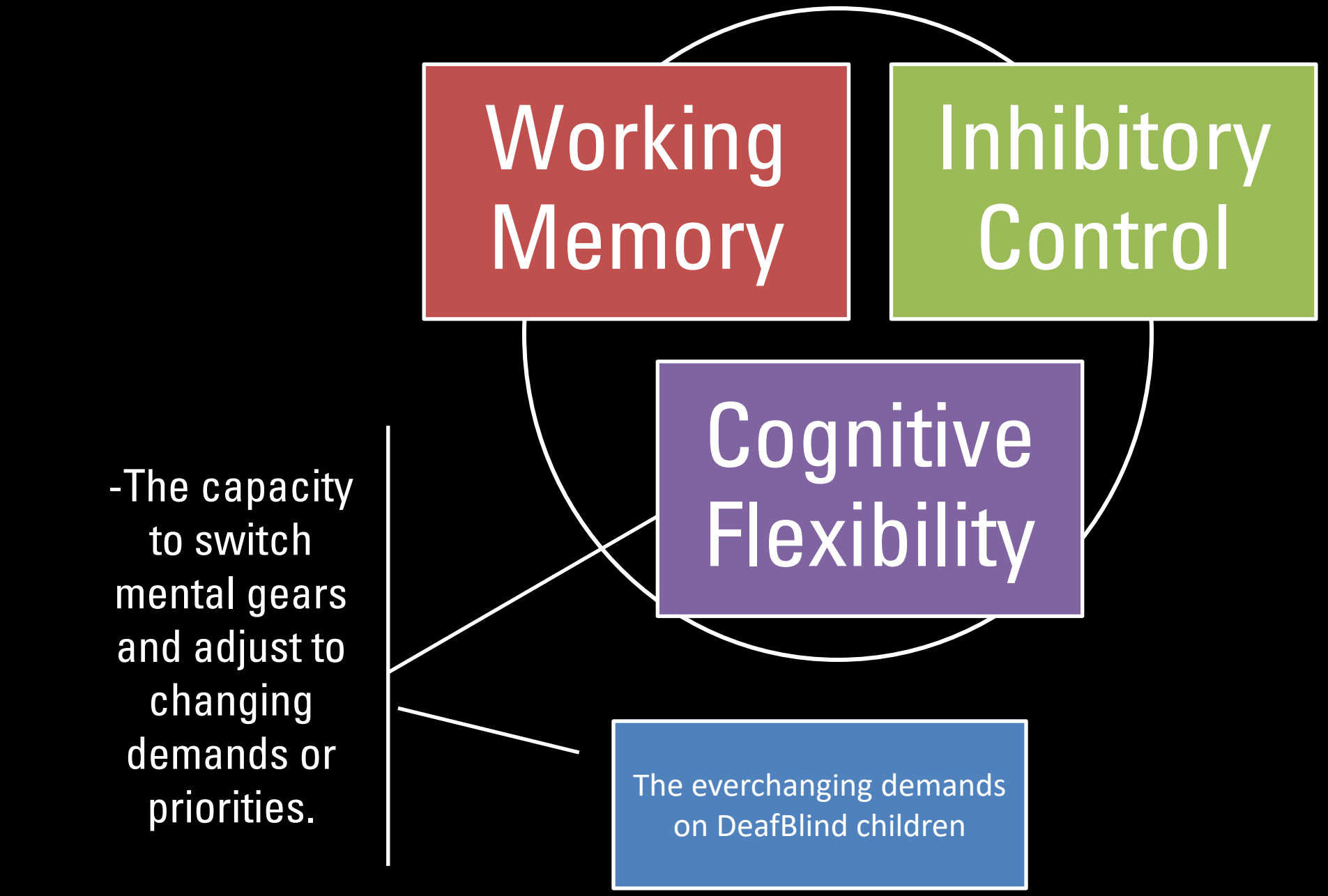


Executive Functions





-The ability to master thoughts and impulses to resist temptations, distractions, and habits, and to pause and think before acting


Working Memory
Inhibitory Control
Cognitive Flexibility
-The capacity to switch mental gears and adjust to changing demands or priorities.
The everchanging demands on DeafBlind children

What are Executive Functions?

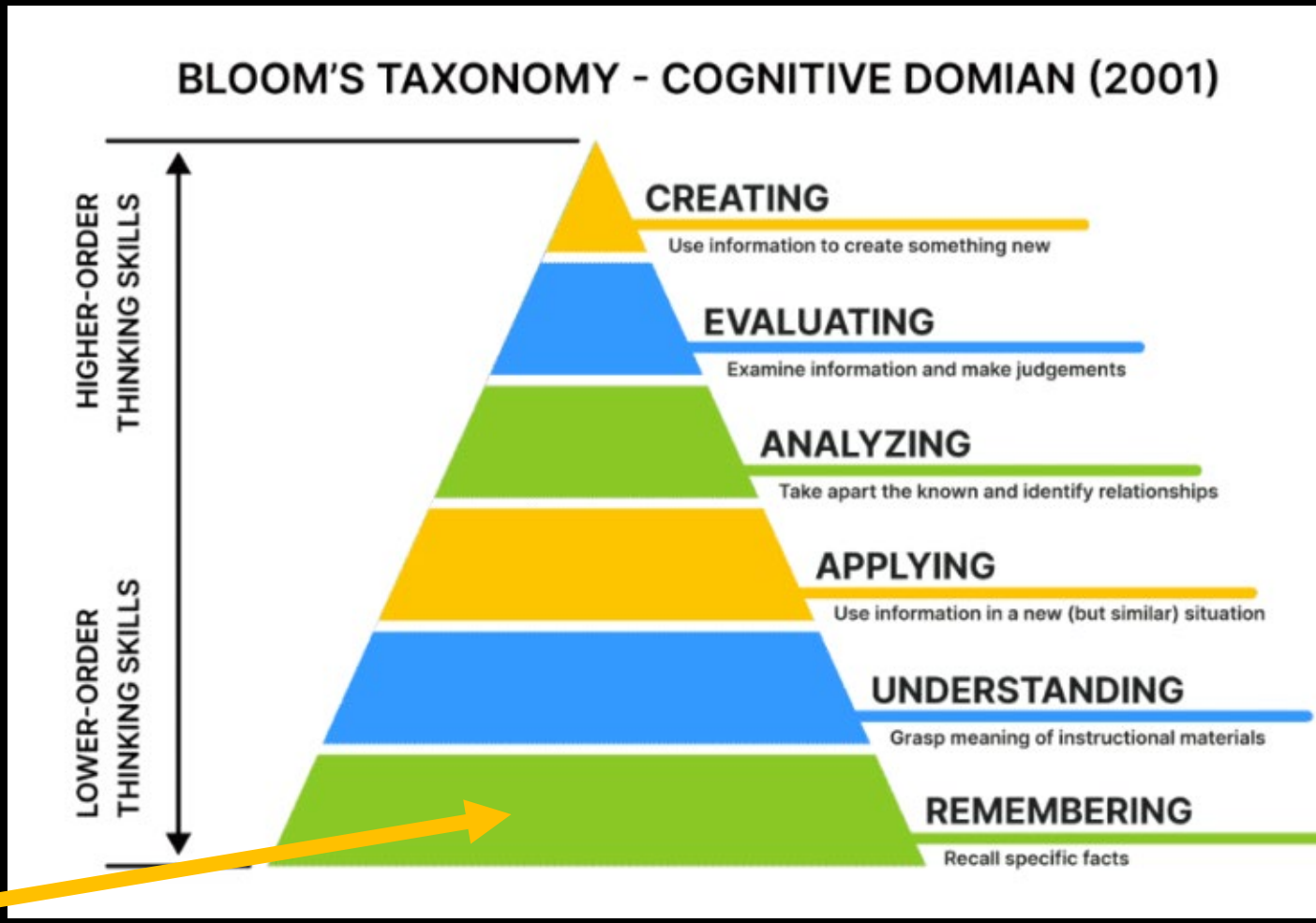
…a set of mental control skills that are necessary for monitoring behaviors that facilitate the attainment of chosen goals, where working memory is a core component.



