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From Chaos to Calm: Balancing the Frontal Lobes for Societal Participation

Gordon J. Horn, PhD
NeuroRestorative Research Institute, Co-Chair
National Deputy Director Analytics & Outcomes
Florida State University College of Medicine, Clinical Assistant Professor

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| Objectives

- Discuss and describe the frontal lobes and executive functions.
- Understand the impact of the frontal lobes with initiation and inhibition.
- Learn and discuss strategies to assist individuals with initiation and inhibition deficits.
- Describe the importance of medications for frontal lobe impairments in daily living.

| Summary of Presentation

- The frontal lobes are crucial for successful integration into society. Two key cognitive ingredients of the frontal lobes are initiation and inhibitory responding to manage behavior. The participants in this course will learn about the role of the frontal lobes and executive functions.
- Participants will also learn about the impact of the frontal lobes with initiation and inhibition and how these cognitive skills impact societal participation. During the workshop, participants will learn strategies to assist individuals with initiation and inhibition deficits.
- The role of medication to reduce the impact of these deficits in daily functioning will be discussed. Practical skills for family members will be provided.

Role of the Frontal Lobes and Executive Functions

“So how is that working for you?”

This is a question the frontal systems should ask with each and every decision.

Examples of how inappropriate behavior can be repeated without awareness.

| Neurophysiology

- Accounts for 1/3 of the mass of the brain.
- Neurodevelopmental pathways are incomplete until age 24-25. Disruption of the pathways due to trauma, injury, illness will substantially change the outcomes of adult development.
- Multiple types of brain injury (including traumatic) often results in deficits in executive functions. This can manifest as problems with self-directed cognitive functioning or they can manifest as problems with self-directed behavioral and emotional self-control.

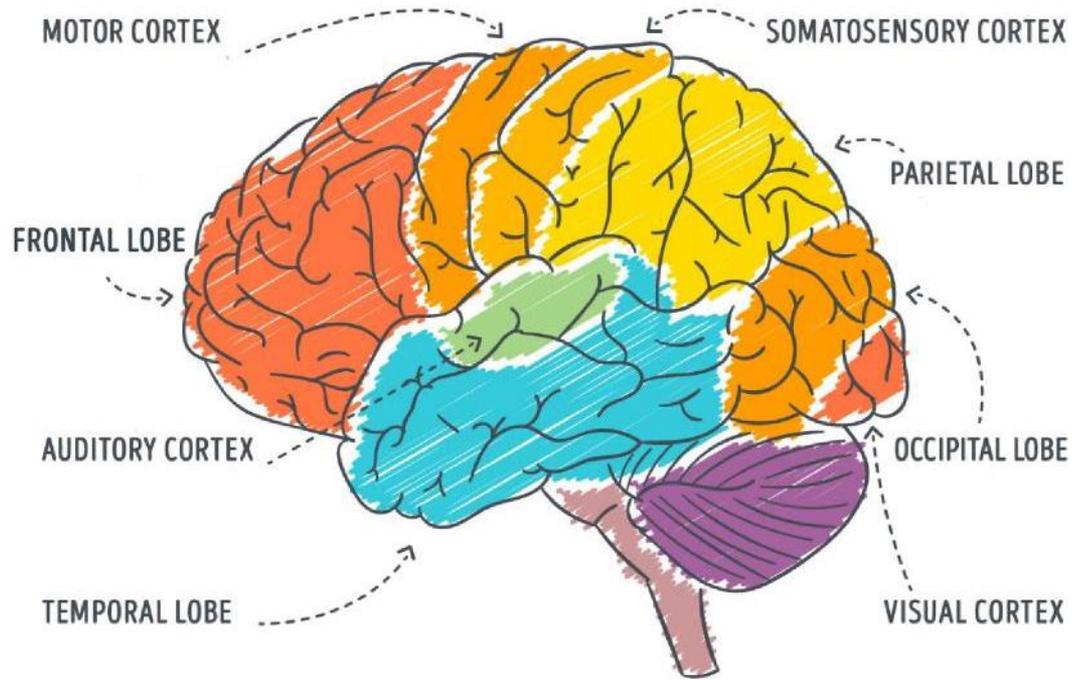
Anatomy and Functional Areas of the Brain

