COGNITIVE/ACADEMIC ISSUES

Tutorial: Advance Organizers

WHAT IS AN ADVANCE ORGANIZER?

There are two main types of advance organizer. First, an advance organizer can be an introduction to a new topic, with the goals of giving students an overview, connecting new information to what the students already know, and illustrating the organization of the new concept or information to be processed and learned. Second, an advance organizer can be a task planner designed to orient the learner to a task by providing organizational cues, like a sequence of steps to complete the task or a list of components of the task, or by showing what a product (i.e., the learning outcome) should look like (e.g., what a well organized story or description looks like).

Therefore, advance organizers can be as simple as a teacher's background discussion before introducing a new concept or a list of tasks to be done by the learner; alternatively, they can be as complex as a detailed flow diagram that pictures many components of a multi-component task and their organization. Advance organization can be provided by words (spoken or written), diagrams and charts, photographs, or actual models of finished products. Advance organizers are cognitive strategies that help to make complex concepts or tasks clear, and also to relate known information to new or unknown information. They may be designed to facilitate orientation to new information, sequential organization through a task, elaboration of a concept, thematic or dramatic organization of narrative discourse, or other forms of cognitive organization. Advance organizers not only facilitate understanding of new information and completion of complex tasks, they also improve learning and memory at the levels of encoding new information, storing it, and subsequently retrieving it. **(See Tutorials on Memory and Retrieval)**

Advance organization may simply be provided by means of clear teacher instructions; however, they are often presented as visual or *graphic* organizers. Examples of *graphic* advance organizers for adults are the diagrams that accompany products that require some assembly. Even intelligent adults are unlikely to be able to assemble novel products from their parts in the absence of a clear sequence of pictures that explicitly present the steps needed to accomplish the assembly. These diagrams are graphic (i.e., pictured) advance organizers.

Maps are also examples of graphic advance organizers. A map graphically represents places in a specific geographic region and their relationships. Without a map, it would be impossible to find ones way around unfamiliar territory. Similarly, graphic organizers used in schools are "cognitive maps" designed to guide students through conceptual territory that is unfamiliar to them. A cognitive map is a visual road map that illustrates some of the connections among concepts. For example, a visual "map" illustrating the components of a story and their sequence may help elementary school students to read or listen to stories more attentively and also to write stories that are more complete and better organized. (See below for features of a story organizer.)

Often these cognitive organizers are referred to as **"semantic maps"** or "concept maps". The analogy with real maps helps to clarify the common sense usefulness of these academic maps – if you don't know the territory, you need a map. A less useful term that is also used in some schools for graphic organizers is "web". This term is less useful because it does not indicate the purpose of the organizer, as the word "map" does, and because the word "web" is often associated with confusion and complexity, not clarity, simplicity, and organization.

So a "map" in this broad sense of the term is an advance external visual organizer that can help with an organizationally complex task. For preschoolers, an organizer map can be as simple as a set of photographs, presented top-down, representing the daily schedule at home or at school. A preschool "map" is also represented by places that dictate specific activities and by containers that indicate where objects

go. The art corner is for art activities, the water table is for water play, the dress-up area is for pretend play, the snack table is for snack, cubbies are for my personal things, and so on. Thus more abstract ideas like activities, sequences of activities, and categories of objects are "mapped" by physical spaces and containers in the preschool room. When these places are kept distinct, the preschooler is much more likely to behave in an organized manner.

By first grade, the places and photographs that are useful for preschoolers may be replaced by graphic organizers on paper. For example, a student who does not know how to tell or write an organized story will benefit from a chart – a set of boxes and connecting lines – that dictates what information to include and in what order.(See below for details.) Or if the teacher wants the students to produce increasingly elaborated descriptions of objects, a chart that has a separate box for each category of attribute (e.g., functions, physical attributes, composition, etc.) will help the student produce well elaborated and organized descriptions. (See below for details.)

As the child ages into adolescence, graphic organizers shift to more structured planning tools such as written outlines, checklists, and day planners, with an emphasis on sequencing of events by time. These external organizers become essential in maintaining the organizational flow of day-to-day events. Most students will continue to rely on some sort of external organizer (e.g., day planner) as a compensatory tool for the remainder of their lives.

Clear orientation to a learning task or instructional activity is known to be one of the most critically important instructional procedures for students with learning problems, almost as important as the amount of practice or number of learning trials. This is true for all students, but particularly those with organizational impairment. Advance organizers have repeatedly been shown to facilitate learning and academic performance.

WHY ARE ADVANCE ORGANIZERS IMPORTANT FOR MANY STUDENTS AFTER TBI?

Organizing schemes, like the organization of a story, plans for a complex task, and other mental models, are processed and implemented by the frontal lobes of the brain. The frontal lobes are particularly vulnerable in traumatic brain injury, and thus, damage to frontal lobes accounts for much of the disorganized thinking and behavior of students with brain injury. Students with brain injury often have organizational problems that are more severe than meet the eye. Their recovery of preinjury knowledge may result in the appearance of reasonable organizational skills. However, when faced with tasks that are novel or assignments that require significant organizing, they may have great difficulty.

Children who have been injured at a young age may have mastered very few of these organizing schemes, in part because they had acquired relatively few before the injury and in part because they need many more learning trials than other children to learn new organizing schemes. In addition, adults often give these children less rather than more exposure to the organizing schemes. Because of the disability, they may simply have fewer opportunities to experience the events in the world, and thus have less opportunity to form effective organizing schemes. Students who are older at the time of injury have had greater opportunity to master a wide variety of organizational schemes, but may lose these schemes – or lose access to them – due to the brain injury.

WHAT ARE THE MAIN THEMES IN ORGANIZATIONAL SUPPORT USING ADVANCE ORGANIZERS?

Understanding the problem

As always, the first task for teachers and parents is to correctly understand the problem. Symptoms of organizational impairment can easily be misidentified as lack of knowledge, an attention problem, memory problem, or behavior problem. For example, if a student stops working on an assignment because of organizational problems, teachers might attribute this behavior to defiance, lack of interest, or lack of

knowledge when in fact none of these issues is involved. Or perhaps the problem is a result of a combination of factors. Therefore, efforts to sort out the relative contributions of these potential contributors to the perceived problem may be required. The problem-solving component of this web site may be helpful in sorting out the issues.

When organizational impairment is found to be a contributor to the student's difficulties with tasks at home or school, its role must be recognized and relevant intervention and support strategies designed and implemented.

Environmental Supports/Teacher Strategies

In one sense, all advance organizers could be considered a teaching strategy and in this sense fall under the heading of environmental supports. That is, an advance organizer can be considered a procedure used by teachers to orient a student to the content of a lesson, to ensure consideration of known information before processing new information, and to illustrate for the student the structure or organization of the to-be-presented information or to-be-completed task.

From this perspective, all of the graphic organizers and related considerations listed below could be considered to be included in this section on teacher strategies.

Facilitating Organization in Students

Please see the Tutorial on Cognitive Intervention for some cautionary comments on traditional attempts to "train" cognitive processes like organization (e.g., sequencing, categorizing, associating) and memory with decontextualized cognitive exercises. Simply practicing remembering random information or sequencing or categorizing varied types of information has been used for decades by therapists and special educators with the hope of producing generalizable improvements in cognitive processes. Unfortunately, research in rehabilitation and special education has shown that cognitive exercises of this sort have little to no functional, generalizable impact on cognitive functioning in academic or other real-world contexts.

In contrast, graphic organizers are context-sensitive procedures designed to help students become progressively more organized as they attack organizationally complex tasks in school or at home. In this case the goal is not simply to help the student complete the task (which is the case with organizers used as environmental compensations), but rather to improve the student's independent organizational functioning. Graphic organizers are initially used as external supports for task completion. However, as the student gains competence and begins to internalize the organizer, it may be systematically withdrawn so that the organizer becomes a component of the student's mental organization.

As with all supports, the goal is to have the organizational support – the "map" – available for as long as it is needed, but then gradually reduce dependence on physical supports as the student internalizes the organizational structure and it becomes a habit. Systematic reduction in supports is necessary to avoid "learned helplessness". However, some students will need to rely on the external organizer indefinitely.

What follows are some examples of graphic organizers commonly used in schools.

Activity Maps

Time Line Graphic Organizer: For preschoolers, a time line (e.g., the schedule for the day) can be represented by a top-down sequence of photographs representing their activities for the day and the order of these activities. By kindergarten and beyond, the sequence can become left-right and printed words should be combined with the photographs or drawn pictures/symbols as the children start to decode printed words. Parents will need to use these same organizers at home to help their child remain organized through a series of home tasks (e.g., getting up, getting dressed, eating breakfast, packing the book bag, getting ready for the bus) both during school and non-school days. For older students with significant organization and/or memory problems, these time line organizers continue to be used, with the student encouraged to preplan aspects of their day-to-day activities.

More Complex Task Analysis and Planner: For more complex activities at a higher level, the following graphic organizer can be used: At the top of the page, include a box for specific task/activity directions (e.g., the goal, time limits, needed information, collaborators). Then comes a checklist for materials that will be needed. Following that is a checklist outlining the steps in the plan, with a possible time frame for each step. Then follows a section for ongoing review. Finally there is a section for final review: Is the task complete? Was it done correctly? Was it submitted on time? What task strategies worked especially well? What did not work?

Concept Maps/Semantic Maps

Narrative/Story Graphic Organizer: Students with organizational impairment tend to write or tell stories that are short, incomplete, and poorly organized. They also have difficulty remembering stories that they hear or read because they do not focus in an organized way on the salient information. The components of a simple story – or episode or a larger story (narrative structure or "story grammar") – can be graphically represented by a sequence of boxes and connecting lines. The chart might have a box at the top for title, under which would be placed three boxes next to each other for characters, place, and time – that is, the basic setting of the story and its main characters. These boxes would then be connected by a line to a large box immediately below representing the event that gets the action started, the initiating event. That box leads to the next box below, representing the main characters' psychological responses to that event (i.e., they were frightened or concerned and therefore had to do something, which becomes the action of the episode). Below that would be a box for the characters' plan – what they chose to do to deal with the issue or problem; then the unfolding action; and finally the resolution or end of the story. With this simple and organized "map" as a guide, students with organizational difficulty in the middle grades and higher can write well elaborated and well organized stories, which would be impossible without the map. Younger students or those with significant organizational impairment may need simplified versions of this organizer.

Concept Analysis/Elaboration Graphic Organizer: Students with organizational impairment often fail to elaborate their descriptions (and their underlying concepts) of objects and activities, or in other cases, elaborate in a disorganized manner with associations that are at best tangential. The components of a well elaborated description or analysis of an object can be graphically represented by a set of boxes radiating out from a central box like spokes from an axle. In the center box goes the name of the object (e.g., horse). A box positioned at 12:00 (i.e., directly above) contains the category of the object (e.g., a horse is an animal). A box at 1:30 contains words for the actions of the object – if it is something that acts (e.g., a horse runs, gallops, jumps, kicks, neighs). A box at 3:00 contains words for the uses of the object (e.g., a horse is used for racing, pulling, riding, showing). A box at 5:00 contains words for the main attributes of the object (e.g., a horse is big, strong, fast, wild or tame). A box at 7:00 contains words for the parts of the object (e.g., a horse has a mane, tail, four legs with hooves). A box at 8:30 contains words for the main locations where the object can be found (e.g., a horse might be found in a barn or stable, at a race track, on a field). And a box at 10:30 contains words for the possibly idiosyncratic associations that the student may make with the object (e.g., when I think of horses, I think of my uncle Herb or the time I fell or …).

Similarities and Differences Graphic Organizer: Students with organizational impairment often fail to connect concepts in a logical and organized manner. Overlapping circles (i.e., a Venn diagram) can be used to facilitate similarities/differences exercises. For example, one circle might include characteristics of dogs and another of cats. The overlap between the two circles would include characteristics they have in common (i.e., their similarities, like four legs, animals, household pets). The parts of the circles that do not overlap can then contain the characteristics of each animal that are not in common (e.g. bark would go under dog, meow under cat)

Essays: Topics and Sub-topics Graphic Organizer: Students with organizational impairment tend to write essays that are short and disorganized. The components of a well organized essay can be represented graphically as follows: At the top of the paper goes the title or general topic of the essay. That is followed by a top-down sequence of large boxes representing the main sub-topics. Within each sub-topic box can go smaller boxes listing sub-sub-topics, possibly including the information for each sub-sub-topic. There should be arrows connecting these boxes, representing the connections or segue sentences. The final box would be labeled conclusion or summary.

Character Analysis Graphic Organizer: Students with organizational impairment tend to analyze characters in ways that are poorly elaborated. The components of a well organized character analysis can be represented graphically as follows: In the center of the page goes the name of the character. In a box above this circle could go information in response to the question, "What does the character do?" In a box to the right of the circle could go information in response to the question, "What does the character say or think?" In a box below this circle could go information in response to the question, "How do others feel about this character?" In a box to the left of the circle could go information in response to the question, "How does the character change?"

Problem-Solving Graphic Organizer: Students with organizational impairment tend to be impulsive and possibly rigid problem solvers, failing to consider and evaluate a variety of possible solutions to a problem. The components of well organized problem solving can be represented graphically as follows: On the top of the page is a statement of the problem. What follows is a series of boxes. At the top of each box is a possible solution to the problem. Within each of these boxes are two sub-boxes labeled "+" and "-" or "advantages" and "disadvantages". There should be at least three or four of these boxes, indicating a need to brainstorm about possible solutions and their relative advantages and disadvantages before leaping to a solution. At the bottom of the page is a box for Best Solution. Finally there is a section for final review: Is the solution a good one? What did I learn about my problem-solving abilities? What could I do differently next time?

http://www.cast.org/publications/ncac/ncac_go.html - presents a variety of graphic organizers for a variety of organizational tasks.

Principles for constructing Graphic Advance Organizers:
There are many books and other commercial products that offer graphic organizers for a variety of activities or thought processes. And there is software that enables users to construct their own graphic organizers. Many of these materials are useful. However, they should be used with some important principles in mind.

The organization of the organizer must match the organization of that which is to be organized: Many organizers found in books are pleasing to the eye, but fail to capture the organization of their content. For example, there are many story organizers that are circular despite the fact that narrative organization is rarely circular but rather linear. Therefore, the graphic organizer should be linear (see above), not circular. The same logical thinking should be applied to all organizers.

The organizer should be as simple as possible: Many commercially available graphic organizers are more complex than they need to be. Individuals who are organizationally impaired may be further confused by organizers that are too complex. The graphic organizer should be as simple as possible, with only as much visual detail as is necessary to communicate the organization of the concept or task.

The organizer should be as concrete as necessary: As indicated above, preschoolers often benefit from photograph routines. Their young minds are too concrete to process abstract symbols and they do not yet read words. In addition, teachers should not assume that just because a student can read, it is OK to provide nothing but written instructions. Even the best educated adults benefit from a series of pictures when "Some Assembly Is Required" to assemble a product. Thus, elementary school students still benefit from picture organizers even if they can read adequately. Similarly, disorganized adolescents who are readers may nevertheless still benefit from photograph organizers for complex tasks. The added concreteness of the photographs can greatly facilitate orientation to the tasks.