-Nicholas, 2005

Why is this important to DeafBlind learners?

Knowledge/ Information Gathering



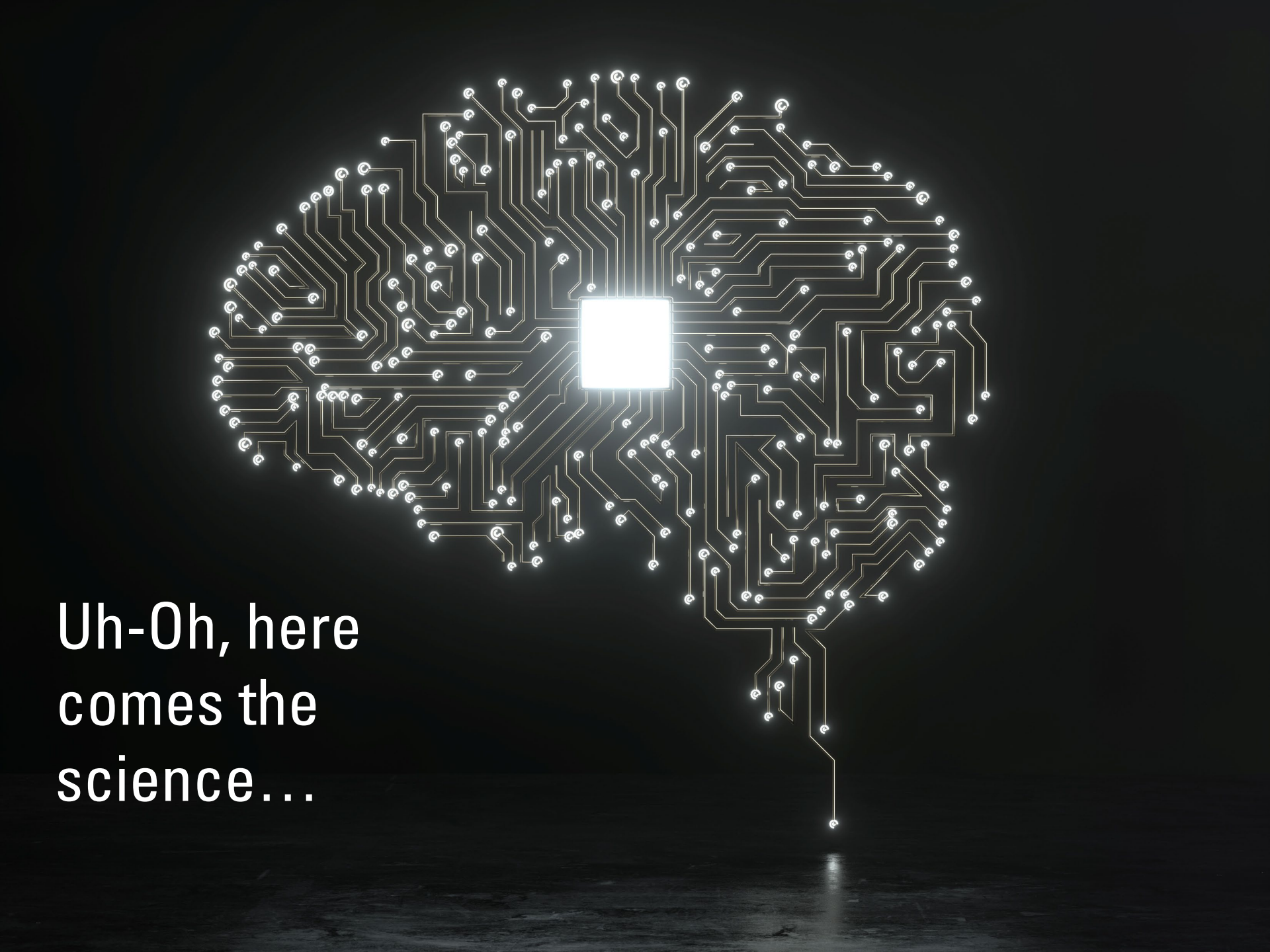
Bloom's Taxonomy underwent a significant evolution from its original version in 1950 to the revised version in 2001.
https://www.idreameducation.org/blog/blooms-taxonomy-cognitive-learning-levels/

