Memory Theory Applied to Interventions
(adapted from M. Sohlberg & C. Mateer, Cognitive Rehabilitation: An Integrative Neuropsychological Approach (2001))

Types of Memory and Memory Concerns

<table>
<thead>
<tr>
<th>Time-dependent forms of memory</th>
<th>Content-dependent forms of memory (all involve long-term memory)</th>
<th>Everyday memory (functional memory constructs)</th>
<th>Amnesia terms</th>
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<tbody>
<tr>
<td>Short-term memory (working memory)*</td>
<td>Declarative memory (Explicit knowledge base)</td>
<td>Prospective memory (Remembering to carry out intentions)</td>
<td>Anterograde amnesia (Inability to acquire new information (new learning) following brain damage)</td>
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<td>Long-term memory</td>
<td>- Episodic memory (Storage of events that are tagged in time and place)</td>
<td>Metamemory (Awareness about one’s own memory functioning)</td>
<td>Retrograde amnesia (The inability to retrieve information stored prior to brain damage)</td>
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<td>- Semantic memory (Storage of facts)</td>
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<td>Posttraumatic amnesia (Period of confusion with inability to remember events moment to moment, usually following decreased consciousness)</td>
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<td>Non-declarative memory (Implicit memory; does not require episodic memory)</td>
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<td>- Procedural memory (Acquisition of perceptuomotor skills and the learning of rules and sequences)</td>
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<td></td>
<td>- Priming (Increased chance of retrieval when previously exposed to information without explicit learning)</td>
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* NOTE: The attention stage is the first stage of memory input and allows the memory system to gain access to and ultimately to utilize incoming information. It includes a multiplicity of functions including alertness and arousal.

At higher levels, it includes maintaining concentration over time (sustained attention), resisting interference (selective attention), and being able to allocate attentional resources (alternative and divided attention). And the concept of working memory, which allows for temporarily holding on to information, is an integral part of the attention process.

Once the attention stage is set, then the tasks of memory include encoding (basic level of analysis performed on material to be remembered), storage (to transfer transient memories to a form or location in the brain for permanent retention), and retrieval (searching for or activating existing memory traces in an accurate and timely manner).
Limitations in Memory and Potential Anatomical Correlates

<table>
<thead>
<tr>
<th>ATTENTION</th>
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<tr>
<td>Decreased alertness, arousal and sustained attention</td>
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<tr>
<td>Difficulties with higher levels of attention (selective, alternating, divided)</td>
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<table>
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<tr>
<th>ENCODING</th>
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<td>Deficits secondary to encoding deficits ([Inability to organize information and link to existing networks])</td>
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<tr>
<th>STORAGE</th>
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<tr>
<td>Difficulty with storage (although encoding is complete)</td>
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<td>Abnormally rapid rate of forgetting</td>
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<tr>
<th>RETRIEVAL</th>
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<tr>
<td>Memory errors of distortion and confabulation</td>
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<tr>
<td>Poor source memory</td>
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<td>Poor self-monitoring and initiative memory retrieval</td>
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NOTE: There is still much to be learned about the neurocircuitry of memory. The roles of the amygdala and mamillary body are thought to be critical to memories with emotional significance, but this process is not fully understood.

The Role of “Errorless Learning” in Supporting New Learning

Clients with mild to severe amnesia can benefit from errorless learning, a method of instruction that reduces errors in the acquisition phase (Wilson, Baddeley, Evans, & Shiel, 1994). Findings from research have encouraged clinicians to be more systematic in their instruction of persons with memory impairments, noting that by eliminating the opportunity for making errors when they are initially learning a task, will improve learning (by tapping into residual explicit memory.)

