

Direct Attention Training: Clinical Procedures and Supporting Evidence

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Disclosure Statement

Royalties are received for the Attention Process Training-3 program described in this talk

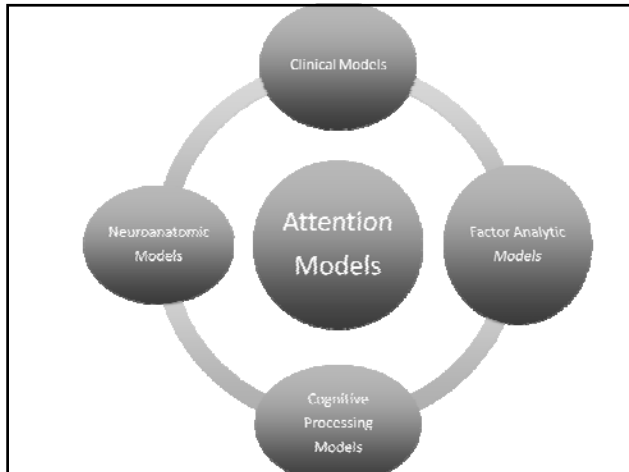
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Objectives

- Describe clinical model of attention and generate examples of therapy tasks and real world tasks that correspond to the different types of attention
- Understand the principles of direct attention training; describe evidence supporting it
- Describe the program decisions that need to be addressed for direct attention training
- Be able to give examples of other approaches for managing attention impairments
- Identify standardized and nonstandardized measures of attention that could be used as outcome measures for attention training

What do we mean by attention?

- Attention is not a unitary concept
- There are many different componential models that are derived from a different theoretical perspectives with clinical relevance



Neuroanatomic Model (Posner's Model)

Attention consists of three separate underlying networks

Alerting: Maintain an alert state(modulated by norepinephrine systems/frontal & parietal cortex)

Orienting: Focus our senses on target information (modulated by acetylcholine/superior colliculus, pulvinar, frontal eye fields, temporal parietal junction superior parietal)

Executive attention: controls emotions & other processes (modulated by dopamine/anterior cingulate, lateral prefrontal basal ganglia)

Cognitive Processing Model

- Vigilance (sustained attention over time)
 - Selection
 - Dual-task performance
 - Automaticity
- (Baddeley, 1986)

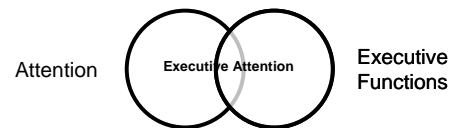
The Multitasking Myth



Clinical Models of Attention

- Deployment of attention
 - Capacity
 - Resistance to interference
 - Mental manipulation
 - Focused Attention
 - Sustained Attention
 - Selective Attention
 - Alternating Attention
 - Divided Attention
- (Mateer & Mapou, 1996)
- (Sohlberg & Mateer, 2000)

“Working Memory” “Executive Attention”



Dysexecutive Symptoms Executive Functions Symptoms

- (Feeney, 2005)
- | | |
|--|---|
| impulsiveness | ineffective planning |
| poor social judgment | decreased flexibility/ shifting |
| social disinhibition | slowed processing |
| Egocentrism | diminished divergent thinking |
| difficulty interpreting the behavior of others | concrete thinking |
| Perseveration | immature problem solving |
| poorly regulated attention | weak self-monitoring |
| disorganization (in thinking, talking, and acting) | inefficient responses to feedback/ consequences |
| weak goal formulation | reduced initiation |
| | dulled emotional responses |

Most models incorporate...

- Maintenance/Sustaining attention
 - Attentional selectivity
 - Attentional capacity
 - Attentional control or shifting
- These seem to be key theoretical concepts with a high degree of clinical significance

Clinical Model of Attention

- Focused
- Sustained Attention
- Working Memory
- Suppression
- Alternating
- Selective

(Sohlberg & Mateer, 2010)

Working Memory

- Multiple systems necessary for successful storage and retrieval of info
- Set of processes that permits us to hold on to info until it is utilized or encoded or allows us to store it until we want to access it

Different Profiles for Different Populations?