DEAFBLINDNESS IS A DISABILITY OF ACCESS AND INFORMATION GATHERING



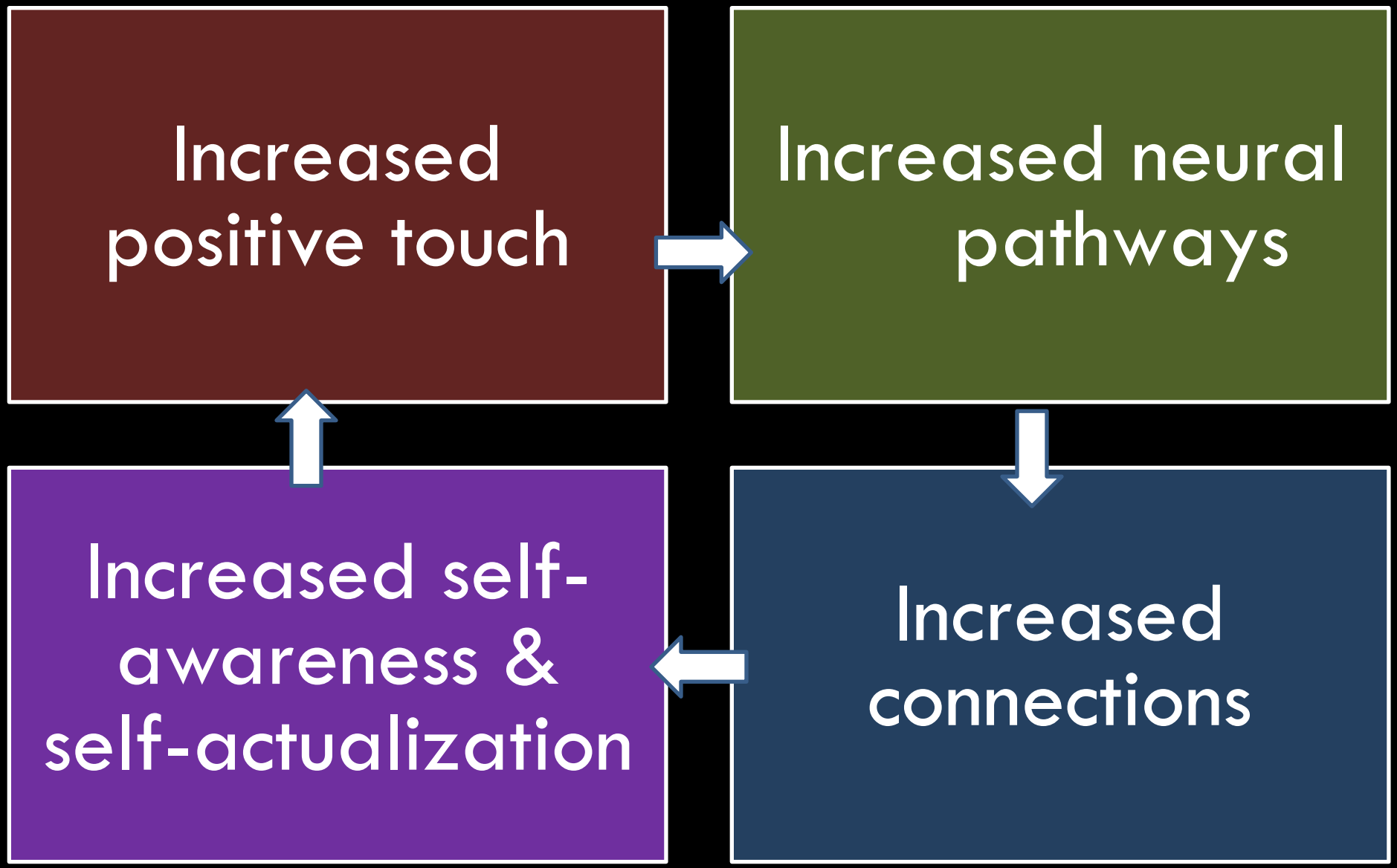
The Somatosensory System & Neuroplasticity




Uh-Oh, here
comes the
science…

The human brain is a malleable organ that responds to the environments we are placed in and the challenges we face. It is considered to be a highly dynamic and a constantly reorganizing system capable of being shaped and reshaped across an entire lifespan. The lifelong capacity of the brain to change and rewire itself in response to the stimulation of learning and experience is known as **neuroplasticity**.

Daisuke, Tomohisa, & Manabu, 2006; Saito, et. al., 2007


Increased positive touch
Increased neural pathways
Increased connections
Increased self-awareness & self-actualization

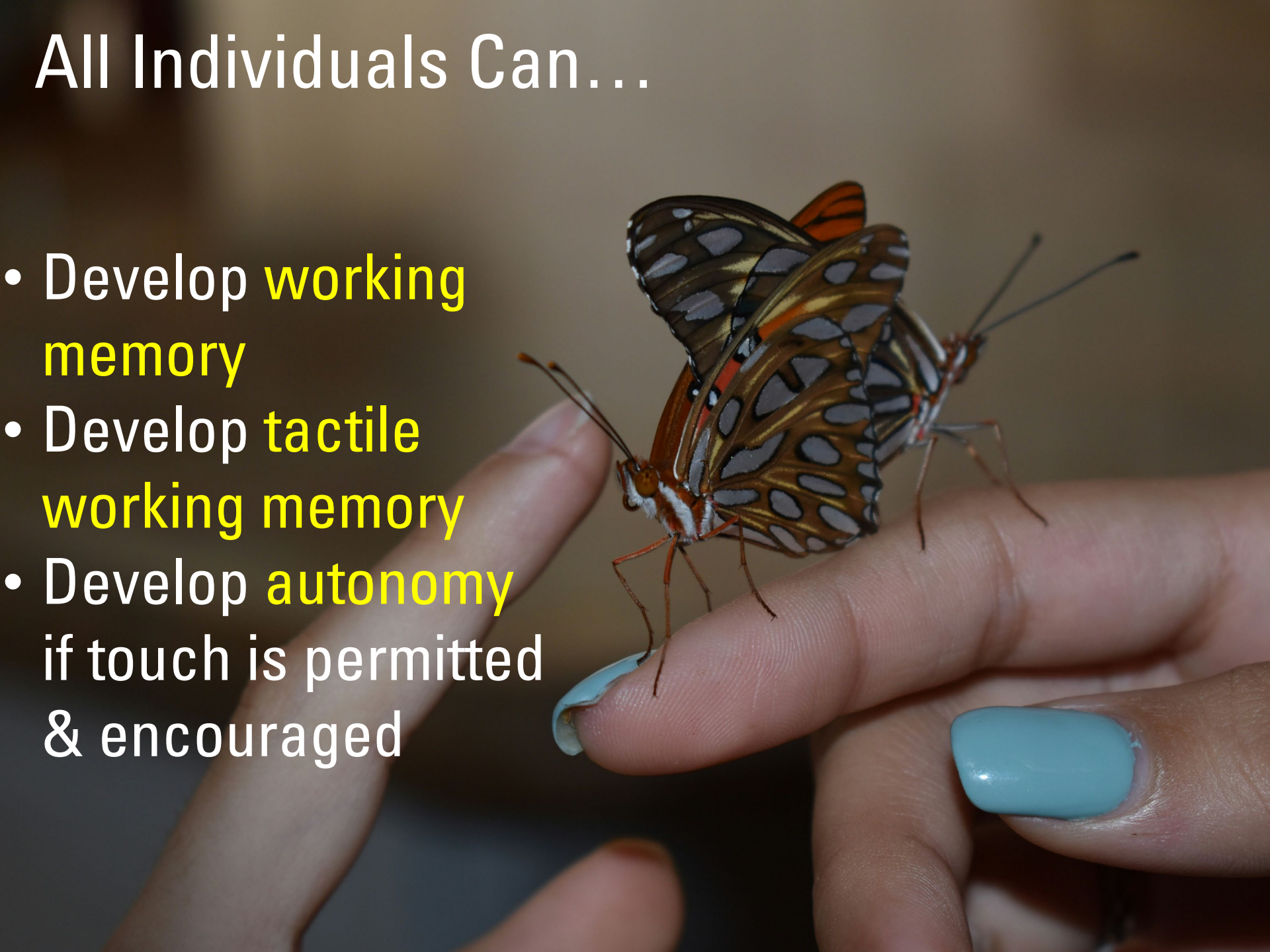
"…evidence from neuropsychology, neuroimaging, and neurophysiological experiments that have highlighted the crucial role played by the somatosensory processing system in mediating bodily-tactile information.

Through the somatosensory processing system, the brain is able to communicate with the surrounding world."