Unfortunately, errorless learning is somewhat antithetical to current rehabilitation practices. Many clinicians train and instruct clients via a traditional “test and correct” method: they observe clients doing a targeted task, providing minimal amounts of cueing, and correct the client’s behavior when the mistake is made. Having clients “guess” at answers and then supplying them with correct information is frequently how information is taught. Research now suggests that, instead, the clinician should provide systematic guidance in the initial acquisition phase resulting in no errors during early learning.
BASICS of Clinical Intervention for Individuals with Memory Challenges
(Adapted from B. Wilson and N. Moffat, *Clinical Management of Memory Problems* (1992))

- Select memory management techniques in light of other cognitive impairments.
- A good assessment is needed to reveal which memory processes are preserved and which are impaired, yielding the most pressing memory problems.
- Simplify information, be clear and concise with instructions.
- Reduce the amount of information to be remembered.
- Check for understanding.
- Try to help the person link information to existing information. Make associations.
- Set up regimens with distributed practice; it is better to work at learning something a few minutes several times a day rather than an hour once a day.
- Help individuals organize information that needs to be remembered.

RESTORATIVE MEMORY METHODS

*Memory Practice Drills*
Research does not support “memory working like a muscle with effective strengthening” but data suggests that memory practice drills actually support deficient attention. There is a plethora of practice regimens, workbooks, and computer programs that offer this approach.

Also, attention process training can benefit these clients. Strengthening the different types of attention will be lay the foundation for later stages of information acquisition.

*Mnemonic Strategy Training*
Mnemonic strategy training has had limited success with those who demonstrate significant memory deficits following brain injury. It has had more success with those suffering from milder forms of brain insults. Of the more popular approaches (e.g., visual imagery; verbal organization (forming acronyms, making paired associations with target words), and semantic elaboration (linking target words or ideas to a story)), the results are highly variable. Mnemonics appear to work well in highly structured settings (laboratories, clinical offices) but have limited generalization to the real world. Also, many injured individuals lack the insight (and capacity) to spontaneously implement the strategy when needed.

*Prospective Memory Training*
Prospective memory training offers those with brain injury a series of repetitive, prospective memory tasks (PROMPT: Sohlberg, Mateer, & Geyer, 1985). In this type of training, the clinician asks the client to remember to carry out a target task in a specific number of minutes. The time limit is increased after the client demonstrates repeated success. Task variables that may be altered during training include (a) type of prospective task – one-step motor commands vs. multistep, functional tasks; (b) time delay; (c) distractor task(s) during the time delay; and (d) associated prompts to initiate task – alarm vs. monitoring independently. In each application, the clinician alters the task, observes the effects, and waits for stable improvement before altering another variable. The goal is to increase the intervening delay systematically as the client’s prospective memory lengthens.

Another popular approach to manage deficits is to teach clients to utilize external aids such as appointment books and life planners. Unlike training, external aids offer management of the deficit rather than restoration of a limitation.
**Metamemory Training**
Many clients after injury suffer from a lack of awareness about their deficits and impairments. This is especially true of memory disturbances. Effective strategies include educational approaches to learning more about memory and experiencing the effects of preserved and damaged memory.

One method is prediction training, helping clients compare their predictions with their actual performance. Training research suggests that differences between predicted performance on various memory tasks and actual test scores decreased over time. This was due to feedback about the client’s accuracy and review of the results by the client.

Another aspect of metacognitive training is teaching clients how to conduct self-instructional or self-monitoring routines (executive strategies) that help them improve their memory function
- Teaching the client question strategies – WSTC: “What should I be doing?” “Select a strategy”; “Try the strategy”; “Check the strategy”
- Verbal mediation – verbalize each step of a multistep task as it is completed
- Problem solving process – problem identification and analysis, generating possible hypotheses based on supporting evidence, evaluation of solutions
- Goal management training – Stop!; define main task; list steps; learn steps; execute the task; check

**Domain-specific Knowledge Training**
Clients with severe memory impairments may benefit from the use of “priming”. By using intact and preserved learning, researchers developed an intervention called the “method of vanishing cues”. This cue fading technique can be used to teach simple to complex knowledge or behaviors used in everyday life. The client is first provided enough information to make a correct response and then parts of the information is gradually withdrawn across learning trials so that the client receives fewer and fewer cues. All cueing is based on the client’s performance in the previous trial.