Principles for Teaching the Use of Graphic Organizers:
There are basic principles that should be followed in teaching with graphic organizers.

Connecting Organizers in Instruction: Several organizers might be used together in teaching a complex lesson with organizers building upon each other in a logical fashion. For example, in elementary school, a concept, like pets, might be chosen for a week's reading and writing lessons. On Monday, the concept

analysis graphic organizer might be used to elaborate descriptions of two or three animals. On Tuesday, the similarities and differences graphic organizer might be used to analyze similarities and differences. On Wednesday, the problem solving graphic organizer might be used to elaborate possible solutions to a hypothetical problem involving the pets. On Thursday the narrative/story graphic organizer might be used to generate material for an interesting story about the pets using all of the information in the graphic organizers from Monday through Wednesday. And on Friday, the story can be written in prose form, with practice reading it as part of the exercise.

Providing Extensive Practice: Students with brain injury require considerable amounts of practice with specific graphic organizers to gain facility with them. Ideally the same graphic organizers will be used over the course of several years within a school building. For some students, extensive practice with a specific type of organizer will lead to internalization of the organizer as an internal mental organizational scheme.

Systematically Reducing External Support: As with all supports, graphic organizers should be slowly faded as the students gain automaticity in using them and internalize the organizational system as part of their own thinking. It is not uncommon, however, that a previously learned organizational strategy will need to be reintroduced when the student is faced with a more complex academic task.

EVIDENCE SUPPORTING THE USE OF ADVANCE (INCLUDING GRAPHIC) ORGANIZERS

This summary of evidence is written for teachers and others who may be required to support their intervention practices with evidence from the research literature or who may simply be curious about the state of the evidence. This summary was written in early 2008. Evidence continues to accumulate.

Graphic organizers are not only relevant to the needs of many students with TBI, they are also supported by a large body of educational research with both disability and nondisability populations. Nesbit and Adesope (2006) estimated that more than 500 articles have been published in peer-review journals, most since 1997, with substantial reference to educational applications of graphic organizers.

In their meta-analysis of 55 experimental studies (with 5,818 participants and 67 standardized mean difference effect sizes), Nesbit and Adesope concluded that there is a generally positive effect of graphic organizers (i.e., knowledge and concept maps) in facilitating knowledge comprehension and retention, with effect sizes varying from small to large depending on how the organizers were used and on the type of comparison treatment. The students who were studied ranged from grade 4 to post-secondary education. Most of the studies were of regular education students (including post-secondary professional education). However, Nesbit and Adesope also summarized data suggesting that low ability students experienced greater benefit than high ability students, suggesting a relatively stronger positive effect for students with cognitive disability. The respected report of the National Reading Panel (2000) identified 11 experimental studies that met stringent methodological criteria and supported the use of graphic organizers to facilitate reading comprehension and memory for text. Bulgren and Schumaker (2006) described 19 studies of advance organizers, all with adolescent participants. Five of the studies used only participants with learning disabilities; the remaining 14 used participants with learning disabilities, low academic achievement, and normal achievement. Seventeen of the studies used group designs; the remaining two used single-subject experiments. All of the organizers used in the studies had been developed at the Kansas University Center for Research on Learning. The 19 studies reported uniformly positive results, interpreted both statistically and clinically, leading the authors to conclude that advance organizers, including graphic organizers, can substantially improve the learning of adolescent students with learning disabilities, low achieving students, and average achieving students.

Because of the organizational needs of many students with TBI, advance (including graphic) organizers appear to be an evidence-based intervention well designed to meet their needs. However, little research is available that documents the effectiveness of advance organizers with this specific population. Graphic organizers were used in combination with other cognitive and behavioral interventions in nine successful single-subject experiments with students with TBI reported by Feeney and Ylvisaker (1995, 2003, 2006, 2008). The graphic organizers were in most cases actual photographic representations of complex tasks.

The participants in the studies were students with TBI and associated frontal lobe involvement, ranging in age from six years to late adolescence. In each case, negative behaviors decreased in frequency and intensity while the amount of school work completed increased in response to the multi-component intervention.

Bulgren, J.A., & Schumaker, J.B. (2006). Teaching practices that optimize curriculum access. In Deshler, D.D., & Schumaker, J.B. (Eds.), *Teaching adolescents with disabilities: Accessing the general curriculum* (pp. 79-120). Thousand Oaks, CA: Corwin Press.

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National Reading Panel (2000). *Teaching children to read: An evidence-based assessment of the scientific research literature on reading and its implications for reading instruction.* Washington, DC: National Institute of Child Health and Human Development and U.S. Department of Education.

Nesbit, J.C., & Adesope, O.O. (2006). Learning with concept and knowledge maps: A meta-analysis. *Review of Educational Research*, *76*(3), 413-448.

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Tutorial: Attention

WHAT IS ATTENTION?

In general, the word "attention" refers to the mental processes that enable people to be alert and to selectively focus on information from the environment or from the contents of their thinking. Included in this set of mental processes are the following:

- *Arousal and alertness:* being awake and receptive to incoming stimuli or other information
- *Preparing attention:* presetting oneself to attend to selected information (e.g., deciding what information to look for before beginning to read a chapter in a text book)
- *Selecting a focus of attention (concentrating):* Attending to only one thing when there are many stimuli occurring at the same time (e.g., listening to the teacher talk when there are other activities occurring in the classroom)
- *Maintaining/sustaining attention:* maintaining a focus of attention over time (e.g., attending to a teacher's lecture for a full 60 minutes;)
- *Suppressing/filtering distractions:* maintaining a focus of attention while also actively avoiding attention to competing stimuli or information (e.g., refusing to pay attention to student chatter while listening to a teacher's lecture)
- *Shifting/switching attention:* changing the focus of attention from one thing or topic to another
- *Dividing/sharing attention:* actively paying attention to more than one source of information at one time (e.g., taking notes and listening to teacher talk at the same time)

Attention is important and has been intensively studied because it is the gateway to the rest of cognition. That is, students must be paying attention if they are to organize incoming information, comprehend it, remember it, engage in problem solving, and the like.

However, it is hard to distinguish primary attention problems from other cognitive problems and from emotional or behavioral problems. For example, if a student's processing of information is slow (i.e., primary speed of processing problem), then it will be difficult to pay attention to fast-paced information. Or if a student has difficulty organizing incoming information (i.e., primary organizational problem), then again attention will be difficult to maintain. Similarly, students who are anxious, sad, or depressed may appear to have attention deficits when the problem is really an emotional problem. Thus staff and family members should try to identify the primary contributor(s) to the problem before proceeding with intervention and support plans. This web site should help with identification.

WHAT ARE ATTENTION DISORDERS AND WHY IS ATTENTION IMPORTANT FOR MANY STUDENTS AFTER TBI?

In the early days and weeks after a severe TBI, individuals may be in a coma or otherwise difficult to arouse. Such a severe disorder of attention is due to severe generalized brain trauma or damage to the brain stem. For most individuals, this state of minimal consciousness passes and the person becomes normally "vigilant", but possibly with a variety of ongoing cognitive deficits.

In the months and years following a severe injury, both children and adults with TBI frequently report problems with concentration, distractibility, short attention span, forgetfulness, and difficulty doing more than one thing at a time. It is likely that these problems are related to damage to the frontal lobes, resulting in poor control over attentional functions, or related to widespread brain damage, resulting in generally slow and inefficient processing of information. Students with these problems may perform at adequate levels on educational or psychological tests that tend to be short and administered in a non-distracting environment. However, concentration, maintenance of attention, and shifting and dividing attention my nevertheless be difficult in busy and noisy real-world settings.

Mild-to-moderate brain injury can also have poorly controlled attention as a consequence. For example athletes who have a concussion often report distractibility to be among their problems for some period of time. This problem may resolve within a few days or weeks or may persist.

Furthermore, attention deficit hyperactivity disorder (ADHD) is one of the risk factors for TBI in children. Thus many students with TBI had a diagnosis of ADHD before their injury. Others acquire attention deficits and related disorders as a result of the injury. Therefore attention-related problems are common among students with TBI.

There are at least two main types of students with ADHD, which may be combined: those who are primarily impulsive and hyperactive (ADHD-H) and those who are primarily inattentive (ADHD-I). Characteristics of ADHD-H include the following: frequent fidgeting, squirming, and leaving the seat; inappropriate running or climbing; difficulty playing quietly; excessive talking; talking out of turn; difficulty waiting; frequent interruptions. Characteristics of ADHD-I include the following: distractibility; failure to pay close attention; careless mistakes; frequent inattention to others; weak sustained attention; poor organization of things and activities; frequent loss of things; poor follow through on tasks; aversion to tasks that require mental effort; forgetfulness. Students with the combined type of ADHD have characteristics from both lists.

Whether the problem is congenital or acquired as a result of brain injury, several problems tend to be associated with attention disorders. Students with attention-related disorders tend to be disorganized and impulsive, to have poor orientation to time, and to learn very inefficiently from the consequences of their behavior. In addition, they may have co-existing learning problems and behavior problems.

WHAT ARE THE MAIN THEMES IN INTERVENTION AND SUPPORT FOR STUDENTS WITH ATTENTION DEFICITS?

Understanding the Problem

As with all problems, step one is understanding the problem. For example, attention problems may be misidentified as non-compliance or defiance. Similarly, problems with organization, memory, or comprehension may be misidentified as attention problems. Anxiety or depression may also result in behaviors misidentified as attention problems. The context-sensitive assessment procedures on this web site may assist in correct identification of the underlying problem(s).

Environmental Accommodations and Supports

Following adult understanding of the student's abilities (and possibly pharmacologic intervention), the next important step is to organize and modify environmental factors with the goal of optimizing the student's successful learning and self-management. Although a distinction is drawn below between environmental management and student training, it is possible that the environmental changes will also result in improvements in the student's functioning.

Expectations: Step one in environmental management is to ensure that education staff and family members have appropriate expectations regarding the attention and self-regulation abilities of students with attention and related disorders. For example, some students are incapable of focusing quietly for more than 10 or 15 minutes at a time. These students should be given regular breaks, possibly including some type of physical activity. Some students are incapable of organizing the materials in their desk or the activities in their planning systems. These students need organizational help from others. If the student's limits are not understood, a negative cycle of problem behavior and punishment is likely to result.

Controlling Environmental Factors: In general, students with attention deficits and related disorders profit from an environment that has a clear structure, stable routines, and well understood expectations.

1. **Stable Routines: (See Tutorials on Organization; Transition Routines; Instructional Routines)** At home and at school, routines should be as stable as possible. Create consistent time schedules. Have consistent places for objects (e.g., for books, materials, etc) and activities (e.g., a quiet study place). Create consistent beginnings and endings to activity periods (e.g., routines for beginning activities should include instructions that are brief and include visual cues). Preset the student to changes in routines. Provide written or pictured cues for the steps of a complex task or routine.
2. **Adequate Change, Novelty, and Interest:** Often students with attention deficits and related disorders engage in off-task or disruptive behavior because they need greater stimulation than other students. This may appear to be inconsistent with the need for stable routines, but need not be. Routines should be reasonably brief and include adequate physical activity (e.g., standing, moving between activities). Learning projects should be interesting and engaging (e.g., colorful materials, personally interesting tasks). Large tasks should be broken down into small steps and adult feedback and encouragement should be frequent and positive. Low and high interest tasks should be alternated so the student has a motivating task to look forward to. "Fidgety" students should be allowed physical activities that do not disrupt other students (e.g., tapping a pencil that has a sponge head).

   It was once thought that students with attention deficits and related disorders would benefit from quiet cubicle spaces with no distractions. Studies have shown that this type of environment is not helpful. Students may need to be in reasonably stimulating environments (e.g., posters on the walls, interesting bulletin boards), but with stable routines within those environments.
3. **Assignments:** To ensure selective attention to task, the following procedures are useful. Make sure that the student has something specific to listen for during listening tasks. When giving assignments, show the student a model of what the finished product will look like. Use job cards, outlines, checklists, graphic organizers, color coding, or other highlighting procedures for assignments. Use a magic marker to highlight instructions, headings, and math process signs on worksheets. Use prompt cards to guide behavior during unstructured times. Ask students to repeat instructions to ensure their comprehension.
4. **Cooperative Learning Groups:** Students who have difficulty attending and organizing themselves often benefit from learning within the context of cooperative learning groups. Their thinking and learning can be organized by interaction with peers. Their need for stimulation and novelty can be met by peer interaction and brainstorming. Students may need to be taught explicit rules for the various roles within learning groups. To control turn taking, a "talking stick" can be passed from speaker to speaker. Peer tutoring has also been found to be useful for students with attention deficits and related disorders. Whether or not cooperative learning groups are used, students with attention deficits and related disorders should have opportunities for task-related talking.
5. **Turning Over Responsibility to the Student:** Environmental management always runs the risk of an unwanted and possibly growing reliance on environmental supports. Supporting students should always be organized around the motto, "Help students without making them helpless." Thus environmental supports should be reduced as it becomes possible to do so. Furthermore, staff should gradually turn over to the student responsibility for organizing tasks and setting deadlines, creating monitoring systems for homework, deciding when and how to complete household chores, asking for help, staying on topic, and solving problems. Students with TBI and cognitive disorders may need more time and smaller steps for this transfer of responsibility. **(See Tutorial on Self-Regulation Routines.)**

Student Interventions

The distinction between environmental and student interventions is somewhat artificial. First, environmental interventions often give students an opportunity to practice their skills, including self-regulation skills, and therefore can be considered part of a package of intervention designed to improve the student's functioning, rather than just relying on environmental management. Second, as stated above, staff and parents can contribute to student independence by gradually turning over to the student responsibility for managing and organizing environmental interventions.

1. **Pharmacologic Intervention:** Stimulant medications are often useful for students with TBI and attention deficits, whether the attention deficit predated the injury or was caused by the injury. Because treatment with medication can be complicated by brain injury, parents and teachers should ensure that the prescribing physician has experience with children with brain injury. Often several medications and doses are explored before the optimal combination is identified. A systematic procedure must be in place to monitor the effectiveness of the medication and its dose.

   Stimulant medication has been shown to reduce problematic symptoms (e.g., impulsiveness, disorganization, poorly controlled attention) in students with attention deficits and related disorders. Behavioral interventions (described below) add to this effect. In some students, the focusing effect of the medication increases the likelihood that environmental and behavioral interventions will be effective.