•Cerebral Cortex

1. **Visual Area:** Sight, image recognition/perception
2. **Association Area:** Short-term memory, equilibrium, emotion
3. **Motor Function Area:** Initiation of voluntary muscles
4. **Broca's Area:** Muscles of Speech
5. **Auditory Area:** Hearing
6. **Emotional Area:** Pain, hunger, fight or flight
7. **Sensory Association Area**
8. **Olfactory Area:** Smell
9. **Sensory Area:** Sensations from muscles/skin
10. **Somatosensory Association:** Evaluation for object recognition
11. **Wernicke's Area:** language comprehension
12. **Motor Function:** Eye movement/ orientation
13. **Higher Mental Functions:** Concentration, judgment, planning, inhibition creativity

•Cerebellum

1. **Motor Functions:** Movement, equilibrium, balance, posture



Neurophysiology Involves multiple subsections that cross into all other areas of the brain, and provides a management effect of signals that are both conscious and out of awareness

| Role of Frontal Lobes

The frontal lobes are the executive manager!



Our entire system is regulated by the frontal lobes because of the involvement of decision making, self-regulation, and neurobehavioral management.

Results in cognitive, emotional, and behavior dysregulation.

(Dimasio and Dimasio, 1990-2000; University of Iowa).

- Think of this massive region (30% of the brain mass) as the regulator and manager of the entire system.
- Differences of left vs. right injury; differences with orbitofrontal vs. lateral vs. ventral.
- Social dysregulation; social awareness impairment; overestimation of skills and underestimation of deficit; impaired initiation.

| Role of Frontal Lobes

Attention, moderate to complex processing, memory integration and storage, decision making, problem solving, initiation/inhibition, self-control, mood regulation, mood expression, and language processing.

- **Creativity Self- Monitoring**
- **Irritability- Agitation**
- **Inhibition Affective**

Do I or Not? **Expression**

One reason for the complexity of change is due to the communication of the frontal lobes with the limbic system and association cortex.

| Location Specific Behavior and Cognition

Ventromedial Cortex (Rewards) – Decision making based on perceptual cues and reward systems; those with substance abuse have been found to have a higher rate of impairment in this area.

Orbitofrontal Cortex (Personality) – Frontal lobe personality (causes dramatic changes in behaviors leading to impulsivity and lack of judgment); ABULIA

Anterior Cingulate Syndrome (Cognition) – Reduced working memory, rule-learning, planning, attention, and motivation behind attention, depression, post-traumatic stress, and obsessive-compulsive disorder.

Dorsolateral Syndrome (Behavior Regulation) – Working memory (monitoring and manipulating the content of); attention; pseudo-depressive symptoms (loss of initiation, decreased motivation, reduced verbal output, behavioral slowness (abulia), reduced learning, task switching (set shifting), planning-problem solving, novelty detection. Additional research in “intuition.

Frontal Lobes and Initiation and Inhibition

Executive Functions and Dysexecutive Syndrome

| Executive Functions

The term “executive functions” refers to integrative cognitive processes that determine goal-directed and purposeful behavior.

Executive functions are subordinate to more basic cognitive processes such as memory and attention. By supervising and coordinating underlying cognitive, behavioral, and emotional processes, executive functions allow for the orderly execution of daily life functions. (Cicerone et al., 2000)

This includes:

Formulating goals, solving problems, anticipating consequences, planning and organizing behavior, initiating relevant behaviors, and monitoring and adapting behavior to fit a particular task or context, and having an intended outcome.

| Executive Functions

Disturbances in these functions are most likely to be evident in novel or unfamiliar situations (Godefroy & Rousseaux, 1997). Initiation is impacted by novelty and complexity.