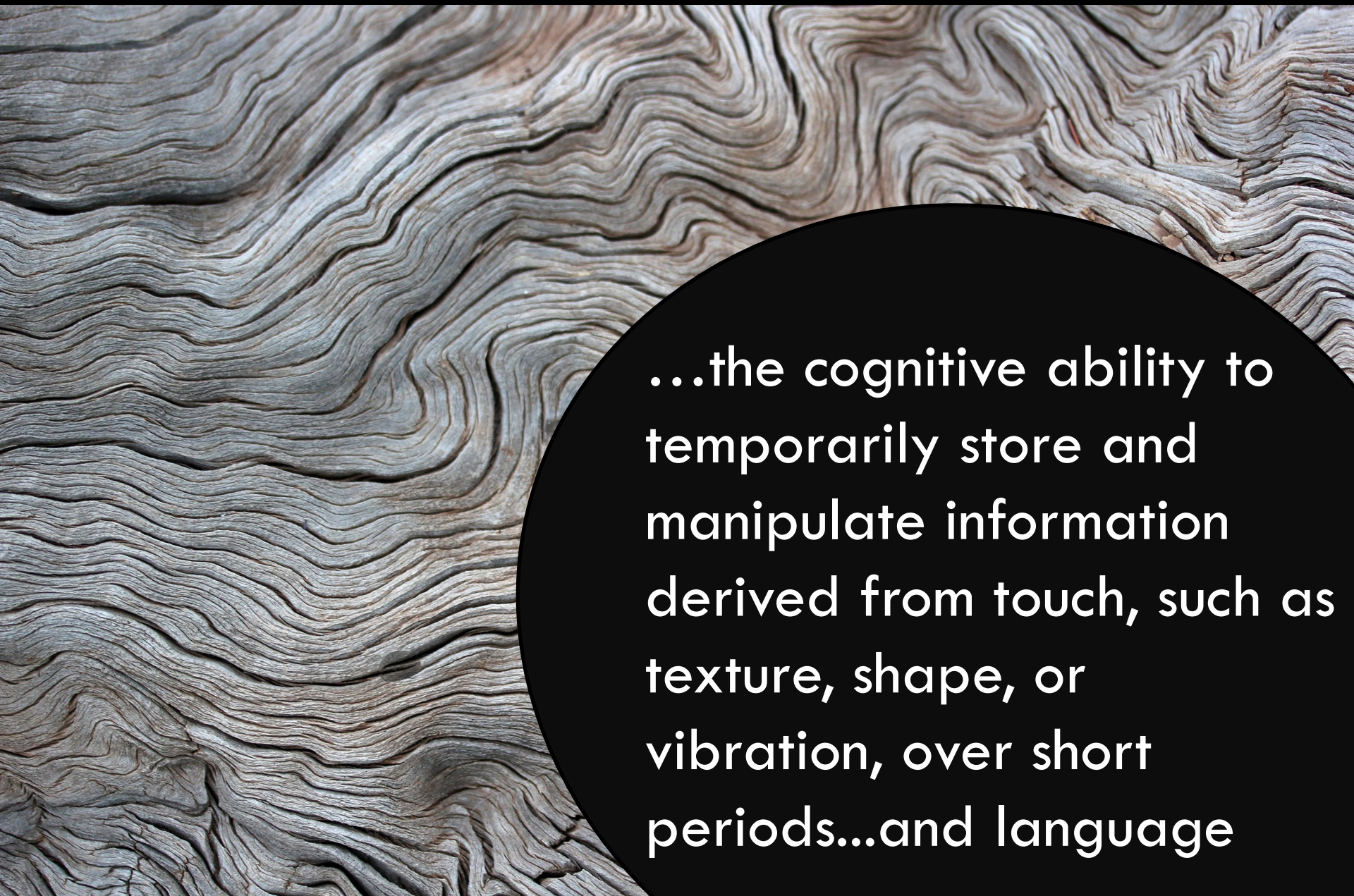
-Nicholas, et al, 2005

All Individuals Can…

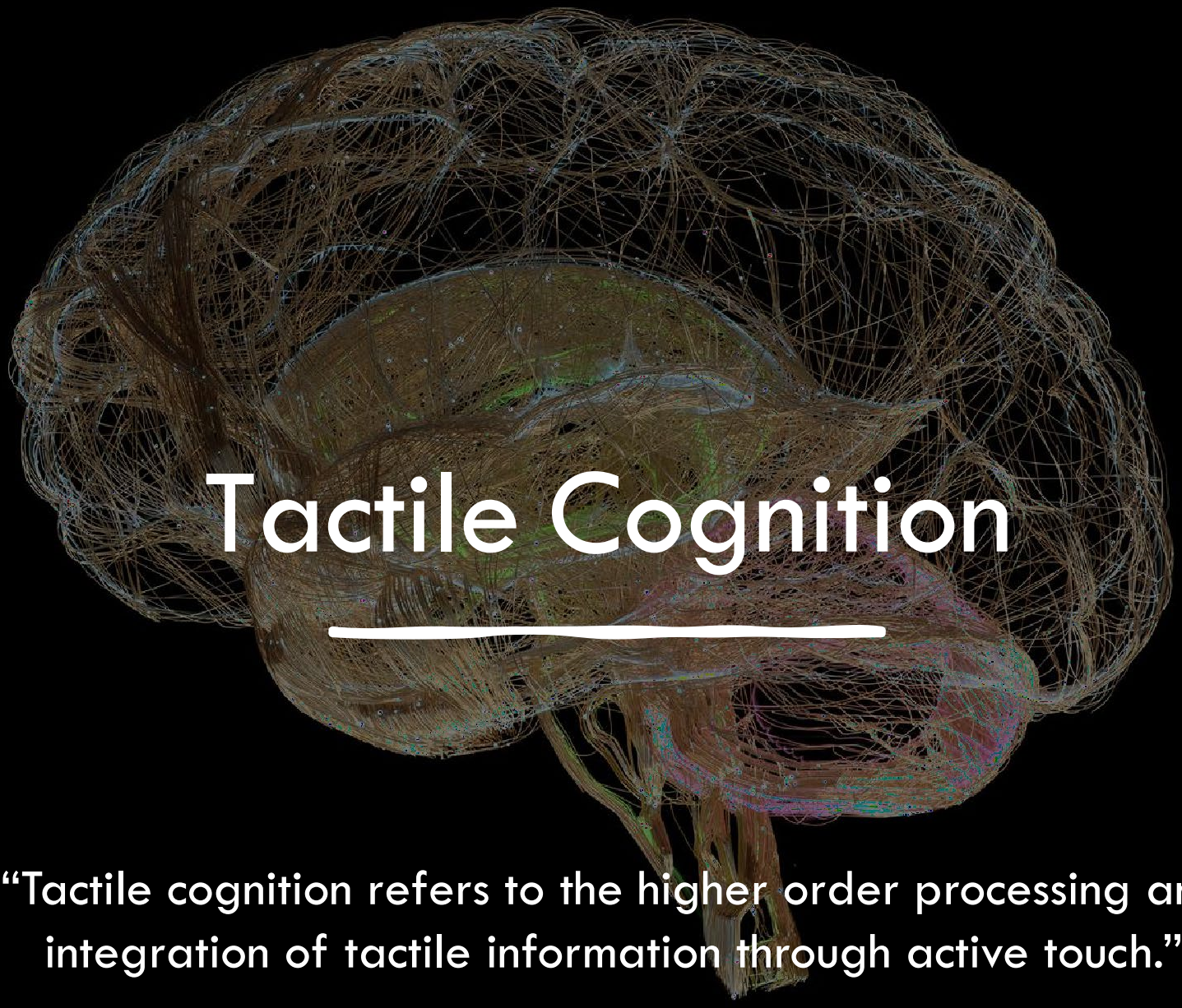
- Develop working memory
- Develop tactile working memory
- Develop autonomy if touch is permitted & encouraged



WHAT IS TACTILE WORKING MEMORY?