2. **Attention Process Training:** In the 1980s and 90s, direct training of attention processes became popular in adult TBI rehabilitation. This intervention involved creating tasks ("exercises") that engaged attention functions in a hierarchical manner. The individual with TBI was then required to practice the exercises using massed (back-to-back) learning trials. The analogy that was often used was that training mental processes is like exercising muscles. Considerable research on this approach has shown that individuals can improve on the training tasks, but that transfer or generalization to everyday activities and settings has been disappointing. This research outcome is consistent with 100 years of research with many different disability groups. In general, cognitive training (e.g., practice remembering, organizing, attending) with tasks and in settings that are not functional for the person can result in improvements on the training tasks, but no functional improvement on real-world activities. If attention process training is considered, referral to a specialist is recommended, with ongoing focus on the functional generalization of any treatment gains made in a therapy setting.

3. **Behavior Management Programs:** Students with attention-related disorders, whether a result of TBI or not, often have co-existing behavior problems. **For details, please see Tutorials on Behavior Management: Contingency Management; Behavior Management: Prevention Strategies; Positive Behavior Supports.**

   Behavior Management: Contingency Management: "Contingency management" refers to a set of procedures designed to change (increase or decrease) the student's behavior by controlling its consequences. There are many details **(see Behavior Management: Contingency Management)**, but the general idea is to increase the frequency of desirable behavior by following it with positive consequences (i.e., reinforcement) and to decrease the frequency of undesirable behavior by following it with no consequences (i.e., ignoring the behavior) or negative consequences (i.e., punishment).

   Specialists in the field of attention disorders frequently offer the following advice about contingency management with these students. (1) Because students with TBI, attention deficits, and related disorders are typically impulsive and because the area of the brain involved is the same area as that which enables humans to learn from consequences, staff and parents should not expect long-term improvements in behavior as a result of contingency management programs. (2) Nevertheless, clearly defined rewards and punishments may be necessary to turn around negative behavior over the short run. For students with attention disorders, the consequences should be more immediate (i.e., given immediately after or shortly after the behavior occurs) and more salient (e.g., intense praise or fun activities for younger students; intense praise for older students) than would be necessary for other students the same age. For example, the promise of an end-of-the-day reward will be ineffective for a young child with attention disorders. Similarly the Monday promise of a weekend reward will likely be ineffective for an adolescent with attention disorders. (3) Intense praise should be provided for effort and small steps, rather than waiting for success with larger or more important tasks. (4) Activity rewards are useful for students with attention disorders (e.g., when you are done with your math problems, you can walk to the water fountain) because they satisfy the need for high levels of activity. For highly active students,

academic activities should include frequent motor activities (e.g., making checks on a checklist, organizing materials, cleaning the chalkboard).

(5) Even if behavior is changed for the better with immediate and salient rewards or punishments, staff and parents should not expect these changes to translate into long-term changes in behavior. Remember, the parts of the frontal lobes that support self-regulated behavior, including attention, also control learning from consequences. So students who are impulsive and have poorly regulated attention are the same students who fail to learn efficiently from the consequences of their behavior. (6) Rewards for positive behavior should be part of any management system for students with TBI and attention disorders or any other disability. A generally positive environment, rich in natural rewards for successful behavior, helps prevent a downward spiral of behavior and a negative self-concept, both of which are likely if the student experiences considerable failure and punishment for negative behavior.

Behavior Management: Prevention Strategies: Prevention strategies are procedures designed to set the student up for success rather than merely reacting to the student's behavior after it has occurred. There are many details **(see** Behavior Management: Prevention Strategies**)**, but the general idea is to increase the frequency of desirable behavior by encouraging the development of positive habits. This is accomplished by teaching relevant skills and by managing the environment to avoid triggers for negative behavior and create triggers for positive behavior. The four keys to behavior management for these students are teach, teach, prevent, and prevent.

4. **Positive Alternatives to Negative Behavior:** Students with behavior problems associated with their attention deficit should be taught positive alternatives to their negative behavior. For example, if a student with a short attention span simply gets up and leaves a task after a few minutes without permission, he should be taught to request a break as an alternative. The break should be short, followed by a return to task. **(See Tutorial on** Teaching Positive Alternatives to Negative Behavior**.)**

5. **Redirection:** Students with attention deficits have difficulty remaining focused on tasks, particularly those that are not intrinsically interesting. Loss of focus should be anticipated by staff who are equipped with scripts of redirection. Redirection can range from physically redirecting the student to the task at hand (e.g., taking him back to his desk and restarting the activity) to providing subtle cues (e.g., a printed cue, like "focus"). When redirecting the student, staff and parents should be careful to avoid reinforcing off-task or other negative behavior. Unintentional reinforcement can occur, for example, if the adult provides too much attention to the negative behavior or talks at great length to the student after off-task or other negative behavior. Furthermore, if the off-task behavior is intended (consciously or unconsciously) by the student to escape the task at hand, then removing the student from the task (e.g., time out) will reinforce the negative behavior, not cause it to decrease.

6. **Well Understood Rules with Natural and Logical Consequences:** Because of the impulsiveness and disorganization associated with attention disorders, there is great value in organized environments in which rules and expectations are well understood by the student and consistently managed and enforced. In #3 above, the point is emphasized that students with TBI and associated impulsiveness and attention problems may not change their behavior effectively in the long run as a result of the consequences they receive for their behavior. Nevertheless it is important to live in a world in which positive behaviors have natural positive consequences (e.g., praise, special privileges) and negative behaviors have natural negative consequences. For example, if the student trashes his room, he should be expected to clean it up after a cooling-down period. If he fails to do his homework, he should be made to do it at a later time. This may not change future behavior, but it does help to teach lessons about how a predictable and organized world operates.

7. **Self-Regulation Programs:** Attention disorders have recently been characterized as executive function/self-regulation disorders, with impulse-control problems being at their core. With this as

background, all of the intervention and support procedures that fall under the heading, self-regulation/executive functions, are relevant for this group of students. **See Tutorials on Self-regulation/Executive Function Routines; Goal Setting; Inhibition; Initiation; Self-Monitoring; Problem Solving.)**

8. **Self-Viewing on Video Tape:** Self-viewing on video with students with attention disorders has been used effectively for two distinct purposes: (1) Observing a group activity and charting positive and negative behavior has been used to increase self-awareness of and reduce the frequency of negative (e.g., off-task) behavior. (2) Self-observation of videos, possibly edited to include only positive behavior, has been used to increase positive behavior and self-concept.

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Tutorial: Cognitive Intervention/Rehabilitation

(See Tutorials on Cognition; Transfer/Generalization; Instructional Routines; Attention; Memory and Memory Problems; Organization; Problem Solving; Concrete versus Abstract Thinking; Cognitive and Learning Strategies)

WHAT IS COGNITIVE INTERVENTION/REHABILITATION?

In the most basic sense, cognitive intervention or rehabilitation includes every procedure that can help people with cognitive impairments to successfully engage in activities that are rendered difficult by those impairments. In this broad sense, cognitive intervention/rehabilitation is a wide-ranging and important field, and includes all of the intervention and support procedures discussed in many of the Tutorials on this web site, including Attention, Memory and Memory Problems, Retrieval, Organization, Problem Solving, Concrete Versus Abstract Thinking, Instructional Routines, Executive Function/Self-Regulatory Routines, Transfer of Training, Cognitive and Learning Strategies, and others.

In schools, cognitive intervention may be implemented in ways that are not referred to explicitly as cognitive intervention. For example, comprehensive programs of classroom-based strategy instruction to improve reading comprehension or written composition can be considered cognitive intervention and, if implemented effectively, can have a powerful and positive effect on the student's development of cognitive and meta-cognitive abilities. In addition, special educators and therapists (e.g., speech-language pathologists, occupational therapists) often engage students in exercises and activities that would be classified as "cognitive rehabilitation" if implemented in a medical setting. These activities may or may not be helpful, depending on the evidence base of the activities, the skill of the therapist, and the extent to which therapy exercises are effectively integrated with classroom activities for transfer. Transfer of training (generalization) from training setting to application setting must always be highlighted as the most critical aspect of intervention if implemented outside of the context of everyday academic or social routines.

Many professionals use the terms "cognitive rehabilitation" and "cognitive (re)training" in a narrow sense to refer to cognitive exercises and activities designed to restore or strengthen underlying cognitive functions. Currently cognitive rehabilitation in this narrow sense is quite controversial. For example, there is no support for the use of "memory exercises" to improve memory functioning across domains of content or "reasoning exercises" to improve reasoning across domains of content. In general and special education, there is virtually no support for "critical thinking exercises" if delivered outside of the context of specific domains of academic content. In contrast, there is evidence to suggest that such exercises may have limited translation to functional improvement There is limited support for the use of attention exercises to improve attentional functioning across domains of content, particularly if those exercises are accompanied by efforts to help the students understand their difficulty in this area and acquire strategies to compensate for the difficulty.

In 2002 a joint committee of the American Psychological Association and the American Speech, Language and Hearing Association distinguished between two interestingly different paradigms, or ways of understanding cognitive rehabilitation: "Traditional Cognitive Retraining" and "Context-Sensitive Cognitive Intervention and Support". These two approaches were defined in terms of their understanding of the focus and goals of cognitive rehabilitation, relevant assessment procedures, treatment modalities and methods, organization of treatment, and setting, content, and providers of treatment. While many professionals combine aspects of these two approaches, it helps to understand the controversies in the field by contrasting the two approaches.

Focus and Goals

Traditional Cognitive Retraining: The focus of intervention is on the underlying neuropsychological impairment, with the goal of restoring cognitive functions (e.g., attention, organization, memory, reasoning, problem solving). In this approach, residual cognitive skills are often utilized to assist weakened abilities. Increasingly the focus of treatment has come to include the use of compensatory strategies to augment restorative interventions and maximize intervention techniques across areas of functioning for the

individual. Cognitive remediation is often done outside of the functional contexts or environments of the individual (e.g., in a hospital or clinical setting).

Context-Sensitive Cognitive Intervention and Support: The focus of this approach is translating the underlying neuropsychological impairments into their negative impact on the person's functional activities in everyday life, and/or the individual's participation in chosen life activities (e.g., school). Needed environmental adaptations and supports to make that participation possible and successful are of primary importance, along with compensatory strategies that might be of use to the student. The primary goal is to help individuals achieve their real-world objectives and participate in their chosen real-world activities that may be blocked by cognitive impairments. In contrast to traditional cognitive remediation approaches, this intervention is typically embedded within the person's natural environments (e.g., in the home or classroom setting).

Assessment

Traditional Cognitive Retraining: Both diagnosis and treatment planning are based on standardized neuropsychological tests, possibly combined with customized laboratory tasks. Testing identifies both cognitive strengths and weaknesses, upon which interventions are based. Outcome tends to be measured by similar tests at a later point in treatment. More recently practitioners working within the traditional framework have begun to add measures of changes in functioning in real-world activities to their test batteries. Recommendations are made to improve performance across other areas of functioning

Context-Sensitive Cognitive Intervention and Support: Assessment takes place across three levels of functioning:

Impairment: Standardized neuropsychological measures are used, with possible expansion of tasks to isolate the underlying processes that are affected in poor performance.

Everyday Activities: Assessment includes systematic behavioral observations of everyday activities (static assessment) and exploration of variables that affect functional performance of everyday activities (dynamic assessment).

Participation and Context: Surveys and reports of real-world participation may be used (static assessment) along with exploration of context variables that affect functional participation (dynamic assessment). The latter includes systematic behavioral observations of the competencies of those individuals providing the student with everyday supports (e.g., classroom assistants) as well as systematic attempts to improve those competencies.

Treatment Modalities and Methods

Traditional Cognitive Retraining: Retraining relies largely on focused cognitive exercises designed to restore impaired cognitive processes or skills. These restorative exercises may be combined with the use of compensatory cognitive strategies to bypass deficits and augment cognitive functioning in daily activities. Family members or others may be involved in treatment to help generalize and practice techniques learned in remediation to the home and community setting.

Context-Sensitive Cognitive Intervention and Support: Intervention and support includes flexible combination of cognitive exercises (if indicated and supported by evidence), task-specific training of relevant everyday skills, and intervention for strategic thinking and compensatory behavior in functional contexts. A critical intervention modality in this approach is environmental modifications, including changes in the support behaviors of relevant people in the individual's natural environments (e.g., in home or school).

Organization of Treatment

Traditional Cognitive Retraining: Cognitive exercises are normally ordered hierarchically in three respects:
Sequence 1: Exercises for basic components of cognitive functioning are mastered before more complex components of the same task are introduced.
Sequence 2: Mastery of skills in acquisition tasks is facilitated before generalization tasks are introduced.
Sequence 3: Reduction of underlying cognitive impairments is addressed using impairment-oriented exercises first, with gradual generalization of skills to everyday activities using compensatory strategies if necessary.

Context-Sensitive Cognitive Intervention and Support:
Sequence 1: Improvement in areas affected by cognitive impairments need not be approached hierarchically.
Sequence 2: Generalization is promoted from the outset by practicing skills in functional tasks.
Sequence 3: The traditional progression is possibly reversed, with real-world participation first facilitated with environmental supports. Next everyday activities are improved with practice and possibly with compensatory behaviors and equipment, and finally underlying cognitive functions improve with internalization of well rehearsed strategies and behaviors.

Setting, Content, and Providers

Traditional Cognitive Retraining: Treatment is typically offered in clinical rehabilitation settings using specialized equipment, materials, and tasks (e.g., specialized cognitive retraining computer software) focused on specific cognitive domains, with a gradual shift to more contextually appropriate materials in the person's life; cognitive retraining specialists (e.g., psychologists, occupational therapists, speech-language pathologists) generally deliver the service.

Context-Sensitive Cognitive Intervention and Support: Interventions may be offered initially in a clinical setting using personally relevant content (e.g., academic materials and tasks). The service is then delivered in personally relevant settings (e.g., classrooms) with personally relevant content. The service may be designed and monitored by a cognitive rehabilitation specialist who then trains and recruits the support of everyday people (e.g., parents, teachers, educators, teaching assistants).

WHY IS COGNITIVE INTERVENTION/REHABILITATION IMPORTANT FOR MANY STUDENTS WITH TBI?

For many individuals, it is during the school years that the greatest demands are placed on cognitive functioning. Students need to pay attention effectively, organize information for thorough comprehension and effective expression (e.g., reading books, writing essays), remember the information and retrieve it for tests, reason effectively, and apply strategic thinking to the many academic problems that arise in school. Thus effective strategies to enhance cognitive functioning within academic settings are critical for all students.

Unfortunately, cognitive impairments are among the most common long-term challenges after TBI in children of all ages. Virtually any cognitive function or combination of cognitive functions can be negatively affected by the injury. However, because certain parts of the brain are more vulnerable than others, there are common profiles of cognitive impairment. Vulnerable parts of the brain include the frontal lobes (especially prefrontal areas), the limbic system (especially the hippocampus associated with memory and learning), and interconnections between the frontal lobes and limbic system structures.