Executive functions are necessary to adapt to deviations from an established routine, react to unexpected events, or correct mistakes.

Brain injury – impairment of thinking before reacting!

Rehabilitation of executive functions is necessary to teach metacognitive skills that can be applied across diverse situations.

Rehabilitation has to incorporate the following, initiation of...

- Cognitive skills
- Emotion regulation
- Behavioral control

| Neurobehavioral Syndromes

Neurobehavioral syndromes have been described in the literature for years. It involves impairment of initiation and inhibition within executive dysfunction.

Criteria for This Syndrome in Post-acute Care:

- Injury must be > 8 months duration
- The following behavioral features are present at least mildly:
 - Irritability, Agitation, and Aggression*
 - Impaired Awareness*
 - Impaired Social Interaction*
 - Impaired Problem Solving*
 - Impaired Initiation*
- Impaired inhibition skills may also factor into this syndrome of impairment
- Effects of changes in environment or psychosocial functioning

Horn, G., Lewis, F, & Russell, R. (2016). Behavioral Dyscontrol Following Acquired Brain Injury: Effectiveness of Post-hospital Neurobehavioral Intensive Programs. Jr. of Neurology and Neuromedicine, 1(8), 29-33.

| Initiation/Inhibition >>> “Go or No Go”

Initiation

The starting of an act, behavior, thought, or communication at the appropriate times and under the appropriate conditions.

Inhibition

The stopping of an act, behavior, thought, or communication at the appropriate times and under the appropriate conditions.

When this system has dysfunction, then the thoughts, mood, and behavior become easily triggered and somewhat random. Context no longer matters.

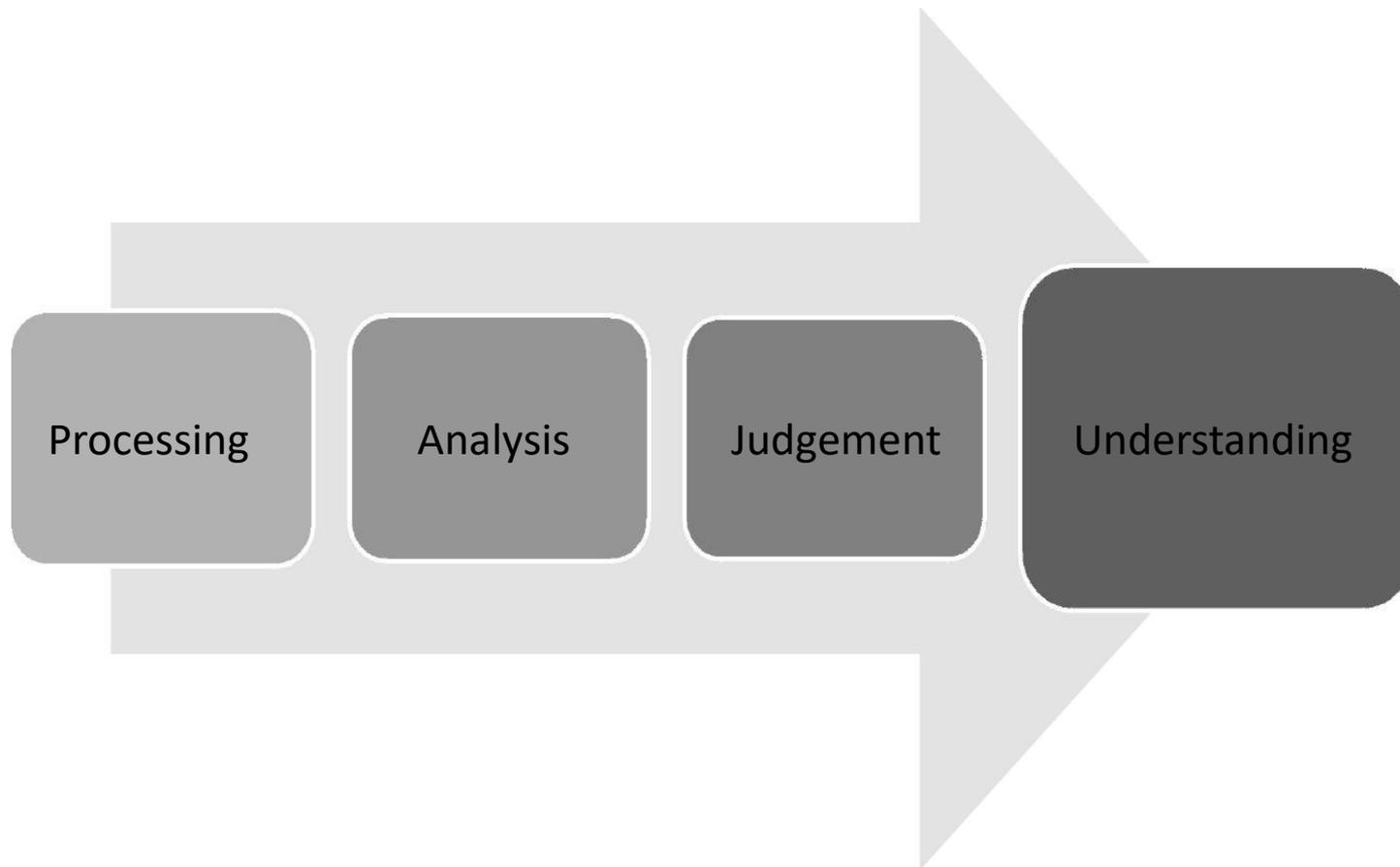
Initiation starts with basic activities such as brushing your teeth, washing, using the toilet appropriately, or checking mail. It is also within highly complex behaviors and actions such as driving a car, listening to a lecture, or making financial decisions.