- TBI
- ADHD
- Cancer survivors
- Fetal alcohol syndrome
- RHD
- Aphasia

Survivors of Pediatric Malignancy

- A growing acquired condition that results in attention deficits
- CNS treatments for leukemia and brain tumors affect neuropsychological development
- Consistent pattern of deficits involving vigilance, working memory, spatial awareness, processing speed and self monitoring

Fetal Alcohol Syndrome

- ADHD is most prevalent symptom
- Attention deficits are stable over time
- Working memory, inhibition, sustained and selective attention frequently implicated (Vernescu, 2008)

Right Hemisphere Disorder

- Attentional deficits (Focused, Sustained, Selective, Alternating)
- Left neglect
- Visuoperceptual deficits

Aphasia

- Growing evidence that individuals with aphasia exhibit deficits on a variety of attention tasks (orientation, sustained, selective, divided)
- Attentional models of aphasia propose that some aphasic symptoms are actually a product of attention impairments
- Resource Allocation Theory (McNeil et al, 1991)

Bottom Line...

- A number of developmental and acquired conditions have attention deficits as a primary symptom

Direct Attention Training: Procedures and Evidence

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Attention Tests

Sustained Attention/Vigilance

- Digit Span-Forward (*Wechsler Abbreviated Scale of Intelligence*; Wechsler, 1999)
- Conners' Continuous Performance Test-II (Conners, 1992)

Working Memory and Executive Control

- Trail Making Test B (Reitan, 1969)
- Paced Auditory Serial Addition Test (Roman, Edwall & Buchanan, 1991)
- Stroop Color and Word Test (Golden, 1978)

Mixed Batteries

(Subtests assess sustained, selective and alternating attention, and working memory)

- Test of Everyday Attention (Robertson, Ward, Ridgeway & Nimmo-Smith, 1994)

Attention Questionnaires

- The Cognitive Failures Questionnaire (Broadbent, Cooper, FitzGerald & Parkes, 1982)
- The Moss Attention Rating Scale (Whyte, Hart, Bode & Malec, 2008)
- The Rating Scale of Attention Behavior (Ponsford & Kinsella, 1991)

Formal/Unstandardized assessment measuring impact

- Attention Rating and Monitoring Scale Cicerone & Azulay (2002) *Clinical Neuropsychologist*, 16, 280-289
- APT Questionnaire (Sohlberg & Mateer, 2001)
 - Questions organized into different attention areas
 - Frequency of occurrence scale
 - Informal portion to elicit specific contexts where problems affect functioning
- Goal Attainment Scaling
- Collaborative Contextual Hypothesis Testing (Ylvisaker & Feeney)

ATTENTION RATING and MONITORING SCALE (ARMS)

DEPT. OF NEUROPSYCHOLOGY, JR. JOHNSON REHABILITATION INSTITUTE

NAME: _____
 AGE: _____ EDUCATION _____ DATE: _____

PLEASE INDICATE HOW OFTEN YOU HAVE EXPERIENCED EACH OF THE FOLLOWING DIFFICULTIES OVER THE PAST 2 WEEKS
 PLEASE ANSWER EACH QUESTION USING THE FOLLOWING SCALE:

NEVER 1
 RARELY 2
 OCCASIONALLY 3
 FREQUENTLY 4
 ALWAYS 5

1. Difficulty returning to a task after being interrupted.
2. Difficulty doing more than one thing at a time.
3. Being easily distracted by things going on around you.
4. Forgetting things immediately or just after being told, for example, phone conversations.
5. Difficulty concentrating in busy or noisy situations, for example, in a shopping center or when more than one person speaking at the same time.
6. Difficulty concentrating or keeping your mind on an activity for more than a few minutes, for example, when reading or watching television.
7. Becoming very fatigued during or after activities where you have to pay attention or sustain mental effort.
8. Difficulty maintaining a "train of thought" and keeping things in order, for example, when doing simple calculations in your head or keeping track of several pieces of information.
9. Starting to do something and forgetting what you meant to do.

please continue on other side.