Damage to the frontal lobes can impair control of attention, even in students who appear to be quite alert. Attention span may be short, distractibility may be severe, and shifting and dividing of attention may be difficult. **(See Tutorial on Attention.)** Controlled memory/learning and retrieval of information may also be difficult. Thus, studying (i.e., trying to put information into memory) may be inefficient and deliberate retrieval (e.g., searching memory during a test) may be weak. **(See Tutorials on Memory; Retrieval.)**

Organizing information and events may also be difficult. This includes relating pieces of information for purposes of deeper comprehension, paying attention to the most important parts of a story or text book, and effectively planning and organizing information when reciting in class or writing essays and stories – and then being flexible with these plans. **(See Tutorial on Organization)**

Damage to the frontal lobes also reduces the effectiveness of problem solving and strategic studying and learning. Thus students whose cognitive processes may be weak also have specific difficulty compensating effectively for that weakness. This deficit requires intensive efforts to teach compensatory strategies so that the student can succeed at school. **(See Tutorial on Cognitive and Learning Strategies.)** Students with frontal lobe injury may also be impulsive, so they do the first thing that comes to mind, which may not be strategic. They may also think and say or write the first thought that comes to mind and therefore make many errors in their school work. The student's impulsiveness may also block her from checking her work (self-monitoring) and making necessary adjustments in response to errors. **(See Tutorials on Impulsiveness/Disinhibition; Self-Monitoring)**

Damage to vulnerable parts of the limbic system – especially the hippocampus – impairs those processes involved in *declarative memory* (i.e., remembering that such and such is the case) and *episodic memory* (i.e., remembering events in ones life). In contrast, procedural memory (i.e., remembering/learning how to do something), routine learning (e.g., developing habits of thought or action), and implicit memory (i.e., certain memories "stick", but the student has no awareness of the memory) may be well preserved even if the hippocampus is damaged. **(See Tutorials on Memory; Retrieval; Explicit and Implicit Memory; Errorless Learning)**

Finally, damage to the frontal lobes may not be evident shortly after injury for the child who is young at the time of onset. For many children injured early in life, these frontal lobe problems begin to emerge later in childhood or during adolescence at a time when these skills are expected to be established.

WHAT ARE THE MAIN THEMES IN COGNITIVE INTERVENTION/ REHABILITATION AND SUPPORT?

Please see the following tutorials for guidance in helping students with specific cognitive impairments:

- Tutorial on Attention
- Tutorial on Memory and Memory Problems
- Tutorial on Retrieval
- Tutorial on Organization
- Tutorial on Advance Organizers
- Tutorial on Problem Solving
- Tutorial on Concrete versus Abstract Thinking
- Tutorial on Cognitive and Learning Strategies
- Tutorial on Errorless Learning
- Tutorial on Instructional Routines
- Tutorial on Learning Trials
- Tutorial on Slow Processing
- Tutorial on Transfer
- Tutorial on Reading Comprehension
- Tutorial on Written Composition
- Tutorial on Self-Regulation Routines

General Comments about Cognitive Rehabilitation/Intervention

Scope of the Service

Teachers and therapists need to remember that helping students with impaired cognition can take the form of (1) making environmental and instructional accommodations, (2) teaching compensatory strategies, and (3) training specific cognitive functions.

1. Environmental and Instructional Accommodations: Each of the cognitive tutorials lists environmental and instructional compensations and accommodations. For many students, this is the most critical aspect of cognitive intervention. As with all support-oriented interventions, the environmental and instructional supports must be systematically withdrawn as the student gains competence.

2. Teaching Students Strategies to Compensate for Cognitive Impairments: The cognitive tutorials also highlight strategies that students can learn in an effort to compensate for their ongoing cognitive difficulties. Strategies in this domain should be considered as complements to and must be coordinated with more general classroom-based programs of strategy instruction (e.g., reading comprehension strategies), which are considered a standard of practice in fields like educational psychology and special education. **(See Tutorials on Cognitive and Learning Strategies; Reading Comprehension; Written Composition)**

3. Activities and Exercises to Improve Cognitive Functioning: The cognitive tutorials also address cognitive training exercises. Cognitive exercises should never be implemented without a plan for generalization to functional classroom tasks and activities.

Consultation from a Specialist in Cognitive Rehabilitation/Intervention

If a program of cognitive rehabilitation/intervention is initiated in the schools, it is important to seek guidance from an experienced specialist in cognitive rehabilitation. Experts able to interpret neurosurgical and neuropsychological assessment findings are often a useful starting point for creating an effective comprehensive program of cognitive intervention. School psychologists are typically not trained in neurocognitive assessment or in interpreting neuropsychological reports in a way that translates them into effective school programs of instruction and intervention.

Transfer of Training

Research has conclusively demonstrated that improvements on cognitive training exercises (e.g., practicing memory, organization, or problem-solving strategies) are unlikely to transfer to meaningful classroom settings and activities without well designed efforts to affect that transfer. For example, engaging students in organizational exercises in a therapy session (e.g., categorizing or sequencing exercises) will not transfer automatically to classroom reading, writing, or content area application where cognitive organization makes a difference. Therefore, if cognitive exercises of any sort are to be part of a therapy or special education program, they must be actively integrated with functional classroom application plans.

Strategy Instruction

Helping students acquire learning and other cognitive and academic strategies, from early elementary school through high school, has become a standard of practice and one of the most strongly evidence-based practices in the field of education. **(See tutorials on Cognitive and Learning Strategies; Reading Comprehension; Written Composition.)** Strategy instruction is known to improve performance on academic outcome measures for students with and without disability. When properly implemented, strategy intervention can also boost the cognitive functioning of students with a variety of learning profiles. Three critical themes have emerged from the strategy intervention literature: (1) Strategy instruction needs to be embedded within the educational curriculum (versus an exclusively therapy-based intervention); (2)

Strategy instruction needs to be explicit and intensive; (3) Strategy instruction needs to be long-term. In addition, teaching strategies is importantly complemented by explicit instruction in self-regulatory self-talk, including self-assessment, goal setting, self-instructing, self-monitoring, self-evaluating, and self-reinforcing. **(See Tutorial on Self-Regulation Routines)**

Cognitive Training Exercises

Cognitive training exercises (e.g., exercises designed to strengthen remembering, organizing, problem solving, and the like) continue to be popular in many special education and therapy settings. Unfortunately, studies of both adults with TBI and children with a variety of cognitive and learning disabilities have repeatedly shown that most cognitive exercises (e.g., repeated trials of remembering random information with no strategy component) are ineffective and should be avoided. In some cases it may be useful to introduce cognitive activities for purposes of helping students understand their own cognitive processes and what they can do strategically to be more effective (e.g., learning to use special procedures to focus attention or to memorize more effectively). To deal with transfer of training problems, classroom-based activities and materials are likely to be the most useful context for facilitating meta-cognitive awareness and for practicing strategies.

In some cases, attempts to train cognitive processes are inefficient or ineffective because the cognitive process is itself embedded in specific information content. For example, being able to categorize and sequence events is dependent on knowledge of the events in question, not on a "faculty of the mind" that is independent of content and therefore able to be "strengthened" with exercises. Therefore students who have difficulty sequencing or categorizing events need instruction in those relevant domains of content, not exercises in categorizing and sequencing. For example, a student who has difficulty sequencing the events of the American revolution needs instruction in American history, not sequencing exercises. Similarly "critical thinking" is known to be dependent on the domain of content in which the thinking is taking place. Therefore, critical thinking should be facilitated within specific academic domains (e.g., math, science, history) and across the entire curriculum.

Tutorial: Cognitive & Learning Strategies

WHAT ARE COGNITIVE AND LEARNING STRATEGIES?

Cognitive and learning strategies are those procedures that a student uses to succeed with a task that would be difficult without special effort. Strategies can be external aids, like a calculator to help with difficult math problems, a clock and a calendar to help keep track of time, lists to remember things to do, a graphic organizer for complex tasks like writing a story, and the like. Or they can be communication strategies, like asking for help. Or they can be internal mental procedures, like repeating information in ones head or creating associations in order to make the information more memorable. Simple school examples include taking notes during a lecture, asking for clarification of complex material in a text, highlighting important information in a text as one reads, and creating an outline before beginning to write an essay.

Everybody uses strategies when tasks become difficult. For example, most readers, not just those with poor reading comprehension, acquire habits of doing something strategic before, during and after reading a text:

Before reading a text: Examples of strategies: previewing the text for orientation to its content; presetting with questions that need to be answered; calling to mind what one already knows about the topic

During reading: Examples of strategies: periodically trying to summarize; highlighting important parts of the text; dealing with comprehension breakdowns; taking notes; looking up new words

After reading: Examples of strategies: summarizing the text, reacting to the content, taking notes

Most competent readers engage in some such activities – without thinking about it – on those occasions when comprehension is important. These procedures are habitual, based on years of personal experience that have convinced readers that if they do not do something special when reading lengthy texts, they will probably not understand or remember much of what they read.

Preschoolers use simple strategies, largely within the context of physical tasks, like seeking help while cutting with scissors, putting their things away in their cubby so they can find them, and the like. School-age children are expected to be strategic in relation to their abstract cognitive and learning tasks. For example, they are taught to check their work for errors before handing it in; to take organized notes during lectures, and to use systematic study procedures.

Being a strategic thinker and learner presupposes that the student

- has a reasonable understanding of her own abilities so that she can make judgments about what tasks are easy and what tasks are difficult – therefore requiring special effort *(self-awareness)*
- has goals that she wants to accomplish *(goal setting)*
- knows that plans must be made to accomplish goals and can make plans *(planning)*
- can initiate strategic behavior *(initiation)*
- can inhibit impulses that are inconsistent with goal-directed behavior *(inhibition)*
- can pay attention to how she is doing *(self-monitoring)* and evaluate performance in relation to the goals *(self-evaluation)*
- can flexibly revise plans and change strategies in response to feedback *(strategic behavior)*

These are the core components of self-regulation or executive functioning; therefore all of the procedures used to promote self-regulation are important in helping students to become more strategic thinkers and learners. **[See Tutorial in Self-Regulation Routines]**

WHY ARE COGNITIVE AND LEARNING STRATEGIES IMPORTANT FOR MANY STUDENTS AFTER TBI?

Cognitive and learning strategies are important for all students. However the theme is of special importance for students with TBI because they often have cognitive impairments (e.g., weak memory, fluctuating attention, poor organization) and because damage to the frontal lobes makes strategic thinking and learning more difficult for them. That is, they are in greater need of strategies, but being strategic is harder than it would be without the injury. To make the situation even bleaker, many students with brain injury are relatively unaware of their needs – or possibly in a state of emotional denial – making the teaching of compensatory strategies even more difficult. **[See Tutorial in Self-Awareness]** Therefore, teaching strategic thinking and learning needs to be a deliberate and intensive process for these students.

WHAT ARE THE MAIN THEMES IN INSTRUCTION AND SUPPORT FOR STUDENTS WHO NEED TO USE COGNITIVE AND LEARNING STRATEGIES?

Teaching students to be strategic thinkers and learners is a major enterprise, covering a great deal of territory and requiring many years of effective teaching. To focus that teaching, educators should be aware of all of the characteristics of good strategy users. Each of these characteristics then becomes a goal for the student with brain injury.

1. Goals: Good strategy users have goals to which strategies are relevant.

2. Metacognition: Self-Knowledge: Good strategy users know that their performance needs to be enhanced (in certain areas), that strategies enhance performance, and that they are capable of using strategies.

3. Metacognition: Awareness of Task Difficulty: Good strategy users are capable of perceiving the difficulty level of tasks and the consequent need for special effort.

4. Metacognition: Strategy Specific Knowledge: Good strategy users know when, where, how, and why to use specific strategies.

5. Initiation/Responsibility: Good strategy users take responsibility for their successes and failures, and initiate strategic behavior when it is necessary.

6. Self-Monitoring: Good strategy users can monitor the effectiveness of their performance with strategies so that improved performance can be its own reward and ineffective performance can be changed.

7. Flexibility: Good strategy users know several strategic procedures and can select the procedure that is useful for a specific problem.

8. Automaticity: Good strategy users use strategies as a matter of routine so that many strategic procedures become automatic and require little effort or planning.

9. Working Memory: Good strategy users have adequate working memory so that they can think about the task at hand and strategic procedures at the same time.

10. Impulsiveness: Good strategy users are not so impulsive that they act before taking critical information into account and considering strategies.

11. Anxiety: Good strategy users are not so anxious about performance that they neglect strategies because of an overriding fear of failure.

12. Support: Good strategy users receive support from teachers, parents, and others for the use of strategies.

13. Content Knowledge: Good strategy users know enough about the subject that they can meaningfully apply strategies within that domain of content.

Implicit in this list of characteristics of good strategy users is the fundamental idea that teachers and parents must not take over all aspects of executive functions/self-regulation for students with disabilities. It is tempting for teachers to unconsciously do exactly that: "I, the teacher, will take responsibility for (1) knowing what you are good at and what you need help with, (2) setting your goals, (3) planning how to achieve the goals, (4) ensuring that you start your work, (5) ensuring that you are not distracted, (6) monitoring and evaluating your performance, and (7) trying new strategies in the event of failure." If this is how teachers (and parents) behave, they will give themselves great practice in strategic behavior, but deny the student the practice that she needs: the teacher improves; the student doesn't. This is not to say that students should be left to their own devices. Rather, teachers and parents provide the supports necessary for the student to experience success, but then pull back on those supports as it becomes possible to do so – the entire time holding in mind this model of what it is to be a strategic thinker and learner.

The 13 points outlined above are goals of strategy intervention. Critical features of the strategy teaching process include the following:

1. Context Sensitivity: Cognitive and educational strategy interventions need to be delivered within the context of relevant curricular (school) content; if not, transfer to real-life activities is unlikely.

2. Direct and Intensive Instruction: Strategic academic skills require direct instruction along with a large number and variety of authentic application trials. Strategies should not be implicit – quietly embedded in academic instruction in the hope that the student will discover them. Rather the strategic procedures should be explicitly described, modeled, taught, and promoted. The student should be clear about the reason for the strategy.

3. Emphasis on Strategic Thinking: Even as strategies are being taught explicitly, there should be ongoing emphasis on the reality that strategies are clever solutions to difficult problems and that using strategies is being smart about achieving ones goals. That is, there should be a general focus on being a strategic student, not just a specific focus on acquiring specific strategies.

4. Long-Term: The shaping of effective cognitive and academic strategic habits and skills requires years of high quality instruction and successful practice. Each school year should pick up where the previous year ended with respect to strategies and both maintain the strategies of the previous year and add elaboration or new strategies.

5. Intensive: Strategy intervention needs to be part of the daily regimen. Ideally similar strategies should be taught across many content areas and also related services (e.g., speech-language therapy, occupational therapy).

6. Personally Meaningful, with a Focus on Correct Attribution: Students need to know that they are responsible for their academic success and that their strategic efforts will be meaningfully rewarded. This requires large numbers of experiences of seeing improved performance and success using strategies.

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Tutorial: Conversation & Cognition

WHAT IS A CONVERSATIONAL APPROACH TO COGNITIVE FACILITATION?