…the cognitive ability to temporarily store and manipulate information derived from touch, such as texture, shape, or vibration, over short periods…and language



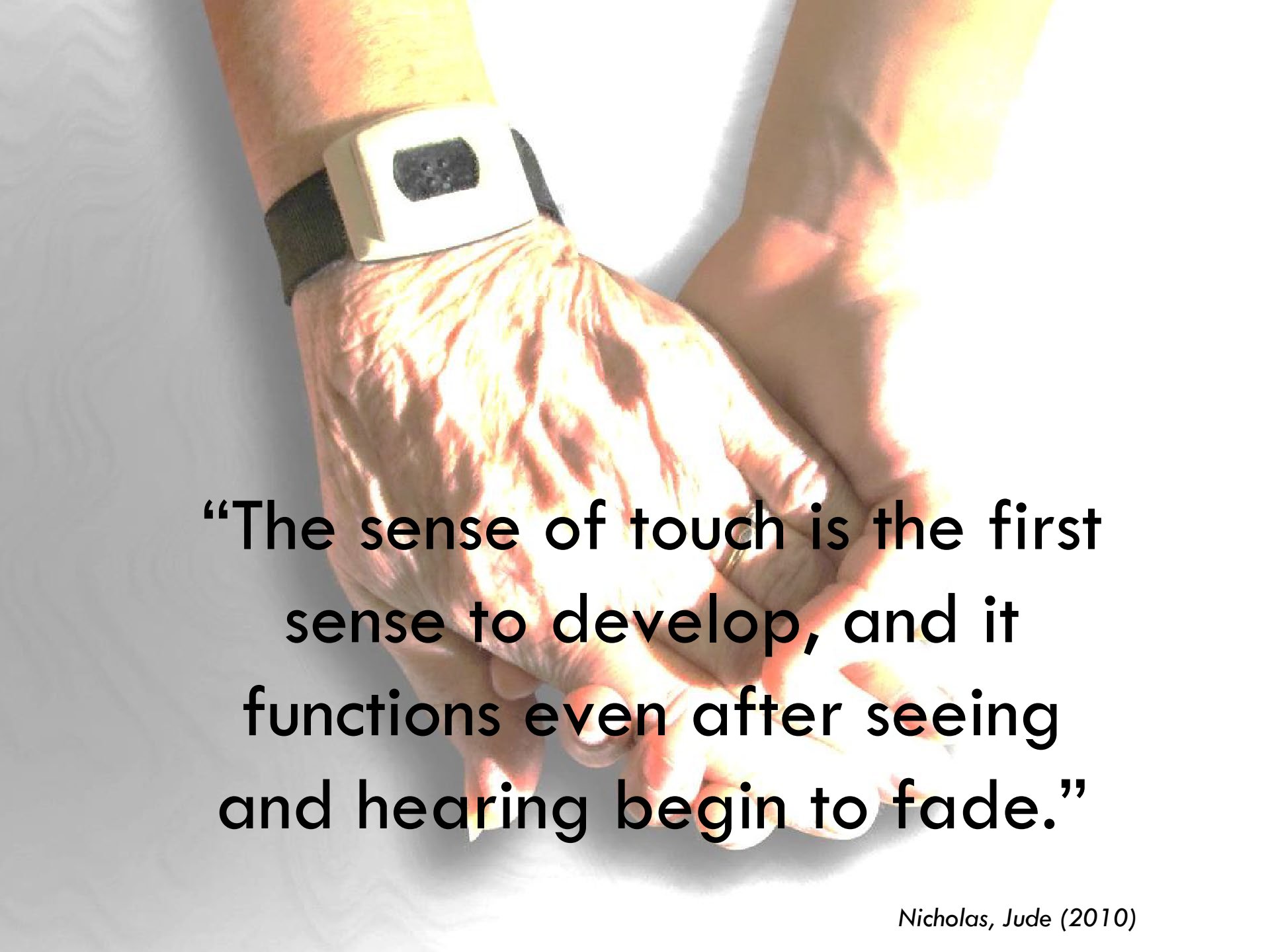
Tactile Cognition

"Tactile cognition refers to the higher order processing and integration of tactile information through active touch."

Nicholas, Jude (2010)

- We lose touch receptors over time
- They tend to peek around age 16 – 18 and then begin to fade
- Early introduction is better





"The sense of touch is the first sense to develop, and it functions even after seeing and hearing begin to fade."

Nicholas, Jude (2010)

How do we develop tactile cognition in learners who are DeafBlind?