Examples for hypothesis testing

- Observation in quiet vs. distracting environment
- Structured observation of a goal oriented task
- Interview—what questions would you ask?

Six Intervention Approaches Applied to Attention...

- Direct training of attention processes (APT)
- Specific skills training (e.g., a cooking routine)
- Training of metacognitive strategies (orienting/pacing)
- Training use of external aids (smartphone)
- Environmental modification/task accommodation (communication board)
- Collaboration-focused programs (personalized goal setting)

Direct Attention Training

The rationale

- Process oriented therapy
- Theoretical basis relies on neuroplasticity
- Repeated stimulation of cognitive process is thought to strengthen the underlying neural processes
- Mostly based on the adult attention rehabilitation literature

Attention Training

- Based on the premise that attentional abilities can be improved by activating particular aspects of attention through a stimulus drill approach
 - Repeated stimulation of attentional systems via graded attention exercises is hypothesized to facilitate changes in attentional functioning
- Includes functions related to sustaining attention over time (vigilance), information processing capacity and speed, shifting attention, resisting distraction

Neuroplasticity/Experience-Dependent Recovery

- Key mechanism: modification of synaptic connectivity
- Plasticity appears to operate differently depending upon the specific neural network; experience induced functional changes occur the most rapidly in motor, language and visual systems after stroke

Attention Training Principle 1

- Use a treatment model grounded in attention theory

A Clinical Model of Attention

- Focused Attention
- Basic Sustained Attention
 - Maintain attention over time
- Executive Control: Working Memory*
- Executive Control: Alternating Attention*
- Executive Control: Selective Attention*
- Executive Control: Suppression*

*requires "executive control"; "complex attention", "working memory"
"resource allocation"

Therapy Principles

- Principle One: Organize Therapy Activities Using a Theoretically Grounded Model
- Principle Two: Provide Sufficient Repetition
- Principle Three: Use Patient Performance Data to Direct Therapy
- Principle Four: Include Metacognitive Strategy Training
- Principle Five: Identify and Practice Functional Goals Related to Attention

Principle 2

- Provide sufficient repetition
 - Home practice

Direct Training of Attention

- Repeated stimulation of attentional systems via hierarchical attention exercises
- Attention divided into components that are targeted discretely

(e.g., Sohlberg, McLaughlin et al., 2000)

Training Decisions based on Patient Performance Data..

How do we select exercises and make decisions about when to stop or modify a program?
See criteria in APT-3 manual and think about when you might override these

Principle 4: Integrate metacognitive strategy training

- Importance of promoting engagement, effort
- See APT-3 section on selecting strategies
- Review strategy handout

Principle 5

- Actively facilitate generalization from the start of treatment
- Examples of functional tasks/measurement
 - Increasing the amount of time the client can engage in a specified productive activity (e.g., reading, computer work, vocational task)
 - Decreasing the amount of cognitive effort it takes to complete a specified productive activity
 - Adding a desired, attentionally-demanding activity to one's repertoire that has not been previously possible (e.g., driving)
 - Decreasing errors on specified activity
 - Decreasing completion time for a specified activity

Direct Attention Training: Procedures and Evidence

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The screenshot shows a software window titled "Fill in the Goal Attainment Scale for Alice". At the top, there are navigation tabs: "Intake Survey", "Strategies", "Tasks", and "Goal Attainment Scale". Below the tabs, the text reads: "Individualize and modify the text below as necessary. Once finished, click Continue." The main area contains a "Goal:" field with the text "improve Alice's working memory in order to improve ____". Below this are five rows representing different levels of outcome, each with a corresponding text template for Alice's performance. The levels are: +2 (Best expected outcome), +1 (More than expected outcome), 0 (Expected outcome), -1 (Less than expected outcome), and -2 (Worst expected outcome). At the bottom, there are fields for "Person to monitor:" (set to "Clician") and "Date to evaluate:" (set to "September 20, 2011"). There are "Show Example" and "Continue" buttons, and a "Back" button at the very bottom.