Studies of cognitive development in children have demonstrated the profound effects of the conversational style of parents and other adults on the subsequent development of cognitive abilities in children. Children learn to think, remember, plan, and organize their thoughts and their language in part as a result of interactions with adults and other, more proficient, children. When these conversational interactions are well conceived and implemented, the child's cognitive growth results from internalizing the thoughtfulness that is present in the interaction. In other words, adults teach their children how to think much as Socrates taught his philosophy students how to think and religious leaders teach their disciples how to think – by interacting with them in a way that reveals higher levels of thoughtfulness.

These cognition-enhancing interactions can be about any topic and take place at any time. Many families organize dinner time in a way that allows for conversations about topics of interest to the students. And bed time reading is another ideal occasion to engage in these positive conversations. Dinner time and bed time conversations may be the best occasions over the course of the day for truly effective "cognitive rehabilitation".

A positive style of interaction that contributes to the child's cognitive growth has three important features:

1. **Collaboration:** These conversations are not thought of as an opportunity to have the child perform and answer a string of "testing" questions. Rather the adult engages the child as a partner – a collaborator – in exploring topics and talking about important matters. The tone is, "We are doing this together; we will help each other; we will have a good time."

2. **Elaboration:** While engaged in these conversations, adults maintain and extend topics, showing the child the many ways in which things and events in the world can be understood. Thoughtfulness emerges in the interaction, a thoughtfulness that the child gradually appropriates and makes his own thinking system.

3. **Fun:** These conversations should be considered fun and not work or drudgery.

WHY IS A CONVERSATIONAL APPROACH TO COGNITIVE FACILITATION IMPORTANT FOR MANY STUDENTS AFTER TBI?

Collaborative and elaborative interactions with adults are important for all children. However, they are particularly important for students with TBI for several reasons. First, these students typically have cognitive impairments in the domains of organization, memory, and planning, domains to which collaborative and elaborative conversations are known to contribute in a positive way. Second, these students experience a great deal of failure and frustration compared with the ease with which they could do things before the injury. Therefore interaction that is not "interrogational" – in which there is no performance and no failure – is important for these students. Third, students with brain injury have considerable difficulty transferring cognitive skills from training contexts to real-world contexts. Therefore, using real-world interactions about real-world topics is an ideal context for this "cognitive rehabilitation".

WHAT ARE THE MAIN THEMES IN A CONVERSATIONAL APPROACH TO COGNITIVE FACILITATION?

Video Introduction to Conversation and Cognition
Video Illustration: Conversation Between a Preschooler and His Dad
Video Illustration: Conversation Between Two Older Boys and Their Dad
Video Illustration: Conversation Between Two Older Boys

The following lists of conversational procedures – general procedures, collaboration procedures, and elaboration procedures – can be used by parents and teachers as a guide to how they can turn everyday interaction at the dinner table or in the car or anywhere into high quality cognitive facilitation for the student. Parents and teachers who have gotten into the habit of "performance-oriented interactions" (e.g., quizzing the student) report that it takes a great deal of practice and discipline to become competent in use of these with these positive conversational approaches. These parents also report that when they do become "competent", they enjoy their interactions with children more and see the positive effects on the children.

A topic that many parents like to talk about with their children is the day at school. Unfortunately, the question, "What did you do at school today, John?" is usually followed by a terse, "nothing." Therefore, at the elementary school level, staff are urged to make photo albums of all the places and events in the school to send home with the students to serve as retrieval cues during conversations about the school day. In addition, teachers are encouraged to write a list of the day's activities at the end of the day, duplicate the list, and send it home with the students. In this way, parents know what happened in school, the child has the visual photo retrieval cues, and an enjoyable collaborative and elaborative conversation about the day at school is possible at the dinner table.

GENERAL PROCEDURES: Facilitating conversation should always focus on parents and teachers:

1. Being playful and showing enjoyment (e.g., joking, teasing, playing with words, laughing, acting animated)
2. Using the language of thinking and organizing (e.g., "Let's think about that" "Let's try to organize – connect these things") and remembering (e.g., "I didn't remember that; but now that you reminded me, I do remember.")

COLLABORATION PROCEDURES: Parents and teachers can model conversational approaches to cognitive facilitation by engaging the student in a collaborative exchange. In these conversations, the adult does the following:

Collaborative Intent

1. Shares information versus routinely asking questions or in other ways testing the child
2. Uses collaborative talk (e.g., "Let's think about this") versus talking like a trainer
3. Communicates understanding of student's contribution (e.g., "I see what you're saying; that's a good idea")
4. Invites the student to evaluate his own contribution (e.g., "What do you think about that; does it sound right to you?")
5. Confirms the student's contributions (e.g., "You're exactly right about that")
6. Shows enthusiasm for the student's contributions (e.g., "I like the way you think!")
7. Makes effort to establish equal leadership roles (e.g., "Let's think about this the way you want to think about it.")

Collaborative Support

1. Gives information when needed, within statements or questions (e.g., “I think you were probably tired at the time, which is why you got upset”) versus ongoing quizzing
2. Makes available memory and organization supports (e.g., calendar, photos, graphic planning systems, memory book, gestures)
3. Gives cues in a conversational manner (e.g., “If I’m not mistaken, the first thing you do at school is reading, right?”)
4. Responds to errors by giving correct information in a nonthreatening, nonpunitive manner (e.g., “I remember that differently; I remember …”).

Emotional Support

1. Communicates respects for the student's concerns, perspectives and abilities (e.g., “I know that in your head it’s a big deal – and that makes sense to me”)
2. Explicitly acknowledges difficulty of the task (e.g. "It's hard to put all these things in order, isn't it?")

Positive Style of Questions

1. Asks questions in a non-demanding manner (e.g., “Could you help me understand why …”)
2. Asks questions in a supportive manner (e.g., questions include needed cues: “Do you need to get the paint first?” versus “What are you supposed to do first?”)

Collaborative Turn-Taking

1. Takes appropriate conversational turns versus interrupting or shifting topics abruptly
2. Helps the student express his thoughts when difficulties arise (e.g. word finding difficulties)

ELABORATION PROCEDURES: Parents and teachers can facilitate cognitive development by modeling ways to elaborate conversations. In these conversations, the adult does the following:

Elaboration of Topics

1. Introduces/initiates topics of interest with potential for elaboration
2. Maintains the topic for many turns versus rapid shifts of topics
3. Contributes many pieces of information per topic; connects more and more pieces of information
4. Invites elaboration (e.g., "I wonder what would happen if …").

Elaborative Organization

1. Conversationally organizes information as clearly as possible
    1. sequential order of events (e.g., First we…, then we…")
    2. physical causality (e.g. "The radio’s not working because it got wet.")
    3. psychological causality (e.g., "Maybe you don’t want to do it because you’re scared.”)
    4. similarity & difference (e.g., "Yes, they’re the same because…; they’re different because")
    5. analogy & association (e.g., "That reminds me of… because…)
2. Reviews the organization of information (e.g., “Hold on; we’ve talked about a lot of things; let’s see if we can put it all together.”)
3. Makes connections when topics change (e.g., “I think you brought this up now because you saw a connection between …. and …..”)
4. Makes connections among day to day conversational themes (e.g., This reminds me of something we talked about yesterday at dinner…”)

Elaborative Explanation

1. Conversationally adds explanation for events (e.g., "Maybe the fact that you were sick at the time had something to do with it.")
2. Invites explanations for events (e.g., Why do you think that happened?")
3. Invites discussion of problems and solutions (e.g., "I wonder whether we can think of a better way to handle this if it comes up again.")
4. Reflects on the student's physical and psychological states (e.g., "You must have felt miserable about that") and invites the student to reflect on her physical and psychological states (e.g., "Can you tell me how you felt about that?").

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Tutorial: Errorless Learning

WHAT IS ERRORLESS LEARNING?

Video Illustration of Errorless Learning

As the name implies, errorless learning refers to teaching procedures that are designed in such a way that the learner does not have to – and does not – make mistakes as he or she learns new information or new procedures. Errorless learning has been contrasted with trial and error learning in which the learner attempts a task and then benefits from feedback, whether the attempt was correct or incorrect.

Trial and error learning may be more effective for students who (1) are more often than not correct, (2) are reasonably confident in their abilities, (3) are able to remember their learning experiences, and (4) are able to remember and use the feedback that they received. Trial and error learning may have the added advantage of producing deeper understanding – but only for those individuals who remember the learning experience. In contrast, errorless learning may be more effective for students who frequently make mistakes, who lack confidence (or may be frankly anxious), and/or who do not remember their learning experiences and the feedback that they receive.

WHY IS ERRORLESS LEARNING IMPORTANT FOR MANY STUDENTS AFTER TBI?

Severe Memory and/or Intellectual Impairment: Errorless learning has been shown to be the most effective way to teach any content (information, rules, procedures, habits, and the like) to individuals with TBI who have significant cognitive impairments and/or severe specific memory problems.

Memory is one of the cognitive functions most commonly affected by TBI. Memory problems are common because (1) damage to the hippocampus in the limbic system of the brain makes it more difficult for information (academic information, everyday memories) to "stick" without special effort, and (2) damage to the frontal lobes makes it more difficult to use the special "strategic" procedures that facilitate retention of information. **[See Tutorials on Memory; (explicit and implicit memory); Cognitive and Learning Strategies]**

Prevention of errors and ensuring errorless learning is the preferred approach in the classroom for many reasons, including the following:

1. Errors "stick" in memory because of emotionality: Errors seem to "stick" in memory more readily than correct responses for students with significant memory problems. This may be because errors are associated with embarrassment or anger or other strong emotions that "drive in" the incorrect response and make that response more likely the next time. If the student does not remember that the response was an error – at the level of consciousness he may have forgotten the entire experience – then the error will continue to be produced and may be difficult to eradicate. This is one important reason to minimize errors in the learning experiences of students with memory impairment.

2. Errors may "stick" in memory because they are self-generated: Errors may "stick" more readily because erroneous responses are self-generated and self-generated responses may be more likely to be retained. This phenomenon creates an interesting challenge for teachers: How can teachers create errorless learning routines while at the same time giving students the sense that they are generating their own responses? Skilled teachers seem to be able to do this. It means that teaching needs to be more than dull rote repetition of easy material. Rather the learning experiences should be fun and students should feel that they are contributing, but with assurance from the teacher that they are most often correct.

3. Significant anxiety can result in increased errors: Errorless learning procedures are important for students who experience significant anxiety when they are threatened with failure. For reasonably confident

students, a little anxiety can heighten attention and retentiveness; therefore it may facilitate learning. However, serious anxiety can substantially interfere with acquisition and retention of information. Some students with TBI are anxious because they are perplexed about what they can do and what they can't do after the injury. Others are anxious because of large amounts of unexpected failure after the injury. Still others are anxious because of changes in brain function. In any of these cases, teaching/learning routines designed to minimize errors are important to reducing anxiety and enhancing overall performance.

4. Significant discouragement, sadness, and/or depression can result in increased errors: Errorless learning procedures are also important for students who are discouraged or frankly depressed about their overall abilities after the injury. Because of all the losses they may have experienced (e.g., loss of abilities, loss of activities, loss of friends), many students with TBI experience depression at some stage of their recovery in reaction to the changes in their lives. In these cases, teachers should work hard to ensure as much success as possible. Errorless learning procedures are one tool to achieve this goal

WHAT ARE THE MAIN THEMES IN ERRORLESS LEARNING INSTRUCTION AND SUPPORT?

It is not always easy to anticipate students' difficulties and create teaching routines that guarantee success or "errorless learning". Some students impulsively produce answers or other responses that are incorrect. Other students are so inconsistent from time to time that a task thought to be easy for the student may unexpectedly be difficult on a given occasion. Despite these difficulties, the goal of teaching without having the student make mistakes is important for many students.
[See Tutorials on Instructional Routines; Apprenticeship Teaching Performance-Oriented versus Support-Oriented]

What follows is a sampling of procedures that can be part of instructional routines that facilitate errorless learning:

1. Adjust your expectations appropriately. Do not ask for student responses unless you are at least 90% sure that the student is prepared to give the correct response.

2. Make sure that students are completely clear about what is expected of them. This may mean (a) giving models of correct responses or having models available for the student to look at, (b) ensuring that the instructions are very clear and well understood by the student, (c) doing the task collaboratively with the student before asking him to do it by himself, and (d) gradually withdrawing your support – and being prepared to offer more support in the event of difficulty. [See Instructional Routines; Advance Organizers]

3. If necessary, **complete the task collaboratively** with the student. "Let's do this together" is a better starting activity than "Let's see if you can do this" for students who need errorless learning. Or "Let's figure out what this means" is a better orientation to a reading comprehension task than, "Now, explain to me what that passage means." **[See Tutorial on Apprenticeship Teaching.]**

4. Make the task doable by either (a) breaking it into parts and teaching the parts separately or (b) giving the student responsibility for only one or two components of a larger task while you do the rest. For example, the task of remembering a story that was read can be made doable by asking the student to listen for only one fact in the story and subsequently asking him to remember only that one fact. Alternatively, the teacher and the student can collaboratively retell the entire story, with the student contributing only one or two components. The advantage of the latter approach is that the meaning of the entire story is held together rather than being fragmented into parts. In either case, gradually add components as the student achieves mastery.

5. Anticipate problems and "pre-correct". For example, if the student is reading and the next sentence has a word in it that you doubt the student can read, say something like, "I see a tricky word in the next sentence – the word is X – let me know if you need help when you get to that word."

6. Provide adequate cues. The cue can be the entire answer (e.g., "I think these two numbers add up to 13; what do you think?") or a sentence completion cue (e.g., "The president at the time was Abraham … That's right, Lincoln") or a semantic orienting cue (e.g., "The branch of government responsible for that… let's think about that… clearly it's not the legislative branch… it must be the… you know the judges and courts … that's right, judicial; the judicial branch of government"). Multiple choice cuing may be helpful (e.g., The president at the time was a. Lincoln, b. Washington, or c. Cleveland). The cue should be strong enough to elicit the correct response. It would NOT be helpful, for example, to give a letter cue (e.g., "The capitol of Wisconsin is MMM…") which might just produce an error response either spoken or just thought. Furthermore, with letter cues of this sort, teachers often create a feeling in the student of being quizzed for the sake of being quizzed and may therefore cause a negative reaction. You should rather start with a cue that is strong enough to elicit the correct response the first time and is presented in a natural way that doesn't seem like a quiz.

7. Ensure large numbers of successful repetitions to ensure learning. Students with significant memory problems may need to learn material much like we learn habits or rote procedures – with large amounts of successful repetition.

When you look back at the lesson after it is completed – or back at the instructional day as a whole – be sure that the student has been successful at least 90% of the time. Students with significant memory and learning problems are often successful less than 50% of the time, sometimes much less. This rate of failure explains much of their discouragement, resistance, oppositionality, and possibly also their retention of erroneous information or mistaken procedures.

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Tutorial: Instructional Pacing

WHAT IS INSTRUCTIONAL PACING?