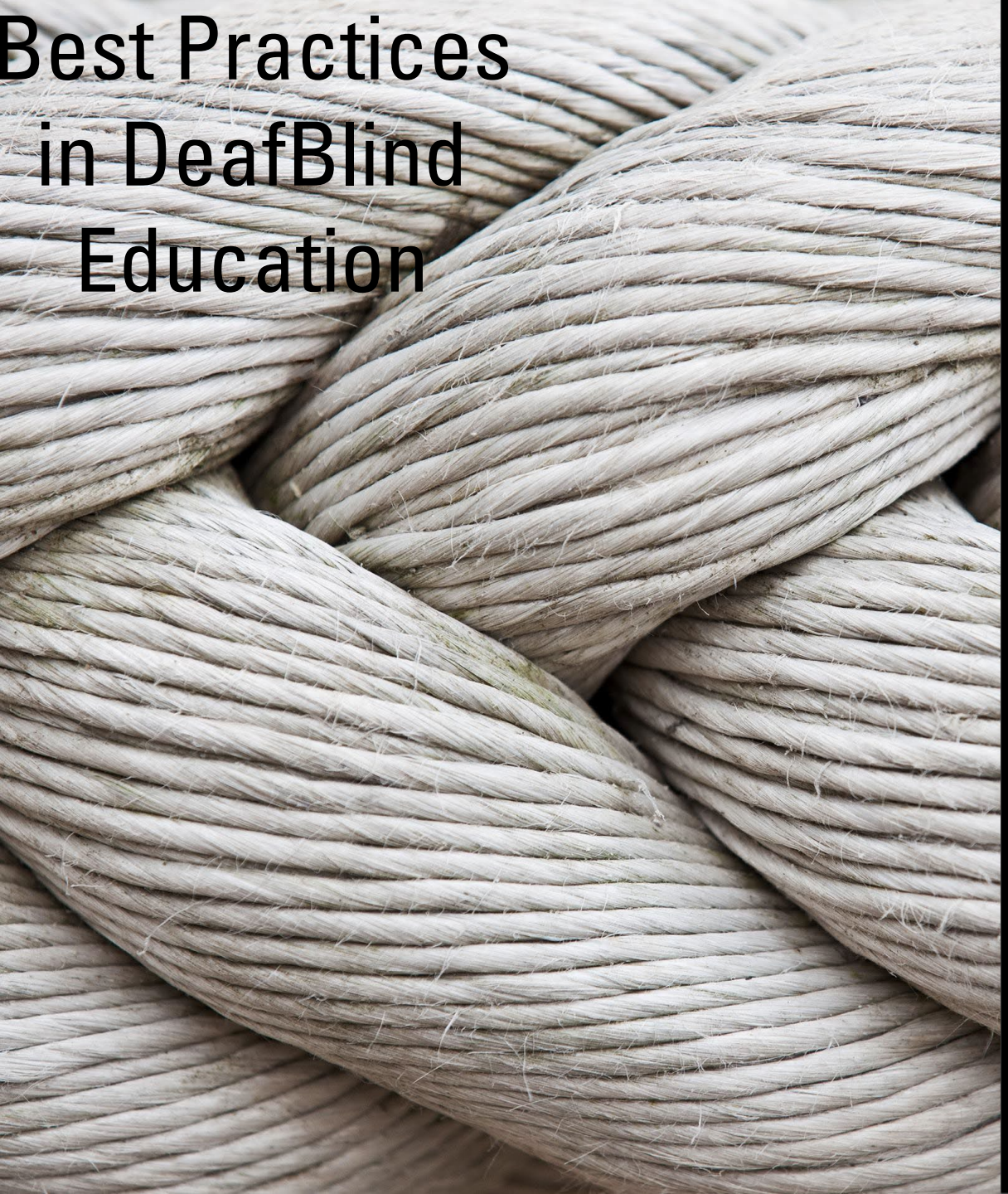
Overlapping Principles/ Theories/Practices

- Best Practices in DeafBlind Education
- Protactile Language
- Tactile Working Memory Scale



Protactile Language principles mirror best practices in DeafBlind education and principles in the Tactile Working Memory Scale

- Hand-under-hand
- Establishing Rapport
- Child-Guided Interaction
- Coactive Movement
- Shared Tactile Exploration



Best Practices in DeafBlind Education

- Constant & repetitive access to thing and people
- Touch that is
  - Respectful
  - Mindful
  - Intentional
- Shared tactile exploration



WHAT IS PROTACTILE LANGUAGE?

Protactile Language was developed by and for DeafBlind individuals & prioritizes touch over all other sensory channels

"In every language, the basic vocabulary of everyday life is drawn from nature and social relations."

— Edward Sapir
American linguist and anthropologist (1884–1939)

Protactile Language is a perfect example of this as the language grew organically from within the community.

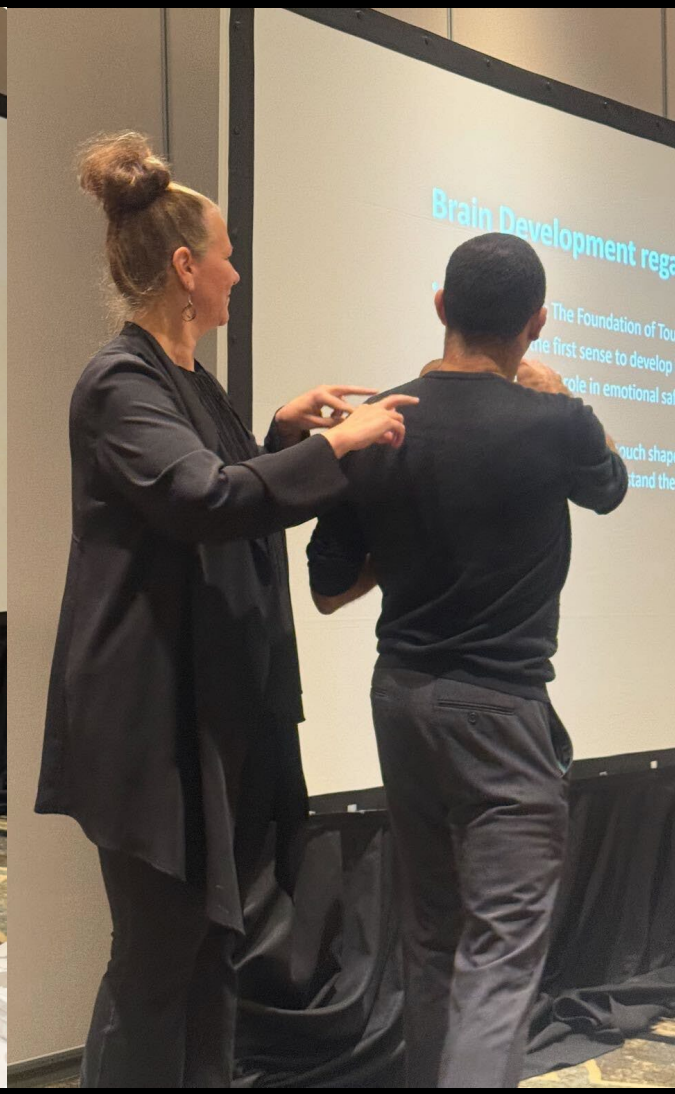
"ProTactile Language allows DeafBlind people to give, receive and exchange information through a tactile channel, rather than relying on auditory or visual channels to access information and language."



Protactile Language

- A language separate from TASL with specific principles and practices
- Designed by and for DeafBlind people based solely through touch
- Currently borrows from ASL but evolving into a completely separate language