Initiation and inhibition include cost-benefit analysis; when this system is not working, then immediate benefit may outweigh long-term benefit, and lead to loss overall

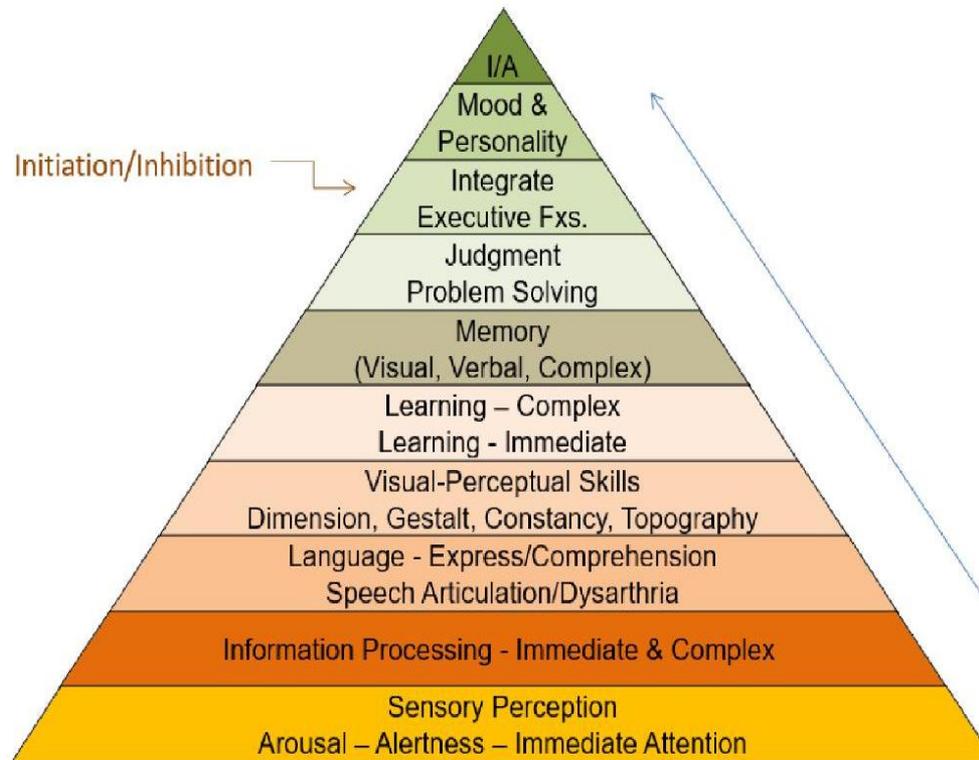
Cognitive Hierarchy

Where is Initiation in the hierarchy?