Instructional pacing is the rate at which instructional activities occur or at which specific "learning trials" are presented to the student. Teachers often think of learning trials as questions that they ask the student or other types of discrete student performance (e.g., completing a math problem). But learning trials can include any student activity that results in learning. Listening to the teacher talk or discussing issues with peers or working on a project can all be considered learning trials. The rate at which these activities occur is called instructional pacing.

WHY IS INSTRUCTIONAL PACING IMPORTANT FOR MOST STUDENTS AFTER TBI?

Many students with TBI have slowed information processing due to diffuse axonal injury **[See Tutorial on Diffuse Axonal Injury]** or other types of damage common in TBI. On the surface, slowed processing would seem to require a slow instructional pace. On the other hand, many students with TBI have difficulty regulating their attention. Slow-paced tasks can contribute to losing attentional focus. Furthermore, when the instructional pace is slow, it may not be possible to secure enough learning trials (repetition) for the student to learn.

Fortunately, it is possible to resolve this dilemma. When all aspects of instructional routines are very well understood by the student, it is possible for even slow processors of information to keep up with a relatively brisk pace of instruction. There is an analogy in playing video games. Unfamiliar games seem to move very fast and it is impossible to keep up. But when the game becomes very familiar and much of the activity becomes background that one doesn't need to pay attention to, then the game seems to slow down and it becomes possible for even slow processors of information to play fast-paced video games.

It has been shown that for most students with learning and other cognitive problems, relatively fast-paced instruction is most useful (assuming they are familiar with the instructional routine: **(See Tutorial on Instructional Routines)**. The students can more easily maintain their focus and they receive the large number of learning trials that they need.

WHAT ARE THE MAIN THEMES IN INSTRUCTIONAL PACING?

1. Instructional Routines: Instructional routines should be well understood and rehearsed until they become automatic. This includes the materials, the introduction, the teacher's language, the student's roles and response modes, the general progression of the lesson, and the like. Understanding and automaticity are a combined result of explicit orientation to the instructional routine and daily consistent repetition. **[See Tutorial on Instructional Routines]**

2. Relatively Brisk Pace: Within well understood instructional routines, the pace of instruction should be as rapid as it can be tolerated by the student. When new material is presented, the pace should be slowed to the tolerance of the student, and the new material can be highlighted and repeated as needed. But during relatively routine phases of the instructional routine, the pace should be as brisk as can be tolerated by the student.

3. Slower Pace When Presenting for New Information: Instructional pacing should be slowed when the information is new or when the instructional routine has changed. It may then be useful to proceed fairly rapidly when the information is familiar and repetitive (e.g., review).

4. Modulation in Relation to the Student's Responses: Obviously the pace cannot be so rapid that it leaves the student behind. Teachers must always ensure that the student is keeping up with the lesson. This is determined by the student's attention and responses.

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Tutorial: Instructional Routine

WHAT IS AN INSTRUCTIONAL ROUTINE?

As we use the term "instructional routine," it refers to all of the elements of teaching/learning events other than the specific content to be taught and the specific materials used in the teaching. The elements of instructional routines include:

1. The teacher's words in getting the student's attention, explaining the task (lesson, project, activity), giving directions, offering assistance, giving feedback (and correction if necessary), reviewing, summarizing, and the like
2. The materials that are available to help the student, including visual prompts, visual organizational supports, models of the finished product, and the like
3. The student's role and expected contribution and responses
4. The amount and type of assistance offered to the student
5. The instructional pacing, number of learning trials, ratio of reviewed to new material, and the like
6. Environmental components: place, other students, supports to enhance attentional focus
7. Self-regulation/executive function components: the student's role in identifying difficulty level, setting goals, making plans, initiating, inhibiting, self-monitoring and evaluating, strategic thinking/planning [See Tutorial on Self-Regulation/Executive Function Routines]
8. Motivational components: interest level of the task and materials, engaging style of the teacher, possibilities for fun, rewards for success (e.g., praise), natural consequences for failure (e.g., poor grade), and the like

WHY ARE INSTRUCTIONAL ROUTINES IMPORTANT FOR MOST STUDENTS AFTER TBI?

Students with TBI may have significant memory/learning problems, may have difficulty gaining clear orientation to their tasks, may be disorganized, may have difficulty controlling their attention, may process information slowly, may not be able to determine what will be easy and what will be difficult, may have trouble identifying key from irrelevant information, and may become easily discouraged because tasks that were once easy are now difficult. In any of these cases, well planned and well understood routines of instruction are helpful

WHAT ARE THE MAIN FEATURES OF INSTRUCTIONAL ROUTINES THAT ARE IMPORTANT FOR MANY STUDENTS WITH LEARNING AND OTHER COGNITIVE PROBLEMS AFTER TBI?

It should be noted that some instructional curricula include specific guidance in most of the following domains. Whether they do or do not, it is well for teachers to make deliberate decisions about each of the following elements of an instructional routine.

1. A well established and understood routine: Students should thoroughly understand the sequence of activities that comprise the instructional routine and their role in it. The routine itself should become a habit – or background – so that the student's cognitive resources can be focused on the material to be learned. The instructional routine includes the transition into the lesson and the transition out of the lesson, which are especially important components for students who have difficulty with transitions. Many students with TBI have difficulty becoming oriented to tasks. They may also have problems regulating their attention and processing information quickly. All of these problems can be addressed to some degree with well established and well understood routines. (See Tutorial on Transition Routines)

2. The student's understanding that he or she will be successful: Anxiety and discouragement are common among students who have lost some of their abilities as a result of brain injury. Thus it is important that students always know that they can be successful. This understanding is built with a history of success and with the confidence that comes with knowing that the teacher will collaborate with the student to get the job done if it is difficult. **[See Tutorial on Performance-Oriented versus Support-Oriented (Apprenticeship) Teaching]**

3. A simple "self-regulation/executive function script/routine" as part of the larger instructional routine: Many students with TBI have reduced insight into their strengths and weaknesses, are not good at setting goals or planning how to achieve them, have difficulty initiating or inhibiting, have difficulty monitoring their own performance and evaluating it, and are not strategic thinkers and learners. These students tend to benefit from "self-regulation/executive function routines". **[See Tutorial on Self-Regulation/Executive Function Routines]**

4. Adequate support to ensure "errorless learning": Many students with TBI have significant memory problems or have a long history of failure, frustration, and associated anxiety. These students benefit from errorless learning procedures. **[See Tutorial on Errorless Learning]**

5. A pace of instruction that is as rapid as the student can process: Many students with TBI have slowed processing of information as a result of diffuse axonal injury [See Diffuse Axonal injury] or other types of injury commonly seen after TBI. While it seems logical to slow the pace of instruction to ensure a student can follow the information provided, slowing the pace may result in increased difficulty maintaining attention and certainly results in fewer learning trials. Once instructional routines are well understood and the procedures to be followed assimilated by the student, the pace of instruction can and should be faster than might otherwise be recommended. **[See Tutorial on Instructional Pacing]**

6. Complete clarity in the student's mind about what is expected: One of the most important features of instructional routines for students with cognitive and learning problems is the clarity of the instructions or other types of task orientation. Often students' mistakes or resistance to tasks are a consequence of poor understanding of what is expected, possibly combined with fear that they will fail. Clarity can be achieved by ensuring that the student is paying attention before giving instructions, repeating the instructions, repeating in different words, writing or picturing as well as verbally presenting the instructions, providing a model of what the task will look like when it is done, and requesting that the student explain what he needs to do before beginning the task.

7. Organizational supports: Students with TBI often have organizational problems. **[See Tutorial on Organization and Organizational Supports]** These organizational problems are often more serious than they appear on the surface to be. Therefore, students usually benefit from advance organizational support. Advance organizers can be as simple as a checklist or outline of a task. Often the advance organizer is a graphic organizer for the task (e.g., a series of boxes and connecting arrows depicting the key elements of a story and their organization). In some cases the organizer can be as explicit as a series of photos kept in the student's organizer to outline the steps required in a given task.

8. Provision of a large number of learning trials: Repetition and Review: Students with learning difficulties after TBI require considerable repetition – a larger numbers of learning trials than their peers – in order to learn and internalize new material. They also need considerable review of what they have learned and cumulative review as they continue to learn in the school year. The trick for teachers is to provide additional repetition and review that the students need while also making the lessons interesting and fun. **[See Tutorial on Learning Trials]** Taping of new materials might allow the student additional options for repetition of new information to enhance learning.

9. Sufficient variation in presentation of learning trials: Ensuring large numbers of learning trials can easily result in boredom. Equally dangerous, if the materials and instructional tasks do not change, the student

may create such specific associations that the learned material or skill will not generalize or transfer to other materials or settings or topics. Therefore, the presentation of the learning task should be varied to some degree over the learning trials (stimulus generalization) and the response from the student should be varied to some degree over the learning trials (response generalization). [ **See Tutorial on** Transfer of Training; Generalization]

10. Gradual progression from easy to more difficult: All learning should progress from easy to more difficult tasks. There are two importantly different ways to guarantee this progression:

(a) Break a complex task into parts and teach the parts separately: The teacher can break difficult or complex tasks into component parts and teach the parts separately so that each step, skill, or concept is easier to master than if they were taught together within a unified whole. For example, the task of remembering the sequence of events in a story may be made easier by engaging students in "sequencing exercises" (e.g., beginning-middle-end) prior to expecting this skill to be applied to multi-component stories. Once the student demonstrates mastery in the sequencing exercises, he can be asked to retell a sequence of activities in a story. The presumed advantage of this procedure is that it makes it possible for the student to succeed with relatively simple tasks. The disadvantage is that it fails to retain the meaningfulness of the story. Furthermore, it assumes transfer of cognitive skills like sequencing from decontextualized exercises to functional application. This assumption is questionable. [**See**  **Tutorial on** Transfer of Training; Generalization]

(b) Maintain the integrity of the task, but complete the task collaboratively: For example, the teacher can engage the student in story listening and retelling, but within that integrated activity, give the student responsibility for only one or two components while the teacher does the rest. For example, the teacher and the student can collaboratively retell the entire story, with the student contributing only one or two components. The components of a story and their organization are then taught within the functional activity of listening to or reading stories and then retelling them. The advantages of the latter approach is that the meaning of the entire story is held together rather than being fragmented into parts and the concern about transfer or generalization is substantially decreased. Perhaps most important is that the task has been made easy enough for the student to be successful.

In either case, components of complex tasks are added as the student gains mastery.

11. Possibly varied student roles: Traditionally students play relatively passive roles during instruction. They are expected to follow instructions, complete assignments, answer questions, and the like. More active roles are sometimes useful to help manage behavior, heighten attention and engagement, and deepen understanding of the material. Active roles might include: (1) being the teacher's assistant, (2) providing peer support, (3) being engaged in "self-regulation/executive function routines" during the instruction. [**See**  **Tutorial on** Self-Regulation Routines]

12. Motivational supports: Motivators can be tangible rewards like stickers or points that can be "cashed in" later for valued rewards. These are called "extrinsic" motivators because they are not related in any direct or natural way to the task. Alternatively, a student may be motivated to read a story because he wants to understand and enjoy the story. This is called "intrinsic" motivation: the reward is internal to the activity. [**See**  **Tutorial on Intrinsic and Extrinsic Motivation]**

The advantage of extrinsic motivators is that they may be more effective for young or discouraged students. The disadvantage is that the use of extrinsic motivators has a tendency to destroy internal motivation. Therefore, systems of extrinsic motivators should evolve into a system of more natural and internal motivators as quickly as possible. This includes interesting materials and tasks that help to engage the student in learning without relying on extrinsic rewards that are not naturally related to the learning task.

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Tutorial: Learning Trials

[See also Tutorials in Instructional Routines; Instructional Pacing; Errorless Learning]

WHAT IS A LEARNING TRIAL?

A learning trial is any event designed to facilitate the learning of a skill, procedure, piece of information, or other content. Learning trials can vary from repeated practice of specific facts with the goal of internalizing those basic facts to a discussion of a novel to a scientific experiment. In each case, the goal is student learning as an outcome of the activity.

WHY ARE LEARNING TRIALS IMPORTANT FOR MANY STUDENTS AFTER TBI?

Many students with TBI have attentional, organizational, memory, learning, and other cognitive problems – and possibly also emotional and motivational problems – that together necessitate thoughtful planning and modification of learning trials. Among other things, students with TBI typically need considerable repetition – very large numbers of learning trials – in order to learn and internalize new material. They may also need considerable review of what they have learned and cumulative review as they learn more. The best approach is for teachers to provide the repetition and review that the students need while also embedding the teaching in application of these skills within new activities to ensure generalization (transfer) and maintenance of the learning. And successful teachers also make the lessons interesting (intrinsically motivating), fun, and success-oriented. **[See Tutorials on Instructional Routines; Errorless Learning]**

WHAT ARE THE MAIN FEATURES OF LEARNING TRIALS THAT ARE IMPORTANT FOR MANY STUDENTS WITH TBI?

What follows is a set of dichotomies that may help in making decisions about how best to teach students with some combination of cognitive, learning, and motivational problems. Thoughtful decision making is necessary in every individual case, guided by the considerations in this discussion.

MASSED VERSUS DISTRIBUTED LEARNING TRIALS:

Video Illustration: Massed vs. Distributed Learning Trials

Massed Learning Trials: intensive, repeated, back-to-back practice of a target behavior or skill

> **advantages:** relatively quick learning; may be needed for habit formation or internalization of a skill or process
>
> **disadvantages:** well documented problems with generalization and maintenance in many cases if the practice activities are not connected in a meaningful way to the activity contexts in which the skills are meaningful; possible boredom or other negative reactions

Distributed Learning Trials: practice trials are distributed among activities throughout the day:

> **advantages:** potentially facilitate generalization and maintenance (see "contextualized" below)
>
> **disadvantages:** may be inefficient in early stages of learning (i.e., not enough learning trials to have an effect)

Combination: It is possible and often desirable to create massed learning trials along with distributed learning trials in naturalistic settings. This combination may be critical for students who have learning

problems that necessitate large numbers of learning trials, but who also are concrete thinkers and learners and therefore have difficulty with transfer or generalization.

DISCRETE VERSUS EMBEDDED LEARNING TRIALS

Video Illustration: Discrete vs. Embedded Learning Trials

Discrete Learning Trials: The target skill is removed (for practice) from its place within integrated activities (e.g., practice specific grammatical forms or word meanings outside of the context of semantically and pragmatically meaningful communication)

> **advantages:** Some children may require discrete trials to discriminate and attend to the specific learning target; discrete trials may lend themselves to greater ease in "massing" the trials – creating adequate practice
>
> **disadvantages:** By removing the learning target from its meaningful context, one may inadvertently teach the wrong meaning (e.g., John learns to say "help" in response to "John, say 'help'" rather than in response to the need for help); well-documented problems with generalization; boredom

Embedded Learning Trials: Practice is embedded within activities natural for the targeted behavior (but not necessarily natural settings – e.g., could take place in "pull-out" therapy)

> **advantages:** potentially facilitate generalization and maintenance (i.e., the stimulus cues for the target behavior and responses to the target behavior are those that will elicit and maintain the behavior in natural activities)
>
> **disadvantages:** child may fail to focus on the learning target if the activity is too complex

Discrete: associated loosely with traditional behavioral approaches to teaching

Embedded: associated loosely with "naturalistic" language therapy activities

But please note: Many behavioral psychologists advocate the use of embedded learning trials for scientific behavior analytic reasons.