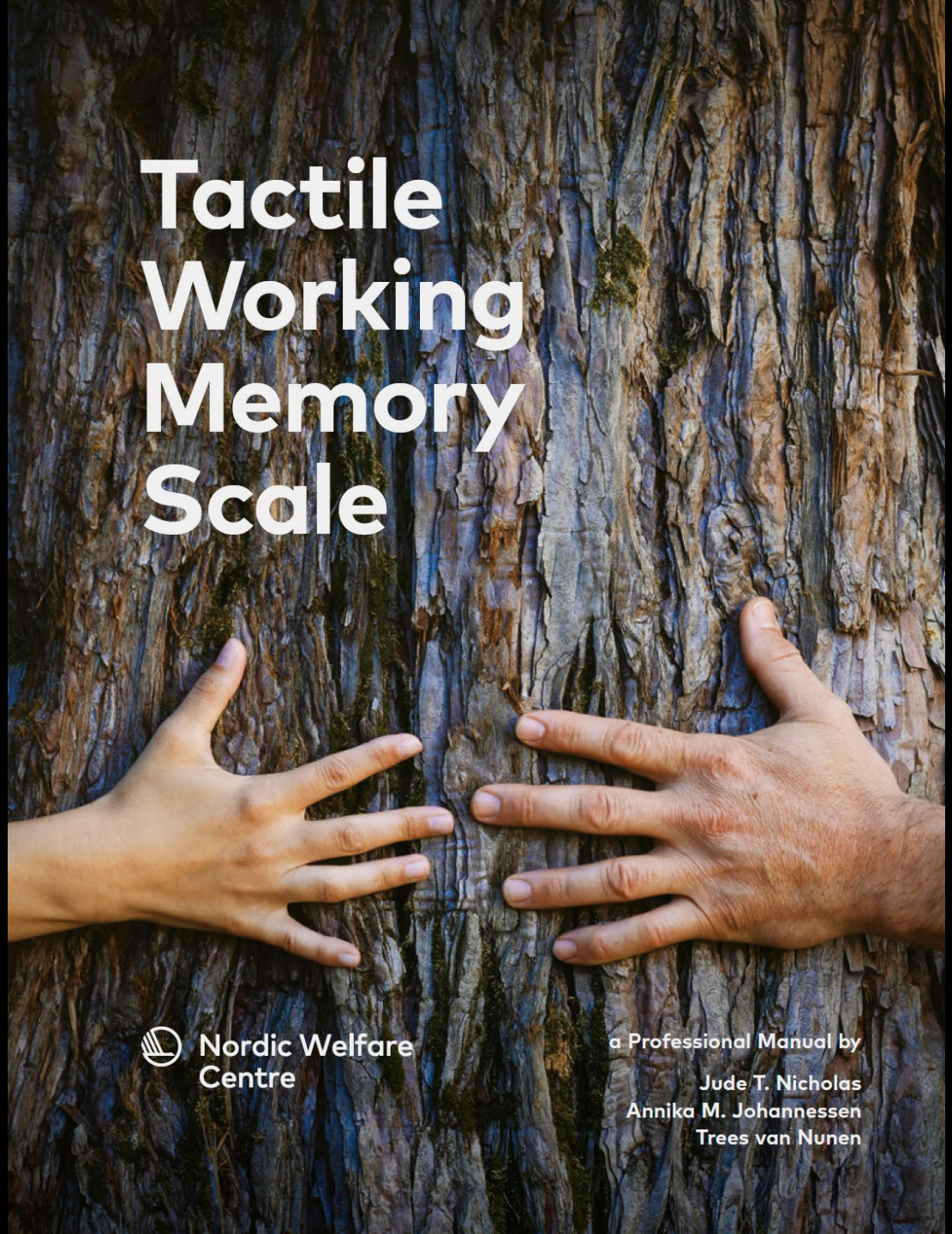


PROTACTILE GUIDING PRINCIPLES



1. Establishing Co-presence
2. Creating a Shared Space/Experience
3. Building Reciprocal Feedback
4. Encouraging Tactile Autonomy

Tactile Working Memory Scale



Nordic Welfare Centre

a Professional Manual by

Jude T. Nicholas
Annika M. Johannessen
Trees van Nunen

Tactile Working Memory Scale

A checklist of learning strategies that support tactile working memory

- Designed to enhance Tactile Working Memory potentials and improve communicative and learning competencies of a child who are Deafblind

- Designed to promote learning strategies in the bodily-tactile modality

Parallel principles with Protactile Language

Bodily-Tactile Modality



"A person with sight and hearing needs a radical shift in perspective in order to experience and understand the world from a tactile perspective, which is the way that people who are deafblind experience their world.

When tactile experiences become meaningful for both partners in an interaction, this becomes the foundation for exploration of new environments, development of meaningful communication, and the building of friendships."

-Landscape of Touch, 2012


“We should view deafblindness as a positive state in which active touch, bodily movements, postures, and hand gestures, are the pre-eminent source of information and not as a negative state of being in which sight and hearing are not present or limited.”
-Jude Nicholas



Developing Meaningful Touch Through a Bodily-Tactile Modality

TWMS

TACTILE WORKING MEMORY SCALE

Instructions

On the following pages is a list of 20 items with examples of behavioral cues that describe the processes of working memory in the bodily-tactile modality. Examples are provided for the items to add clarity. The given examples are illustrative and not exhaustive.

The TWMS professional manual also illustrates descriptions of the 20 items and demonstrates several examples of perceptual, cognitive, and social cognitive strategies that may enhance bodily-tactile working memory. Please read **Tactile Working Memory Scale - A Professional Manual** manual before using the scale.

The items within the scale could be rated through direct or video observation. The TWMS must be administered by an examiner who has good observational skills and a knowledge of the person's repertoire of behaviors. Most valid results are obtained if several individuals who have close contact with the person (teachers, support teachers, parents, specialists) evaluate the person on a collaborative basis. The examiner may use the space provided under "comments" for observational notes.

Read each item carefully and draw a circle around your response for each example.

Draw a circle around:

P **Present** – when you can clearly observe the behavioral cues relevant to the item.

E **Emergent** – when you can to a certain degree observe the behavioral cues relevant to the item: partially present.

A **Absent** – when you cannot observe any of the behavioral cues relevant to the item.

N/A **Not Applicable** – when an item doesn't apply in the current assessment context, due to relevant individual factors such as severe motor or physical limitation or other situational factors.

Before you begin rating the items, please fill in the information regarding general data.

General data

DATE OF ASSESSMENT: _____

NAME: _____

AGE: _____ GENDER: _____

Visual loss: ☐ None ☐ Mild ☐ Moderate ☐ Severe

Visual aid/optical devices/other _____

Hearing loss: ☐ None ☐ Mild ☐ Moderate ☐ Severe

Hearing aid/cochlear implant/other _____

Displays signs of tactile defensiveness ☐ Yes ☐ No

(Negative reaction to touch: objects to being touched by others; avoids using hands; avoids touching objects)

How do you rate the following functions?

Gross motor functions ☐ Good ☐ Average ☐ Poor

(Gross motor skills coordinate larger movements of the body: lying, rolling, sitting, crawling, standing, walking, running or jumping)

Fine motor functions ☐ Good ☐ Average ☐ Poor

(Fine motor skills coordinate precise, small movements of the body: holding small items, buttoning clothing, turning pages, eating or cutting with scissors)

Balance and coordination ☐ Good ☐ Average ☐ Poor

(Maintaining a controlled body position during tasks/activities: sitting at a table, retrieving an object from the floor or changing from a standing position to sitting)

TWMS

TACTILE WORKING MEMORY SCALE

P	**Present** – when you can clearly observe the behavioral cues relevant to the item.
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TWMS