**Creation of a Personal History**
For clients with severe retrograde amnesia their loss of memory for life events prior to their injury can be significant. In addition, their ability to acquire new learning can also be thwarted. A treatment plan should incorporate a method to help them relearn aspects of their personal history. It will be important to take advantage of any spared, nondeclarative memory in order to teach essential information (i.e., the movie “50 First Dates”). Either priming or expanded rehearsal practices can be used to teach discrete facts about personal history. It can also be very helpful to enlist those closest to the client to help create an autobiography (e.g., a photographic life essay, written history, video, or orientation pages in a memory book). Anecdotal information gathered from cognitive rehabilitation clients suggests that having access to this personal history was comforting and that they referred to it for months and even years after injury.
WORKING WITH COMPLEX ATTENTION

Clinical Model of Attention

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<tr>
<th>Type / Component of Attention</th>
<th>Function</th>
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<tr>
<td>Focused attention</td>
<td>Basic responding to stimuli (e.g., head turning to auditory stimuli)</td>
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| Sustained attention           | • Vigilance: maintenance of attention over time during continuous or repetitive activity  
                                • Working memory: actively holding and manipulating information |
| Selective attention           | Freedom from distractibility; not being drawn off task by extraneous or irrelevant stimuli (both external and internal) |
| Alternating attention         | Capacity for mental flexibility; ability to move between tasks with different cognitive requirements |
| Divided attention             | Ability to respond to two tasks simultaneously (e.g., driving and listening to the radio) |

FOUR APPROACHES TO MANAGING PROBLEMS WITH ATTENTION

Attention Process Training
Based on the premise that attention can be improved by providing opportunities for stimulating a particular aspect of attention. Treatment usually involves having clients engage in a series of hierarchically organized, repetitive drills or exercises that are designed to provide practice on tasks with increasing attentional demands (thus increasing cognitive capacity). There are several commercially available attention training programs (APT – Park, Proulx, & Towers, 1999; Sohlberg and Mateer, 2000). Unfortunately most of these activities are usually not “functional” and tend to resemble laboratory tasks. This is because most functional tasks (meal preparation, ADLs) are multifaceted and require activation of other cognitive processes as well. These training procedures single out attention concerns and address them in a more isolated fashion.

- **Sustained attention tasks**
  - Listening to target words and pressing a buzzer when target is identified
  - Paragraph-listening comprehension exercises
  - Sequencing an auditorily presented passage
  - Mental math exercises

- **Alternating attention tasks**
  - Listening to target words and then switching to listen to a different target
  - Paper and pencil task requiring alternating between writing (circling) letters and numbers
  - Mental math exercises, starting with a number and then adding and subtracting selected numbers
• **Selective attention tasks**
  o Any of the sustained tasks with a background distractor of noise or visual intrusion or movement
  o Placement of visual distractors (overlays) on a paper-pencil task
  o Locating specific shapes or objects that are not prominent within a complex figure

• **Divided attention tasks**
  o Reading paragraphs for comprehension and simultaneously scanning for a target word
  o Completing a sustained attention task while simultaneously performing a reaction-timed computer task
  o Completing a time monitoring task (tracking elapsed time) while simultaneously engaging in a sustained memory task

**Use of Strategies and Environmental Supports**
Two types of interventions: self-management techniques (client learns to initiate) and environmental supports (modifications to lessen attention deficits)

• **Self-management Strategies**
  o These can be designed for a specific task or specific environment
  o Orienting procedures – client is trained to ask 3 questions: “What am I doing?” “What was I doing before this?” and “What am I supposed to do next?”
  o Reading – can be mediated by a six-step process: previewing subheadings, reciting subheadings, asking questions, reading for detail, rereading subheadings, and rehearsing.
  o Pacing – managing fatigue or maintenance of concentration over extended periods of time by breaking tasks into smaller parts, building in breaks, acknowledging time of day, and building self-monitoring if cognitively possible
  o Key Ideas Log – jotting down extraneous ideas (or reciting them into a voice recorder) and addressing them later after task completion