| Cognitive Data Hierarchy - Basics



Cognitive Hierarchy –Brain Model



(NAB, 2003)

| Rehabilitation Hierarchy – A New Model

Audition
Dizziness
Motor Speech
Pain/Headache, Vision, Use of Hands

Inappropriate Social, Irritability, Symptom Sensitivity
Depression, Fund of Information, Visual Perception
Anxiety, Fatigue, Mobility, Non-Verbal Communication, Verbal Communication

Self-Care
Family Function

Initiation, Productivity
Attention, Impaired Awareness, Memory
Novel Problem Solving, Social Contact

Leisure and Recreation
Money Management
Home Skills
Transportation Use

Cognition Impact on Rehabilitation

Hierarchical Regression

Outcome measure: Participation T-score at discharge

Block numbers and Dependent Variables	Change in R ² (variance/contribution to outcome)	Sig. Level
Initiation	32%	.0005
Visual Spatial*	Block 2 combined	.0005
Memory	9%	
Fund of Info*		
Problem Solv*		
Attention Concentration		
Mobility	6%	.0005
Verbal Comm	< 1%	.08 (n.s.)
Depression	Block 5 combined	.01
Anxiety	1%	
Irritability	Block 6 combined	.01
Inappropriate Social	1%	
Impaired Awareness	2%	.01

Visual spatial skills (6%), Fund of information (2%), and Novel Problem Solving (1%) were the largest cognitive contributors to outcome after initiation.

Sample: Neuro Rehabilitation (n = 1385)