APT-3 Technology Supports Principles of DAT

- Increased access
- Supplemental practice for optimal therapy dosage
- Capture & analyze performance data
- Provide immediate, objective feedback
- Reflection and strategy logs promote engagement and generalization

Attention Process Training-3 (APT-3) – Sohlberg & Mateer (2011)
Lash & Associates (www.lapublishing.com)

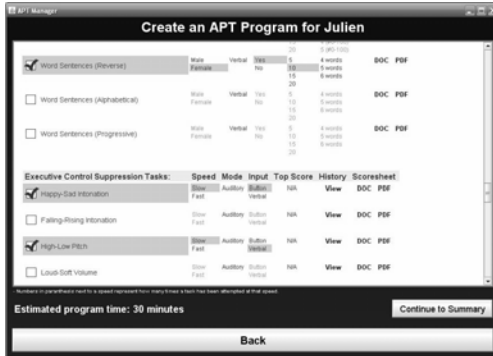
The screenshot shows a software window titled "Welcome to Attention Process Training for Alice". The main area contains the text "The current APT program: NA". Below this, there are four icons with corresponding labels: "Create or Select an APT Program", "Edit Current APT Program", "View Data on Performance", and "Run Current APT Program". At the bottom, there is an "Exit" button.

The screenshot shows a software window titled "Edit APT Program for Alice". It displays a table of "Basic Sustained Tasks" with columns for "Task", "Speed", "Clinician", "Mode", "Top Score", "History", and "ScoreSheet". The table lists various listening tasks, such as "Listening for 1 Number", "Listening for 1 Letter in a Word", "Listening for 1 Noise", "Listening for 1 Animal Sound", "Listening for 2 Numbers", "Listening for 2 Letters in a Word", "Listening for 2 Noises", and "Listening for 2 Animal Sounds". Each task has a checkbox, a "View" button, and a "PDF" button. At the bottom, there is a "Save Changes" button and a "Back to Menu" button. The estimated program time is shown as "10 minutes".

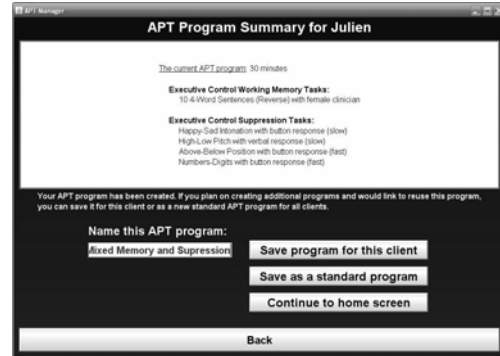
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APT-3 task selection continued