Combination: It is possible to combine discrete and embedded learning trials by having the student practice a targeted skill in a discrete manner, followed immediately by embedding the skill in a functional activity.

CONTEXT-SENSITIVE VERSUS DECONTEXTUALIZED LEARNING TRIALS

Video Illustration: Context-Sensitive vs. Decontextualized Learning Trials

Context-Sensitive Learning Trials: Learning takes place within a context (place, activity, people, stimuli and reinforcers) that is natural for the learner and the learning target. For example, learning reading comprehension strategies for specific types of reading takes place within the student's content classes, using the reading texts of the various content curricula (versus in a clinic room using materials other than curricular materials)

> **advantages:** potentially facilitates generalization and maintenance; stimuli and reinforcers are more likely to be natural, thereby promoting generalization/maintenance

disadvantages: may be difficult to achieve an adequate number of learning trials; may be difficult to ensure that the learner is focused on the learning target

Decontextualized Learning Trials: Practice is offered in a training context (place, activity, people, stimuli and reinforcers) without features of the natural environment

advantage: easier to ensure large numbers of learning trials; may be easier to ensure focus

disadvantage: may block generalization and maintenance

Combination: Again, it is possible to combine approaches, perhaps introducing a strategy outside of a natural application context, and subsequently applying and practicing the strategy in context. However, in the case of students who are concrete thinkers and learners (very young or frontal lobe injury), one must always be concerned about transfer of training (generalization).

PLANNED VERSUS INCIDENTAL LEARNING TRIALS

Video Illustration: Planned vs. Unplanned Learning Trials

Planned learning trials: The time, place, and activity for learning, as well as the specific teaching procedures, are planned by the teacher

advantages: easier to achieve an adequate number of efficient learning trials; easier to organize the teaching targets in an effective manner

disadvantages: if not natural, may interfere with generalization and maintenance

Incidental learning trials: teachers, parents, and others seize teachable moments when the opportunity to learn occurs naturally ("follow the child's lead")

advantage: may facilitate motivation and generalization/maintenance

disadvantages: may not provide for sufficient practice unless everyday people are included as teachers; may not support well organized teaching

Combination: Again, it is possible for teachers to plan specific learning trials, but also encourage other adults (e.g., assistants, parents) to capitalize on incidentally occurring teaching opportunities within a generally planned approach.

DELIBERATE VERSUS INVOLUNTARY LEARNING

Video Illustration: Deliberate vs. Incidcental Learning Trials

Deliberate: The learner's conscious goal is to learn or remember the information or acquire the skill (e.g., a student memorizes material in preparing for a test)

advantage: quicker learning for those capable of "trying to learn" (e.g., memorizing)

disadvantages: learning is less deep and therefore may not endure; impossible for children who lack the cognitive ability to understand learning as a goal and/or who lack deliberate access to learning strategies that need to be used when one is "trying to learn"

Involuntary ("incidental" in a second sense of this term): The learner's conscious goal is not necessarily to learn anything, but rather to complete the activity; learning is a bi-product of processing the learning target as a means to achieve the activity's goal (e.g., students write a "social story" with a goal of writing a nice little story, but incidentally learn a social skill in the process).

advantage: promotes deeper processing (understanding) and therefore endures longer

disadvantage: may require teacher creativity to design learning tasks

CONSEQUENCE-ORIENTED VERSUS ANTECEDENT-SUPPORTED LEARNING

Video Illustration: Consequence-Oriented vs. Antecedent-Supported Learning Trials
Consequence-oriented: The learner is asked to perform, with learning resulting from the feedback/reinforcement provided after the performance; improvement is indicated by increasing percentage of correct responses. **[See Tutorial on Traditional Training Model versus Apprenticeship Teaching]**

advantage: There is a long history of theory and evidence supporting this approach to teaching for several populations and teaching targets

disadvantage: This approach necessarily includes considerable failure, which is dangerous for some learners; "errorless learning" is known to be best for some populations of learners and requires antecedent supports

Antecedent-supported: The learner is provided with whatever support is necessary to produce the correct response, with improvement indicated by systematically decreasing levels of support (see "apprenticeship model" – also associated with "positive behavior supports" in behavioral psychology and some heavily scripted and support-oriented approaches to teaching)

advantage: There is little failure, which is important for those who need errorless learning because of their cognitive or emotional profile

disadvantages: Some people find it harder to document progress (not a real disadvantage); hard to mobilize needed supports in all contexts; for some people and some learning targets, failure is useful for efficient learning (i.e., trial and error learning)

Consequence-oriented: associated loosely with traditional operant behavioral approaches; however, not all "behaviorally oriented" teaching relies largely on consequences

Antecedent-supported: associated loosely with apprenticeship approaches and other "support" approaches

Combination: Many "behavioral" teaching approaches advocate rich antecedent supports (e.g., for errorless learning) along with organized consequences. Similarly apprenticeship teaching that focuses on antecedent supports does not neglect natural and logical consequences.

EXTRINSICALLY VERSUS INTRINSICALLY REINFORCED LEARNING TRIALS

Video Illustration: Extrinsically vs. Intrinsically Reinforced Learning Trials Extrinsically reinforced: Success is rewarded with a sticker, token, points or other reinforcer that is not naturally and logically related to the behavior in question

> **advantage:** Highly desirable extrinsic reinforcers may have the effect of engaging the student and changing behavior quickly
>
> **disadvantage:** Extrinsic reinforcers do not facilitate transfer to natural activities and may foster dependence on extrinsic reinforcement in the long run; many experiments with many populations have shown that reliance on extrinsic motivation destroys internal motivation

Intrinsically reinforced: Success is rewarded with the logical and natural outcome of the behavior. For example, communication success is rewarded with satisfying interaction; academic effort is rewarded with a good grade;

> **advantage:** Intrinsic reinforcement facilitates transfer to natural contexts and blocks undesirable dependence on extrinsic reinforcers;
>
> **disadvantage:** Natural and logical consequences of a behavior may not initially be strong enough to motivate the behavior in the case of a person with a long history of failure

Combination: Combining approaches may again be useful, for example using extrinsic reinforcers initially to engage the student, but then shifting as quickly as possible to intrinsic reinforcement because of the dangers associated with long term use of rewards that are not naturally and logically related to the behavior that is being taught. **[See Tutorial on Extrinsic and Intrinsic Motivation]**

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Tutorial: Organization and Organizational Supports

WHAT IS ORGANIZATION?

To be successful in school and in life, people need to be able to organize their things, their activities, their thinking, their writing, and their speaking. For students, organization of things includes keeping school papers in appropriate files/folders, keeping possessions in the cubby or locker in some semblance of order, and ensuring that there is some sensible storage system for clothes, school things, and other items in their room. Organization of activities includes maintaining a schedule and moving easily from activity to activity, following accepted social protocol in activities, like eating out, and organizing study time effectively to get everything done in the allotted time. Organized thinking includes placing ideas together in reasonable systems, being able to break large tasks into smaller tasks that fit together in a logical and reasonable way, solving problems in a step-by-step manner, and the like. Organized writing and speaking includes telling stories and describing events in an organized manner and recognizing the needs of the communication partner. Some individuals are extremely organized thinkers and can live effectively in a world of disorganized things. They don't need things around them to be neatly organized. Others who are not organized thinkers may need the things around them to be very well organized.

Cognitive psychologists use terms like "cognitive schema" or "knowledge structure" (organized mental representations within which isolated bits of information or isolated behaviors become integrated and meaningful) to refer to the mental realities that are the basis for virtually all meaningful, successful thinking and behavior in the real world. Cognitive schemas or knowledge structures are the basis for:

1. cognitive processes like remembering (thinking back in time in an organized way), planning (thinking forward in time in an organized way), grouping (putting items together according to salient attributes), sequencing (putting events together as they are organized in time) and other organizational processes;
2. language competence in the domain of organized discourse (e.g., understanding and producing narratives, writing essays, maintaining coherent conversations, and other forms of connected language);
3. activities of daily living like dressing, grooming, and eating;
4. successful social behavior in real-world social contexts.

Typically developing kindergartners have already internalized hundreds of these organizing schemes, which enable them increasingly to think, act, talk, and solve problems in an organized manner. These schemes range from very basic two-part associations that can be acquired in infancy – for example, drop an object; it falls – to complex social scripts – like the things, foods, activities, language, and songs that constitute a typical birthday party. In the latter case, there are many distinct pieces of knowledge that are integrated together to form the child's complex, but organized understanding of a birthday party. And it is this understanding that enables the child to act in a socially successful manner at the parties, to remember events that occurred, and to talk about the party in an organized manner.

Organizational schemas that include people and their activities are called scripts. For example, pieces of knowledge that are brought together to form the eat-at-McDonalds script include places (e.g., the restaurant, the ordering counter, the eating sections, the bathrooms), people and their roles (e.g., customers, clerks, cooks, managers), things (e.g., cooking items, serving items), apparel (e.g., the special clothes that the staff wear), language (e.g., "Would you like fries with that?"), and sequences of activities. By age 5, typically developing children have internalized a large number of these scripts, which help them to behave in an organized way in many places and under many circumstances, to engage in socio-dramatic play, to remember their experiences, and to talk about their experiences in an organized way.

Transition times offer adults opportunities to teach children many new cognitive schemas or knowledge structures. [See Tutorial on Transition Routines] When activities end with a review of what the child was trying to accomplish, what the plan was, what he did, and how it turned out, he has an opportunity to solidify that particular activity as a script, but also to internalize one of the most important self-regulation

routines, Goal-Obstacle-Plan-Do-Review. [See Tutorial on Self-Regulation Routines.] These important ways of thinking are further reinforced when the next activity begins with a statement of the goal and formulation of a plan. Thus transition routines offer adults an opportunity to teach children how to think in an organized way, how to plan, how to remember, how to talk in an organized way, and how to organize their behavior to achieve their goals in a way that is consistent with the interests of others. When these routines become internalized and habituated -- over time, across settings, and across people in the student's life – the student can be expected to handle transitions with greater ease and, more important, will be able to think in a more organized manner, with all of the advantages that go with organized thinking.

WHAT ORGANIZATION PROBLEMS ARE ASSOCIATED WITH TBI?

Organizing schemas like scripts, plans, and other mental models are processed and implemented by the frontal lobes. The frontal lobes of the brain are particularly vulnerable to brain injury, and thus, damage to frontal lobes accounts for much of the disorganized behavior of students with brain injury. Children who have been injured at a young age often have mastered very few of these organizing schemes, in part because they need many more learning trials than other children, but even more because adults typically give these children **LESS** rather than more exposure to the organizing schemes. Because of the disability, they may simply have fewer opportunities to experience the events in the world, and thus have less opportunity to form effective schemas. Students who are older at the time of injury have had greater opportunity to master a wide variety of organizational schemes, but may lose these schemes – or lose access to them – due to the brain injury.

WHAT ARE THE MAIN THEMES IN INTERVENTION AND SUPPORT FOR STUDENTS WITH ORGANIZATIONAL IMPAIRMENT?

Need for an External Advance Organizer

(Video Illustration of Advance Organizers)

One of the keys to teaching schematic organization or knowledge structures comes from the common sense adage, "If you don't know your way around the territory, you need a map." This certainly applies to physical organization, like getting around cities one has never visited before. It also applies to activities, as anyone will attest who has breathed a sigh of relief seeing a sequence of pictures following the dreaded words, "Some assembly required". The sequence of pictures that guides us through the assembly is like a map through the unfamiliar and complex activity. Similarly, PhD students are grateful for the lengthy detailed outline they are told to follow in writing their dissertation. A PhD dissertation is a large, multifaceted project, and without advance guidance provided by this "map", it can appear overwhelming to the brightest of students.

So a "map" in this broad sense of the term is an advance external organizer that can help with an organizationally complex task. For preschoolers, an organizer map can be as simple as a set of photographs, presented top-down, representing the daily schedule at home or at school. A preschool "map" is also represented by places that dictate specific activities and containers. The art corner is for art activities, the water table is for water play, the dress-up area is for pretend play, the snack table is for snack, cubbies are for my personal things, and so on. Thus more abstract ideas like activities and sequences and categories are "mapped" by physical spaces and containers. When these places are kept distinct, the preschooler is much more likely to behave in an organized manner.

By first grade, the places and photographs that are useful for preschoolers may be replaced by graphic organizers on paper. For example, a student who does not know how to tell or write an organized story will benefit from a chart – a set of boxes and connecting lines – that dictates what information to include and in what order. The chart might have three boxes next to each other at the top of the page for characters,

place, and time. These boxes would then be connected by a line to a large box immediately below representing the event that gets the action started, the initiating event. That box leads to the next, representing the characters' responses to that event. Below that would be a box for the characters' plan; then the unfolding action; and finally the resolution or end of the story. With this simple and organized map as a guide, even disorganized students can write well elaborated and well organized stories, which would be impossible without the map.

As the child ages into adolescence, graphic organizers shift to more structured planning tools such as written outlines and day planners with an emphasis on sequencing of events by time. These external organizers become essential in maintaining the organizational flow of day to day events. Most students will continue to need to rely on some sort of external organizer as a compensatory tool for the remainder of their lives.

As with all supports, the goal is to have the map available for as long as it is needed, but then gradually reduce dependence on physical supports as the student internalizes the organizational structure and it becomes a habit. **[See Tutorial on Graphic Organizers]**

Models of Completed Projects

A second critical support for students with organizational weakness is a very clear idea of exactly what they are trying to accomplish. "This is what it will look like when you are done" is guidance that teachers should be in a position to give their students. The model might be as simple as a filled in page of math problems. Or it might be a one page essay with three paragraphs. Or it might be an art project. The key idea is that students who have difficulty imposing organization on their thinking and behavior need a very concrete idea of what the outcome – the product – will look like. This also applies to college students who are always grateful when professors show them what a good essay looks like before asking them to write one of their own.

Advance Rehearsal

Rehearsal is useful as preparation for any difficult or stressful task. In elementary school, the first few weeks of the school year are a time to teach the classroom routines and scripts explicitly and with sufficient repetition so that the students habituate these routines and scripts. Some schools invite middle and high school students in a day early in the fall to walk through their schedule and gain some familiarity with places and routines. Parents often ask their children to practice what they are going to say before going solo to a party or other event. Thus rehearsal is a common sense procedure.

In school settings, it is well to ask students to rehearse transition routines before they are expected to negotiate the transitions on their own. When necessary, use of maps and graphic organizers should be utilized to ease the transition.