• **Environmental Support**
  o Task management strategies – discerning difficult and distracting environments from helpful ones. Determining whether auditory and/or visual intrusions are more disrupting. Creation of “quiet space” and becoming aware of “quiet locations” in the community (stores, restaurants) that limit disorientation
  o Environmental modifications – organizing client’s physical space to reduce attention load, memory, and organizational abilities. Filing systems, message centers, bill payment systems, organizing and labeling spaces, reduction of clutter, color-coding. Posting directions and providing cues may also be helpful. Something as simple as a “Do not disturb” sign hung on the door.
  o Increasing success of environmental supports – carefully assess the context, have a plan for measuring success (and failure), investing client and others in the supports, and building in time for the client to acclimate to the changes and become accustomed to them.
Use of External Aids
Devices found to be particularly useful for individuals with attention impairments include:
- Written calendar systems with day planners
- Written checklists
- Electronic organizers
- Voice-activated message recorders
- Task-specific devices such as pill box reminders, key finders, and watch alarms

Psychosocial Support
Because significant changes in memory and function also impact emotional systems (reactive effects such as grief, rage, anger, and denial), there is a need to engage social supports to every extent possible. Those providing cognitive therapies may need to also engage supports such as (a) supportive listening, (b) brain injury education, (c) relaxation training, (d) psychotherapy, and (e) grief counseling. The greatest change has been a movement from the medical model of “experts treating patients” to one of partnership with clients. This partnering helps the client take more control, determine what is important, self-determine goals, and reduce feelings of victimization and discouragement.
MANAGEMENT OF DYSEXECUTIVE FUNCTION

Selection of therapeutic approach will depend on a significant number of variables:
1. Time since injury
2. Severity of dysexecutive symptoms
3. Areas of cognitive strengths
4. Co-occurrence of other cognitive deficits
5. Client’s level of awareness
6. Rehabilitation priorities of the client, family, and staff
7. Support available in the “discharge” environment and living situation

Therapies are described in greater detail related to attention processing, selecting/using external aids, awareness interventions, and behavioral interventions in (1) Sohlberg and Mateer’s *Cognitive Rehabilitation: An Integrative Neuropsychological Approach* and (2) M. Levine’s *Educational Care: Understanding and Helping Children with Learning Differences at Home and in School*.

There are a series of interventions that are available to assist clients in reducing the impact of these deficits, particularly with problems related to reduced initiation, organization, planning, sequencing, and self-regulation. The goal of all interventions is to mitigate and lessen the effects of dysexecutive syndrome for the survivor. Certainly there is admission that these interventions require support and training of those in the client’s environment as well as systematic training of the client.

*Environmental Management*
- Organization of physical space – reduces the load on executive functions; requires systematic evaluation of client’s living space – includes labeling, bulleted boards, designated clutter space, family planning calendars, message centers, filing systems
- Posting of prompts – extension of organization and reminders to support initiation – grooming routines on bathroom mirrors, operating procedures for laundry posted by appliance, before-going-to-school routines posted on the closet door
- Manipulation of physiological factors – limitations to behavior-altering substances through good nutrition; good sleep hygiene; moderation of activity levels and energy management; and medication monitoring

*Teaching Task-specific Routines*
- Make sure that the identified tasks are “relevant” to the client
- Analyzing and reducing task demands – choosing simplified tasks (3-ingredient meal preparation in one pan) at first and master those
- Avoidance of conflict situations – set-up activities to reduce disruptions, conflict and stress
- Teach the modified routine – generate a task routine and teach the client the routine with increased levels of independence being the goal – grooming, dressing, housecleaning, writing e-mail, making phone calls, hobbies with sequential tasks
  - Writing a task analysis – routine is broken into single, logical steps to be sequenced
  - Develop a checklist that makes each step very explicit – allows client to judge step completion (and self-feedback)
  - Provide sufficient practice for each step, using errorless learning
  - Make sure reinforcement and motivation are built into the task to succeed
Training the Selection and Execution of Cognitive Plans

Unlike task-specific routines, exercised in cognitive planning seek to help the client identify cues about when and where to implement a behavior. A major challenge is to help clients override pre-morbid automatic responses to situations as well as helping them manage impairments in initiation, prospective memory, distractibility and impulsivity. Generalizations from training environments to naturalistic settings requires careful and systematic planning and training. Both planning and errand completion activities can be modified for higher-functioning clients in order to improve their mental flexibility or their ability to repair or take corrective action.

Planning Scenarios – therapy allows the client to practice planning activities. The client analyzes the situation, tries to discern the steps needed (in order) and tasks involved, and eventually the resources needed. Logs of these activities can provide feedback to increase awareness and address denial.