Strategies

For Initiation and Inhibition Deficits, and Other Frontal Lobe Concerns

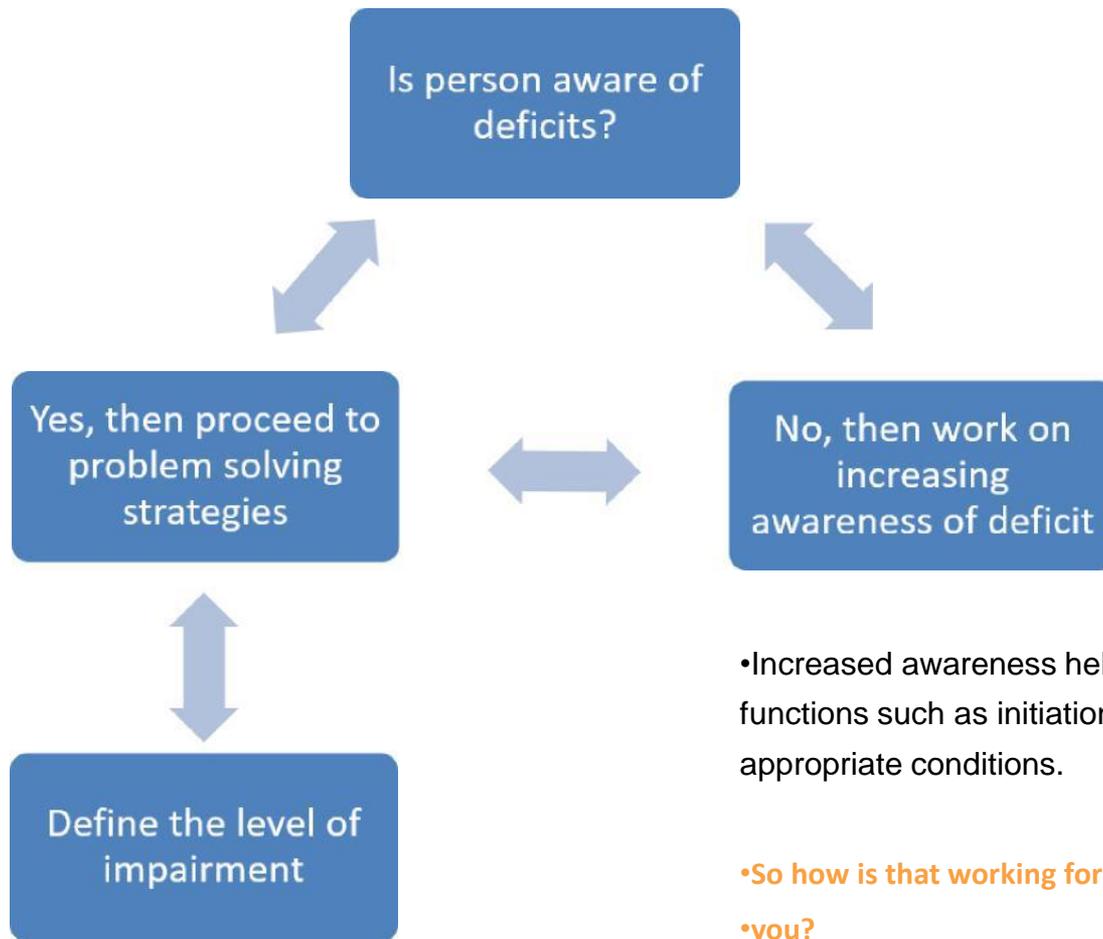
| Strategies

Goal: create a structured plan leading to the desired outcome; execution of responses; use of feedback to compare the plan with the achieved outcome. Use of Natural Consequences for shaping of the frontal lobes.

- **Identify** the demands of the task
- **Plan** the appropriate sequence of responses
 - Prediction → expected = awareness
- **Implement** the plan with self-monitoring of performance with use of strategies (structure and cues are flexible); use of self-ratings (0-5)
- **Comparisons** are made between the effectiveness of their action with the predicted effects and consequences
 - Incorporation of therapist feedback (ratings are compared)
- **Change** the approach if the information indicates to change. Learning takes time!



| Strategies – Decision Tree



•Increased awareness helps to get to functions such as initiation under appropriate conditions.

•So how is that working for you?

| Strategies – Person or Environment

Internalized (Person) vs. Externalized (Environment) Strategies

Internalized – This is when the injured individual is actively working on developing problem solving, planning, organization, and self-monitoring techniques. Top-down approach. Therapy focuses here!

- The goal is to develop strategies that continuously help to manage in changing conditions, which leads to appropriate initiation of thought, behavior, and mood.

Externalized – This is when the injured individual has initiation impairment that impacts simple to complex daily activities; outside sources are used to provide prompts, cues, and feedback of performance. This may include electronic aids, other persons, or an environment that allows and disallows certain activities or behaviors. Bottom-up approach.

- The goal is to have continuous use of external aids to shape behavior and thoughts into appropriate outcomes.

| Strategies – Barriers

Environmental/Social Barrier

Is the individual in a situation where the barrier causes one to look as though they are not initiating? Neurobehavioral factors here as well.

Example: Being unable to access medication due to environmental barrier which makes it appear as though the individual is not engaging in treatment.

Physical Barrier

Is the use of a piece of equipment getting in the way of engaging in a behavior?

Example: use of a wheelchair or walker; if you are unable to maneuver the wheelchair without assistance, then the individual may not be able to get what is needed.

Cognitive Barrier

At what level is the person's cognitive process (*Awareness, Insight*)?

Example: I want to drive, and understand how, but my processing is too slow to drive in typical traffic.

| Strategies – Define Impairment

What is the level of impairment?