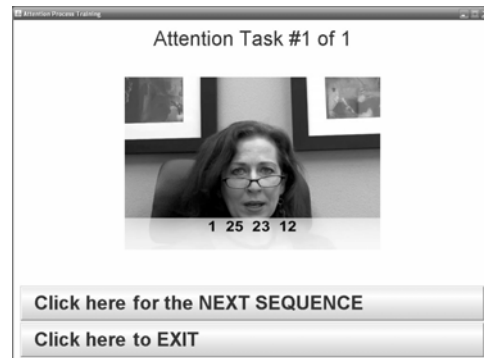
APT-3 program summary



Sustained Attention task



Working Memory task



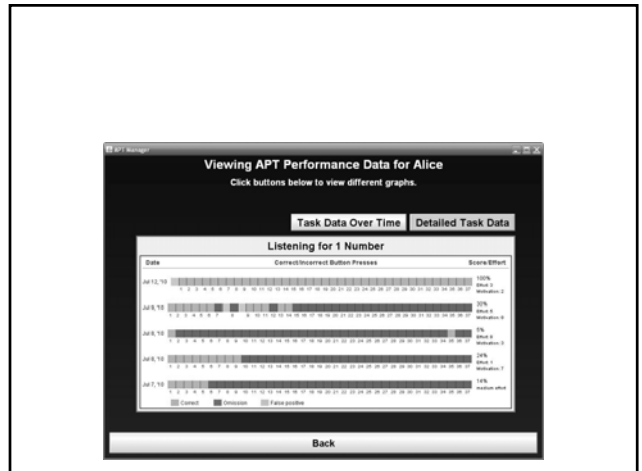
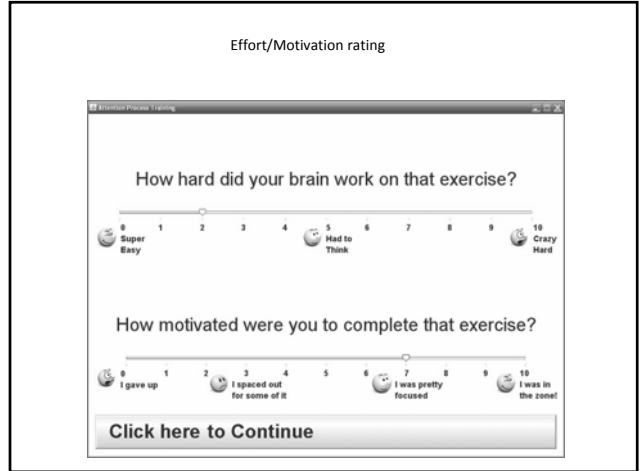
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Suppression Attention task



Effort/Motivation rating



Home Practice



Enhanced Goals of APT-3

Enhance Personal Factors:

- Increase self-efficacy & positive beliefs about program
- Encourage internal locus of control
 - Feedback on task performance
 - Motivational/effort ratings
 - Goal Attainment Scaling

Enhance Therapy Program Characteristics:

- Increase therapy dosage (home practice drive)
- Maintain engagement/motivation (varied stimuli)
- Decisions based on objective performance data
- Actively program for/facilitate generalization from outset
- Provide clear, standardized instructions for each task

Purpose of our Research Study

- Need to understand factors that may enhance therapy compliance
- Locus of control or autonomy critical to compliance
- Delivery of APT-3 via television allowed us to evaluate locus of control with two telerehabilitation conditions:
 - "Push" Scheduling: TV automatically turns on at scheduled times (external locus of control)
 - "Pull" Scheduling: Client self-initiates therapy program at time of choice (internal locus of control)

Sohlberg, Lemoncello, & Lee (2011). The effect of choice on compliance using telerehabilitation for direct attention training: A comparison of "push" versus "pull" scheduling. *Perspectives on Neurophysiology and Neurogenic Speech and Language Disorders*, 21, 94-106.

Research Question #1

Do individuals with acquired brain injury (ABI) receiving attention training (APT-3) complete more home practice sessions when the attention exercises are automatically "pushed" to their television or when they can self-initiate and "pull" them to their television on their own schedule?

Hypothesis: Individuals will complete more sessions under the "pull" condition when they have control of timing of their home practice (internal locus of control).

Research Question #2

Will individuals with ABI indicate a preference for the “push” vs. “pull” conditions following the experiment?

Hypothesis: Individuals will prefer the “pull” condition due to greater autonomy.

Research Question #3

If individuals receiving attention training complete home practice training at least twice weekly, will there be an improvement in attention as measured by neuropsychological attention tests and a goal attainment scale?

Hypothesis: If individuals receive once weekly individual treatment supplemented by twice weekly home practice, there will be improvements in attention as measured by attention tests and functional goal attainment.

Research Study

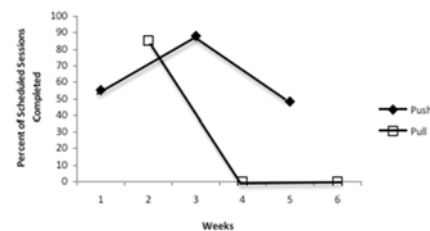
- 2 female participants
- Single subject experimental design using alternating treatment conditions (push vs pull)
 - Pre/Post attention assessments (92% agreement)
- 6 weeks duration
 - 1 weekly clinic session* (100% fidelity of implementation)
 - Asked to complete twice daily home practice
 - Generalization practice homework assigned
 - Self-selected push/pull preference in week 6