TACTILE WORKING MEMORY SCALE

Items	Examples	Comments	Rating
1) Uses active touch and motion to direct focus of attention towards an object of interest	– orient towards a specific object in the immediate vicinity (e.g. leans toward, reaches out, searches, grasps or picks up a specific object)		P E A N/A
2) Uses active touch and motion in systematic exploration of an object of interest	– uses self-generated movements/exploratory procedures to purposefully detect/explore the physical dimensions of an object in the immediate vicinity e.g., strokes the outlines of the object to judge size; squeezes or traces the object's edges to judge shape; holds and supports the object to judge weight; tracks an object using fine scale detail tracing to a large-scale shape; tracing to perceive all parts of an object/tool) – uses self-generated movements/exploratory procedures to detect the surface properties of an object (e.g., squeezes or presses to determine hardness/softness; strokes a surface to detect texture; gently touches a surface to detect vibration, pressure or determine temperature)		P E A N/A
3) Uses active touch and motion to identify similarities or differences among objects	– compares things that are similar or contrast things that expresses differences in the immediate vicinity (e.g., tactilely matches similar shaped/textured objects; tactilely discriminates between different shaped/textured objects; tactilely categorizes/labels various shaped/textured objects)		P E A N/A

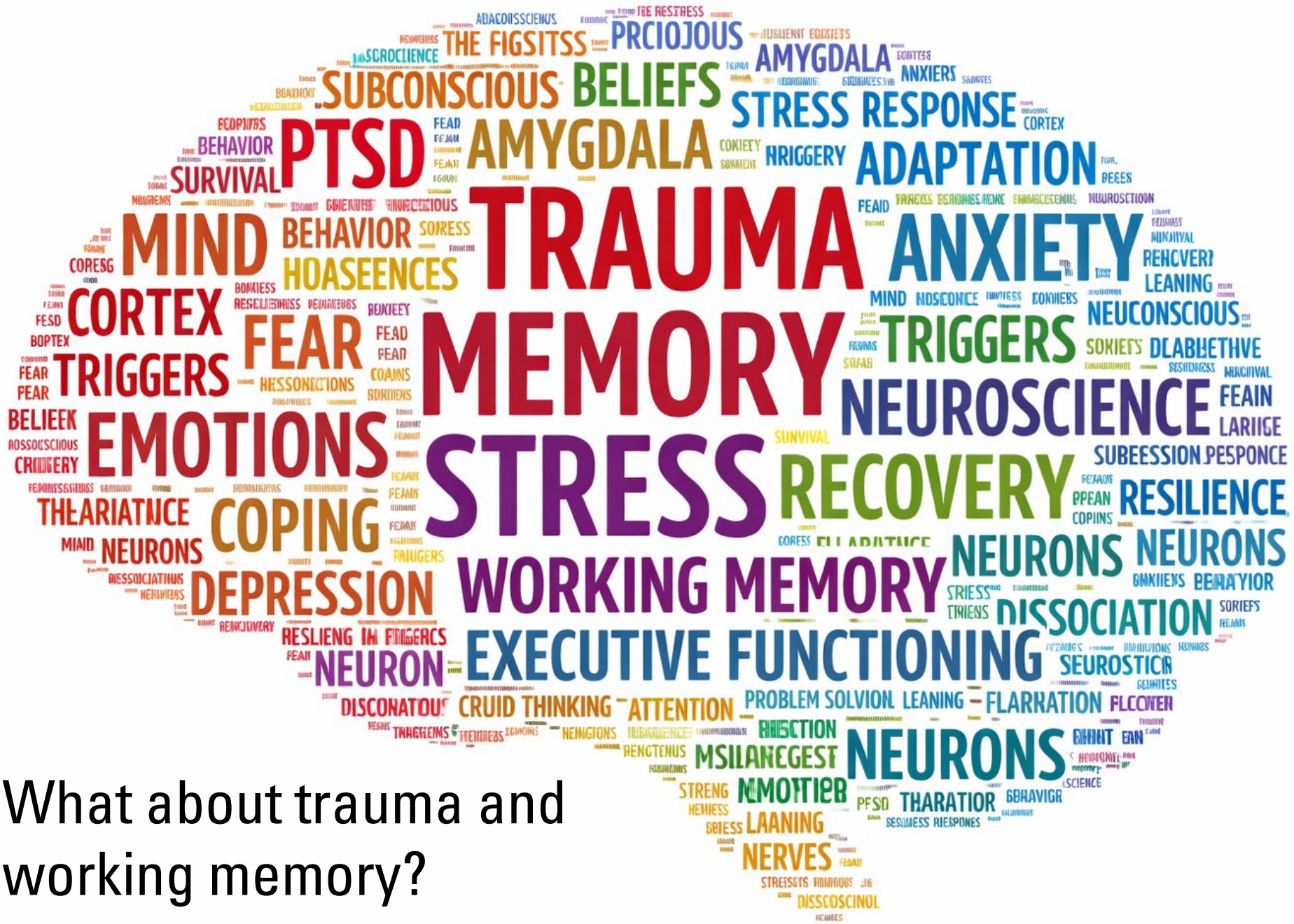
DOMAINS	Encode						Maintain						Manipulate					
Present (P)																		
Emergent (E)																		
Absent (A)																		
N/A																		
Items	1	2	3	5	6	8	4	7	10	11	12	15	16	9	13	14	17	18	19	20
BEHAVIORAL DESCRIPTIONS	Tactile focused attention	Object manipulation (ventral stream function)	Tactile object identification (ventral stream function)	Tactile object location (dorsal stream function)	Spatial navigation (dorsal stream function)	Social Working Memory: person oriented	Tactile object recognition (ventral stream function)	Tactile spatial recognition (dorsal stream function)	Social Working Memory: mutual & joint attention	Social Working Memory: retaining social info	Tactile sustained attention	Sustained attention: interaction-time	Selective attention: interaction-novel condition	Social Working Memory: emotion-perception	Tactile selective attention	Attentional switching	Attentional switching: interaction-topic change	Attention manipulation: long-term working memory strategies	Attention manipulation: maintenance cognitive strategies	Attention manipulation: metacognitive strategies

Manipulate					20	Attention manipulation: metacognitive strategies
					19	Attention manipulation: maintenance cognitive strategies
					18	Attention manipulation: long-term working memory strategies
					17	Attentional switching: interaction-topic change
					14	Attentional switching
					13	Tactile selective attention
					9	Social Working Memory: emotion-perception

				16	Selective attention: interaction-novel condition
				15	Sustained attention: interaction-time
				12	Tactile sustained attention
				11	Social Working Memory: retaining social info
				10	Social Working Memory: mutual & joint attention
				7	Tactile spatial recognition (dorsal stream function)
				4	Tactile object recognition (ventral stream function)

Maintain

DOMAINS	Present (P)	Emergent (E)	Absent (A)	N/A	Items	BEHAVIORAL DESCRIPTIONS
Encode					1	Tactile focused attention
					2	Object manipulation (ventral stream function)
					3	Tactile object identification (ventral stream function)
					5	Tactile object location (dorsal stream function)
					6	Spatial navigation (dorsal stream function)
					8	Social Working Memory: person oriented



What about trauma and working memory?

Trauma and stress negatively modulate working, short-term, and long-term memory processing and storage.



"CHILDREN WITH MULTIPLE DISABILITIES LIVE IN A FRAGMENTED WORLD, OFTEN FULL OF STRESS AND ANXIETY."

Dr. Jan van Dijk

Protactile Language Interpreting Modules





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