Mild – Use of internalized strategies; use of external strategies

Example – concussion; person is having headaches; pre-injury was running two businesses and now is having difficulty understanding why headaches are triggered. Internalized strategy is to learn pacing (initiating) and have a “stress scale” of when symptoms increase to 5-6/10 with the use of a “stop” (inhibition) strategy for rest.

Moderate – Use of internalized strategies; use of external strategies with assist

Example – moderate TBI with + LOC for 2 hours; person has difficulties with routine and managing daily needs/demands; requires the use of a phone for prompts and reminders (Initiating), and develops a pattern of reviewing his list of to-dos each night and each morning upon awakening (Inhibition).

Severe – Use of external strategies with assistance

Example – Moderate to severe TBI with +LOC for 24 hours with amnesia of 3 days. He requires the use of a prompting system (phone, computer), and has family prompt him each morning of the day’s activities (External Initiation); when he gets “stuck”, then he calls a family member for prompting. He also has daily reminders of his deficits. Supervision required (External Inhibition).

| Strategies – Metacognition

Metacognition refers to “thinking about thinking.” It is a top-down approach. This includes knowledge and control.

Metacognitive Knowledge – represents both the person’s moment-to-moment awareness of his or her thinking and more stable beliefs about one’s cognitive ability.

Metacognitive Control – represents the person’s self-monitoring of their thinking and the ability to adapt to changes in the environment or task-demand(s).

Highly complex behaviors are the product of self-regulation skills including

- Setting goals >> appropriate initiation
- Comparing performance >> rating one’s self in relation to others
- Making decisions to change or select an alternative approach >> Did it work?
- Executing the behavior or change in behavior (outcome leads to stopping)

| Strategies – Metacognition

Framework for Metacognition Training (reference guide)

Guide – 4 parts including Awareness, Planning, Execute and Self-monitor, Self-evaluate.

Awareness Intervention (Cheng & Man, 2006)

Awareness of knowledge, performance prediction, perform and monitor, feedback with short-term goals.

Self-Awareness Training (Goverover et al., 2007)

General self-awareness, define-predict-anticipate errors, choose strategy and assess assistance need, self-assess and therapy assess, keep a journal

Time Pressure Management (Winkens et al., 2009)

Awareness of processing speed; Time pressure management (competing tasks, feeling overwhelmed or distracted, loss of priority, plan); monitor performance and expect the unexpected; generalize the outcome to differing tasks and differing levels of complexity.

| Strategies – Metacognition

Framework for Metacognition Training (reference guide)

Guide – 4 parts including Awareness, Planning, Execute and Self-monitor, Self-evaluate.

Social Problem Solving (Von Cramen, Von Cramen & Mai, 1991)

Problem orientation, generate alternatives, decision making and solutions, and solution verification (did it work?).

Goal Management Training [stop-think-plan] (Levine et al., 2000)

Stop – raise awareness; Define or think through the problem (what am I doing?); learn the steps and reduce anxiety and pressure; Check – what is the main goal and how will this help?

ICRP Activity Analysis (Cicerone et al., 2008)

What is the task to be accomplished?; What are the parts of the task or activity (anticipate success); Identify strategies for use during the task – perform – self-monitor limits and application; Self-evaluate with feedback from others.

| Strategies – Additional Thoughts

Consider resistance to be cognitive rather than psychological.

- Psychological resistance is related to “not wanting to do it”.
- Cognitive resistance is related to being “cognitively overwhelmed” by the task and not being able to formulate a response to make a change.

Example

If I tell you that you have to go to work by a new route, but I do not tell you which route to take or when you have to do this by, then you will come up with various options without much effort. You initiate the task almost immediately because the solution is relatively simple and you have already done this in the past.