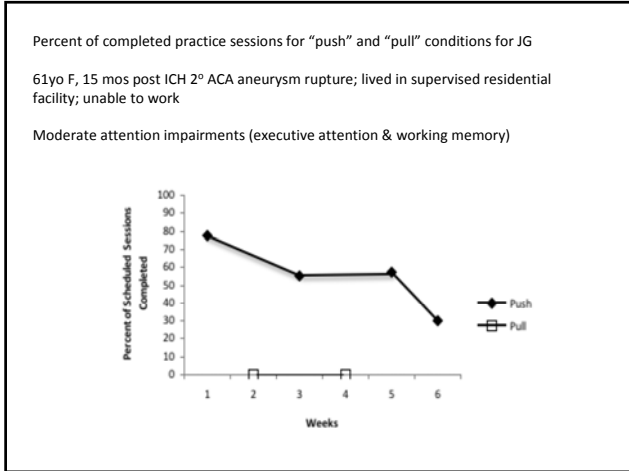
*Special thanks to graduate students David Kaplowe & Katie Samples for their assistance with this project.

Percent of completed practice sessions for “push” and “pull” conditions for KC

40yo F, 2 yrs post toxic medication reaction; lived in her own home; managed household and parent with min assistance from her mother; unable to work

Moderate attention impairments (executive attention & working memory)





- ## Results
- Both participants completed more sessions in the push versus the pull condition (contrary to hypothesis)
 - Both participants *preferred* pull condition (consistent with hypothesis)
 - Findings likely suggest an interaction between self-efficacy, therapy beliefs, and autonomy
 - Is autonomy less important when motivation and self-efficacy high?
 - Structure important for clients with cognitive impairments (ATC effective for reminders)

Pre/Post Testing

- Improvement on attention measure (Paced Auditory Serial Addition Test: PASAT). Total Scores reported as T-score matched for age and educational levels:

	Pre-Treatment	Post-Treatment	Improvement
KC	38.10	60.75	2 SD
JG	32.26	42.35	1 SD

- No improvement on PPVT control measure
- Positive changes on GAS:
 - KC-best expected outcome
 - JG-expected outcome

Goal Attainment for KC

GAS Level	Criteria
+2 <i>Best expected outcome</i> LEVEL ACHIEVED	KC will experience "occasional" difficulty with all of the following: (a) maintaining a "train of thought", (b) forgetting things immediately after being told and (c) becoming fatigued during or after activities that require sustained mental effort. These issues will happen most days. She will experience 1-2 memory lapses per week where she cannot recall the content from a significant interaction.
+1 <i>More than expected outcome</i>	KC will experience "occasional" difficulty with two of the following: (a) maintaining a "train of thought", (b) forgetting things immediately after being told and (c) becoming fatigued during or after activities that require sustained mental effort. These issues will happen most days. She will experience 3-4 memory lapses per week where she cannot recall the content from a significant interaction.
0 <i>Expected outcome</i>	KC will experience "occasional" difficulty with one of the following: (a) maintaining a "train of thought", (b) forgetting things immediately after being told and (c) becoming fatigued during or after activities that require sustained mental effort. These issues will happen most days. She will experience 5-6 memory lapses per week where she cannot recall the content from a significant interaction.
-1 <i>Less than expected outcome</i>	KC will continue to experience "frequent" difficulty with (a) maintaining a "train of thought", (b) forgetting things immediately after being told and (c) becoming fatigued during or after activities that require sustained mental effort. These issues will happen most days. She will experience an average of one memory lapse a day where she cannot recall the content from a significant interaction.

Goal Attainment for JG

GAS Level	Criteria
+2 <i>Best expected outcome</i>	JG will maintain topics in conversation by demonstrating the ability to self-correct 100% of the time.
+1 <i>More than expected outcome</i>	JG will maintain topics in conversation by demonstrating the ability to self-correct 75% of the time. She will get off-topic no more than once during a conversation.
0 <i>Expected outcome</i> LEVEL ACHIEVED	JG will maintain topics in conversation by demonstrating the ability to self-correct 50% of the time. She will get off-topic no more than twice during a conversation.
-1 <i>Less than expected outcome</i>	JG will maintain topics in conversation by demonstrating the ability to self-correct 25% of the time. She will get off-topic easily and forget where she began.
-2 <i>Worst expected outcome</i>	JG will be unaware of when she is off-topic. She will get off-topic easily and forget where she began.