Errand Completion Tasks – used to address planning, sequencing, initiation, and execution. The task can have compensatory supports (to-do lists, checklists) or may be a cognitive function of the task. Therapies move from easy to more difficult. The task can be community-based and concrete (finding a burger place, getting a business card) to abstract (finding something for free, investigating steps to get a passport).

Time Management Tasks – used to help the client gauge the passage of time and manage scheduling tasks and activities. Client is told to track time of activities (prospective memory techniques also work here) and then success leads to extension with structures worksheets, scheduling planners, and planning events.

Metacognitive Strategies

Self-instructional routines (mediated by inner speech) to help mitigate volitional behavior. The client ask him/herself a series of questions to mediate thinking and behavior. WSCT and GMT are two examples.

Components of metacognitive/self-instructional training include:

1. Identifying the tasks/problems where the executive function impairs function
2. Select activities that will improve client’s daily functioning (even if training effects are hyperspecific and don’t generalize beyond training tasks)
3. Identify the nature of executive dysfunction (impulsivity, poor planning, lack of error detection)
4. Design self-instructional procedure or choose metacognitive strategy
5. Model doing the task, using each step
6. Have the client practice the task while saying the self-instruction elements out loud
7. Provide cue cards when helpful (for prompting)
8. Fade from (a) speech to (b) whispering to (c) inner speech
9. Decide if self-instruction can be generalized to other tasks (if so begin practice)
10. If generalization is possible, have client keep a log of times s/he used self-instruction or when it might have been helpful even if client forgot to implement it.
WORKING TO IMPROVE UNAWARENESS

Educational Approach

Academic personalization – provide clients with information about the neurological problem (brain injury) in print, on videotape, on audiotape. This approach works best with those open to receiving information but it must be given in a way the client can appreciate it (in relation to other cognitive deficits). The best way to accomplish this is through personalization of information (see information and then share how this is the same or different from themselves.)

Medical record review – increase awareness that there is damage to the brain and function has changed. Includes a systematic review of information and can help the client to create their “Brain Injury Notebook” holding important documents and information regarding the incident and concerns after acquired injury.

Other’s rating comparison – discrepancies between self-rating of function(s) with ratings of others who know the client. Uses a simplified rating scale with areas of ability, asks client and someone that the client chooses to complete the scale, helps the client put both ratings together and explore areas of agreement and discrepancy.

Experiential Exercises

These have as their goal to help clients actually experience changes in their ability, in order to increase their awareness of the nature of the changes. These are most helpful for individuals whose lack of awareness is rooted in organic brain dysfunction (not denial) and they have sufficient cognitive abilities to begin linking cause and effect.

Comparison of prediction and performance – estimating performance and then comparing it to external feedback; can be introduced as a method to see where strengths and weaknesses lie

Tracking of performance or behavior – using self-monitoring and behavior logs agreed upon by the clinician and the client; may include a support person to assist with monitoring

Goal setting process – both the client and the clinician look to set goals that are related to areas of deficit and are focused in a positive manner (e.g., Increase use of day planner; decrease episodes of forgetting homework)

Caregiver Training and Education

All the above-mentioned interventions will also be helpful for families and caregivers (and those who provide therapy and education). Important to let them know that clients can learn to use systems and not have to “understand” the areas of deficits in order to be functional. Important to discuss caregiver expectations of the client, their awareness of the injury and its deficits, and understanding of changes after acquired brain injury. For some, this may required extended counseling with the family.

Procedural Training and Environmental Support (PTES)

In cases of severe impairment or where the client exhibits complete disinterest or indifference, awareness of the levels of deficits may not be achieved. These clients can still maximize their functioning, without awareness, through PTES. Interventions can include training on compensatory systems, facilitating prompts and cues in the environment, and rearranging physical space to facilitate task completion.

NOTE: Key to any of these interventions is to reduce defensive reactions of the clients. It is important that the clinician monitor the emotional distress of clients who are becoming enlightened about their changes states of cognitive functioning and capacities.
RESEARCH AND CONTEMPORARY RESOURCES