If I tell you that you have to go to work by a new route, and the route can only be using side roads and only roads that travel north, and it must be done by tomorrow, then initiation of the task becomes difficult because you calculate the probability of being correct and having a response – there is no answer to this problem – when you figure this out, then you do not initiate the act.

| Strategies – Answers & Education

- Recognize the deficits by having someone point them out and showing difference between what is perceived versus what is actual (use of NP exam results can help).
- Show how the deficits impact daily functioning – have the person perform a task; use the Mayo Portland to show comparisons.
- If behavior, emotion, or cognitive control is lost, then comment and bring this to the person’s attention to improve awareness of the impact of the problem.
- Provide education – this can be through written material, through internet articles or websites that are intended for education. Use of YouTube to show examples of problems and their impact.
- Provide evidence or examples of when the impairment has impacted performance.
- Alternative Explanations for Outcome – “I am not interested” may mean the task is beyond the level of the individual.

Daily Living

Medication(s) may be helpful

| Stimulant Type Medication

Stimulants may help, but their focus is within the frontal systems only. However, initiation may be a lack of dopamine in multiple locations, not just in the frontal lobes. Stimulants include Ritalin/Methylphenidate, Cylert, Vyvanse, etc. The effect is mostly dopamine and norepinephrine in the frontal systems.

Broad based medication(s) can impact initiation and other cognitive functions beyond the frontal lobes. Amantadine has been used in brain injury recovery and rehabilitation to help enhance the processing within dopamine pathways throughout the brain.

There is controversy of “if and when” stimulant medication may be used.

| Dopamine Receptors and stimulants

Dopamine receptors are distributed widely and have an impact on multiple functions.

Physically, these receptors help with motor skills and functions. When disrupted, it can produce things like tremor.

Cognitively, dopamine receptors are throughout the brain to help with general processing. Also, dopamine has been implicated in memory, learning, and decision making along with sustaining attention and focus when necessary.

Using stimulants may help to improve processing overall, but also improve multiple other functions as well. However, the risk is whether the improvement comes with side-effects. One major side effect is hallucinations when too much dopamine is stimulated.

| Mood Stabilizers/Mood Changers

Types of medication to consider for behavioral and mood initiation and inhibition control

- Mood stabilizers that are seizure medication (regulates the integration of frontal and temporal centers for behavior control, impulsivity reduction, and improved insight regarding behavior).
- Antidepressants (for depression)
- Anxiolytics (anti-anxiety)
- Antipsychotics for severe behavioral dyscontrol

Daily Living

Daily Activities – Keep the Brain and Body Active

| Activity

Use of schedule and routine for basic prediction of behaviors

- Activities of daily living routine
- Bedtime behaviors and routine
- Meal times – meal nutrition (reduced carbs, reduced caffeine, etc.)
- Use of technology for engagement and stimulation – may need to be time limited for use.
- Novelty at home or in the community – weekly be sure to do something out of the routine.
- Set goals for activities based on the person's cognitive abilities.
- Focus on and reinforce positive behaviors and positive achievements!

I Final Thoughts

Initiation is a complex cognitive, behavioral, linguistic, and emotional function that requires integrity of other functions before you can externally and self-regulate effectively.

Initiation is complex because it is influenced by the environment and by processing of information.

Inhibition is the converse of initiation and these two functions work hand and glove to produce appropriate outcomes.

| Final Thoughts

The frontal lobes are highly complex. They include multiple layers of function.

There is no one solution to solving the problems of dysfunction. Greater severity of injury results in needing more assistance and developing the right environment.

Consider: neurobehavioral assessment, behavior intervention and change, cognitive reinforcement, positive reinforcement, modeling of appropriate behaviors, use of ratings, medication, environmental structure.

Balancing the frontal lobes means things are working mostly, but not perfectly!

| What do we pay attention to?

Were your frontal lobes paying attention during this presentation?

What was the question that was repeated twice in this presentation that summarizes how to positively impact the frontal lobes?

What color was the question??

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Questions?

Gordon J. Horn, PhD

National Deputy Director of Analytics and Outcomes

gordon.horn@neurorestorative.com

I want to thank NeuroRestorative for supporting this presentation and the research completed on initiation and outcomes.

Questions?