Summary & Implications

- Weekly sessions with home practice appeared to facilitate improved attention with carryover to functional activities
- Methods to increase home practice (intensity) are needed to demonstrate robust treatment changes
- Important area of future research is on the affective variables that affect compliance with home programs (self-efficacy beliefs, autonomy, motivation)

Designing an APT-3 Program

Task selection
 Strategy selection
 Goal selection
 Generalization activity selection

Administration of APT-3 Tasks

Therapy dosage: frequency and duration
 Task pacing
 Metacognitive strategy training
 Documentation of performance
 Program modification

Measuring Outcomes: Pre-/Post-Treatment Measures

Tests
 Questionnaires
 Observation
 Goal Attainment Scales

Measuring Outcomes: Ongoing Measures

APT-3 task data
 Generalization activities

What does attention training look like in a therapy session?

- Sample exercises from APT (organized by component that they address)
- Case example in manual
- Measurement
 - Therapy progress?
 - Generalization/impact?
 - Impairment measures?

Traditional Evidence Classifications

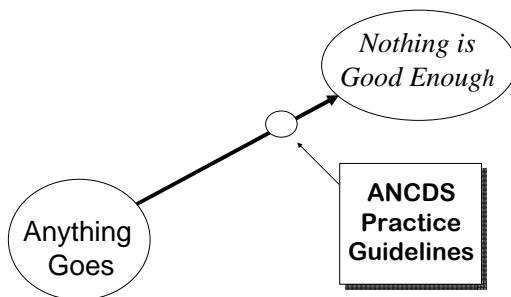
- **Class I:** One or more well-designed randomized, controlled trials (RCTs)
- **Class II:** One or more well-designed, observational clinical studies with concurrent controls (e.g., control or cohort studies), including single subject designs with multiple-baselines and 2 or more participants
- **Class III:** Expert opinion, case series, case reports, studies with historical controls

Quality Standards Subcommittee of the
American Academy of Neurology (1999)

Classifying Practice Recommendations

- **Standard**
 - High degree of certainty based on Class I or very strong Class II studies
- **Guideline**
 - Moderate degree of certainty based on Class II or strong consensus from Class III studies
- **Option**
 - Evidence is inconclusive (e.g., conflicting, expert opinion)

ANCDS Position



Practice Guidelines

- Treatment gains beyond the clinic were observed only in studies with
 - (a) individualized attention exercises
 - (b) treatment sessions that were 1 hr (vs. 2 hr) in duration
 - (c) at least weekly treatment sessions
 - (d) outcome measures that included a range of different tests sensitive to attention and working memory
 - (e) outcome measures that included activity-based measures using client self-report data.
- Improvements in the acute stage could be accounted for by spontaneous recovery

Research Evidence

- Generally supportive
 - Galbiati (2009)
 - Serino et al. (2006)
 - Butler et al. (2008)
 - Luton et al. (2011)
- Generalization continues to be questioned
- Limited information on dosage & frequency
- More robust outcomes with more intensive therapy

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- Identify standardized and nonstandardized measures of attention that could be used as outcome measures for attention training

References

Primarily Pediatric

Galbiati, S., Recla, M., Pastore, V., Liscio, M., Bardoni, A., Castelli, E., Strazzer, S. (2009). Attention remediation following traumatic brain injury in childhood and adolescence. *Neuropsychology, 23, 1, 40-49.*

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Pero, S., Incoccia, C., Caracciolo, B., Zoccolotti, P., Formisano, R. (2006). Rehabilitation of attention in two patients with traumatic brain injury by means of 'attention process training.' *Brain Injury, 20, 11, 1207-1219.*

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