Cues and Prompts

Cues and prompts ("coaching") are a common support for all students, particularly those who are likely to get lost and then lose focus within the course of the organizational activity. .

Collaboration

When tasks are organizationally complex, it is useful for teachers or aides to offer their services as collaborators. "Let's get this done together" is a useful starting place. The student can then take over responsibility for more and more components as it becomes possible to do so. This systematic reduction of supports is critical for facilitation of the student's independence.

"This is Hard, I Need Help"

Whether it's a preschooler trying to tie her shoes or a graduate student writing a PhD dissertation, a critical skill when faced with organizationally demanding tasks is to ask for help. Teachers and parents should routinely remind students, "If it gets tough, ask for help." When students gain comfort saying, "This is hard; I need help", they can then be asked to identify why the task is hard, and then request specific types of help: "This is hard for me because ....; I need this kind of help to get it done....." **(See Tutorial on Self-Regulation Routines)**

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Tutorial: Retrieval & Retrieval Problems

WHAT IS RETRIEVAL?

There are three main aspects to memory or learning: **encoding** (i.e., putting the memory into ones head or knowledge base); **storage** (holding the memory there over time); and **retrieval** (pulling the memory out when needed). Thus retrieval is the act of remembering something that was previously learned or experienced. It can either be *deliberate* retrieval (i.e., trying to remember; using strategies to remember) or *involuntary/effortless* retrieval (i.e., memories or learned information or skills come to mind with no effort, possibly triggered by environmental events). Retrieval can include retrieval of words, information, skills, habits, or personal experiences.

WHAT RETRIEVAL PROBLEMS ARE ASSOCIATED WITH TBI?

Retrieval problems of one sort or another are associated with many types and locations of brain injury. Retrieval problems, including word retrieval problems, are among the most common symptoms of brain injury. **[See Tutorial on Word Retrieval]**

1. Difficulty retrieving words can be caused by damage to several parts of the brain because word meaning information is stored in many parts of the brain and involves large numbers of neural connections. Word retrieval problems are particularly associated with the "language zones" of the left hemisphere (toward the back and bottom of the left frontal lobe and front of the left temporal lobe) and with other parts of the frontal lobes that are associated with retrieval generally.
2. General difficulty with effortful or strategic retrieval (trying to remember) is usually associated with damage to the frontal lobes, common in TBI. Encouraging these students to try harder to remember may just make their problem worse.
3. Retrieval problems are also associated with anxiety. "Performance anxiety" is a common experience and everybody reports that it is harder to retrieve information or words when experiencing significant anxiety. Some degree of anxiety is common after TBI, possibly for specific neurologic reasons and possibly because so much in life is more difficult and frustrating after a brain injury. **[See Tutorials on Anxiety; on Instructional Routines; on Performance-Oriented versus Support-Oriented (Apprenticeship) Teaching]**

WHAT ARE THE MAIN THEMES IN INTERVENTION AND SUPPORT?

1. Understanding the Problem: As with all problems, step one is understanding the problem. Retrieval problems are easily misidentified as lack of knowledge. Psychological or speech-language testing helps to identify specific retrieval and word retrieval problems. One way to identify and document retrieval problems is to present tasks with different response requirements: free retrieval, cued retrieval, and recognition memory. If the student performs significantly better on cued retrieval and recognition memory tasks than on free retrieval tasks, then there is reason to believe that the student has a specific retrieval problem.

- **Free retrieval:** previously presented information or skills/procedures need to be retrieved from storage with no external support (e.g., "Tell me what you remember about the chapter you read.").

- **Cued retrieval:** Some cues are provided to structure and support the retrieval process (e.g., "You know that chapter you read? Let's think about **who** was involved .....? And where were they at the time? And how did it **start**?").

- **Recognition memory:** In this case, the individual does not have to retrieve information; rather the task is simply to affirm or deny. For example, true/false and multiple choice questions are

recognition memory tasks (e.g., "So, John, we need to think about who was in the story; was it Jane or Sally?").

2. Accommodations: Accommodations need to be made for students with retrieval problems in both testing and instruction. With all students who have specific retrieval problems, staff and parents need to use something other that free recall quizzing to find out what the student knows and to teach new information. These tasks are by definition difficult for students with retrieval problems, cause frustration, and do not allow the student to reveal what he knows. Therefore, adults should get into the habit of asking questions (if questions are needed) that embody some kinds of supports (cued retrieval or recognition memory).

Testing Accommodations: If a student has documented retrieval problems, then test procedures should use recognition memory tasks (e.g., multiple choice or true/false) rather than or in addition to free retrieval tasks. Retrieval tasks may simply reveal what you already know – that the student has retrieval problems. These tasks will NOT tell you what you want to find out with testing – namely what the student actually knows in his head.

Instructional Accommodations: Similarly, everyday instructional tasks should not be organized around teacher questions requiring students to retrieve information without support. This will simply frustrate the student and little teaching and learning will be accomplished. Apprenticeship teaching procedures can be used. These procedures do not rely on ongoing demands for unassisted performance from the student. [See Tutorial on Apprenticeship Teaching]

Conversational Accommodations and Supports: [See Tutorial on Word Retrieval]

3. Instructional Strategies to Assist Students with Retrieval Problems

Errorless Learning Tasks: With students who have significant and general memory problems, teachers should always try to use errorless learning procedures in their teaching. **[See Tutorial on Errorless Learning]**

Semantic Maps: With students who have relatively specific word retrieval problems, helping them to organize their word knowledge with "semantic mapping" is useful. **[See Tutorials on Word Retrieval; and Semantic Mapping]**

Elaborative Encoding: Multiple "Retrieval Routes": Providing a variety of associations – including multi-sensory associations – for new information may create useful "retrieval routes" to get at the information when it is needed. New information should be as well elaborated – in an organized way – as possible.

Retrieval Strategies: Teaching the student retrieval strategies can be effective, but only for students whose general cognitive functioning is at a high enough level that retrieval strategies can be remembered and used functionally. *Effortful retrieval* is retrieval guided by an organized retrieval procedure or strategy. In most cases, the goal is to activate related words or information or experiences so that the desired word or information or experience will be triggered.

For example, in searching for a word, it is wise to begin describing the concept in an orderly way, thereby activating retrieval routes that may trigger the desired word. **[See Tutorial on Word Retrieval]** Similarly, in searching for information, it is wise to begin reciting what one knows, thereby activating related information that may facilitate retrieval of the desired information. In attempting to remember the location of an object (e.g., ones keys), it is wise to retrace ones steps, again activating related experiences that may trigger the placement of the object. **[See Tutorial on Teaching Cognitive and Learning Strategies]**

Apprenticeship Teaching: In general, students with specific retrieval problems may benefit from teaching routines that are more toward the support-oriented (apprenticeship) end of the teaching spectrum than the performance-oriented end of the spectrum. **[See Tutorials on Performance-Oriented versus Support-Oriented (Apprenticeship) Teaching; and Instructional Routines]**

Practice Asking for Help: Students may need help remaining calm when faced with a retrieval problem – and then asking for assistance in retrieving the information. Asking for help is better than suffering in silence.

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Tutorial: Approaches To Teaching: Traditional Training versus Apprenticeship

[See also Tutorials on Instructional Routines, Errorless Learning, Instructional Pacing, Learning Trials

WHAT IS THE TRADITIONAL TRAINING MODEL OF TEACHING (PERFORMANCE-ORIENTED TEACHING?

Traditionally, teaching routines involve the following sequence of steps:

1. identifying a learning task
2. modeling the target behavior for the learner
3. demanding/requesting performance from the learner, possibly with cues or prompts to facilitate successful performance
4. providing corrective feedback (in the event of failure) or motivational feedback (in the event of success) to the learner after he or she performs

Most teachers routinely teach by asking questions (or demanding other types of performance) and then giving feedback. This type of teaching is very popular and can be successful for many students.

The following categories of students are NOT good candidates for teaching that highlights performance (remembering that even a simple question is a performance demand).

1. Anxious students: For students who are anxious, this style of teaching can be extremely problematic *because it highlights performance demands, which cause anxiety*. At the core of all such teaching, however pleasant and supported it may be, is the demand for performance. Performance demands typically induce anxiety in every human being, but particularly in students who are anxious and who frequently fail when required to perform.

2. Students with a significant history of failure: Students who are discouraged or depressed because of a substantial history of failure should experience as much success in school as possible. Apprenticeship teaching can be used to guarantee success, whereas performance-oriented teaching leaves more room for student failure.

3. Students with serious memory problems: For students with serious memory problems, errors often"stick" more readily than correct responses (perhaps because of the emotionality associated with errors). Thus errorless learning is preferable for these children versus performance-oriented teaching that opens the door to errors.

4. Manipulative students: Students who like to manipulate adults are given opportunities to manipulate when they are asked to perform.

5. Oppositional and defiant students: For students who are *defiant*, performance-oriented teaching can be dangerous because it *creates many opportunities for defiance*. It is far better for teachers to reduce the opportunities for defiance than to have to react to repeated acts of defiance.

WHAT IS THE APPRENTICESHIP MODEL OF TEACHING (SUPPORT-ORIENTED TEACHING)?

The alternative model of teaching is that associated with apprenticeship, which has the following sequence of components:

1. A meaningful task is identified.
2. The teacher makes sure the student knows exactly what the learning target looks like (e.g., via modeling, visual supports, etc.).

3. The teacher invites the learner to *participate as a collaborator* as much as possible (without demanding performance – that is, "we work as a team to ensure that the learning task is completed successfully").
4. The student acts independently only when fully ready to do so.

The learning occurs not as a product of "model+plus+performance demand+plus+feedback/reinforcement", but rather as a product of *supported participation*, with the learner accepting more and more responsibility as competence and confidence grow. In apprenticeship learning, there need be no errors – or associated anxiety and need to escape.

The simplest form of apprenticeship teaching occurs in the following math teaching routine:

Teacher: We need to figure out which of these piles is more; can we do it as a team?
Student: OK
Teacher: OK: there are 7 here and 4 here – I think this is more – what do you think?
Student: yes
Teacher: We did it! 7 is more than 4; let's say it together;
Both: "7 is more than 4"
Teacher: great; ready to do one alone? or do you want to do it as a team again??
etc

This is contrasted with a direct question, which may elicit anxiety in some students **[See Tutorial on Anxiety]** and defiance in others **[See Tutorial on Oppositionality]**. The teaching routines of Direct Instruction programs are organized around this routine of errorless learning – errorless because the student does the task with somebody else long enough to be confident when asked to do it alone. Furthermore, errors are "pre-corrected" – that is, if a teacher expects that the student will have difficulty, then the teacher offers the support needed to ensure that the student will be successful. When Direct Instruction teaching routines are well implemented, the students experience no anxiety – and learning can be fun. **[See Tutorial on Errorless Learning]**

Apprenticeship learning is used in many important types of teaching in which errors are unacceptable (e.g., resident surgeons learning surgery; apprentice plumbers, electricians, auto mechanics, and others learning their trades). It is also standardly used by parents in their interaction with young children. It is the approach to teaching that has been used throughout history and across cultures when the teachers know that the learning is extremely important and that errors need to be avoided. It is a teaching style that is used less commonly than performance-oriented teaching in schools; however, it is quite easy to implement. For example, in OT a block design task can be introduced as "We are going to take some of these blocks and make something that looks like this picture. C'mon, we can do this together." And then the student could be given more responsibility as he gains skill and confidence.

It is interesting to reflect on the fact that Direct Instruction programs – often thought to be purely performance oriented – use a teaching routine much like that described here as apprenticeship learning.

THE 90 - 90 RULE

A good rule of thumb in teaching students who are anxious, discouraged, or defiant, or who have a serious memory problem is the 90-90 Rule:

1. Ask the student to perform (e.g., to answer a question) only if you are **at least 90% certain that the student will be successful**. If you are not 90% certain, then provide the supports necessary to ensure that the student will be successful.
2. Make certain that **the student is successful in at least 90% of learning trials** (e.g., answering questions) over the course of the day. Students with disability often fail at an alarmingly high rate of failure, explaining much of their anxiety and negative behavior.

WHY IS APPRENTICESHIP TEACHING PARTICULARLY IMPORTANT FOR MANY STUDENTS WITH TBI?

Many students with TBI have severe memory problems, and therefore should not be forced to make errors in their learning (because errors "stick"). Many students with TBI are anxious and have a history of failure since the injury, particularly in relation to their standards of success from before the injury. And many students with brain injury have a long history of manipulativeness or oppositionality. For all of these reasons, students with brain injury are often strong candidates for apprenticeship style teaching.

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Tutorial: Word Retrieval & Word Retrieval Problems

WHAT IS WORD RETRIEVAL?

The terms "word retrieval" and "word finding" refer to the processes involved in mentally identifying and then producing the word or words needed to express a thought or name an object. Word retrieval is one among many types of information retrieval. **[See Tutorial on Retrieval]** Because words have two very different storage systems in the brain, word retrieval relies on the development of both systems.

Meaning (or Semantic) Storage System: The meanings of words are stored in the brain as a large number of connections and systems of connections among nerve cells. These connections correspond to what we call word associations. For example, when a person is asked "What's a sparrow?" she might reply, "A sparrow is a bird (category). Like all birds, they fly and sing and ...(actions); they're not used for food or much of anything except to look at and listen to (use/function); they have a beak and wings and skinny little legs and feet (parts); they are small and grayish and round, with a shrill call (attributes); they make their nests in trees and are found in the following locations in summer ... (location); and when I think about sparrows, I think about my uncle the bird man...(idiosyncratic associations)" The specific details are not so important here; however, the important concept is that word meaning is a set of more or less organized associations that correspond to large numbers of neural connections in the brain. These neural connections can encompass large and distant areas of the brain. Each meaning connection represents one "route" to that word in the brain.

Sound (or Phonologic) Storage System: In order to say a word, we also need to know what sounds go together to make the word. These sounds and their organization are stored in the phonologic storage system of the brain – again, a set of nerve cell connections, but this time not so wide spread in the brain.

Thus there are two storage systems and they need to work in harmony in order to support fast, fluent, and effortless retrieval of words.

Word retrieval problems occur when a student tries but fails to produce a word that is known to be part of his receptive vocabulary (i.e., he knows the meaning of the word and has produced it before). Word retrieval problems are indicated by the "tip-of-the-tongue" difficulties, by frustration at not being able to say what one wants, by frequent use of nonspecific words like "thing, stuff, watchamacallit" and the like, or by frank admission of retrieval difficulty (e.g., "I know the word; I just can't think of it").

Word retrieval problems might result in slow but accurate retrieval (i.e., there is a delay, but the student manages to retrieve the word), slow and inaccurate retrieval (i.e, there is a delay, and the word produced is incorrect), fast but inaccurate retrieval (the student retrieves a word quickly, but it is incorrect), or total retrieval failure (i.e., no word is produced). A speech-language pathologist might be able to document word retrieval problems by comparing the results of a receptive vocabulary test (i.e., understanding words) with an expressive vocabulary test (i.e., naming things or pictures).

WHY ARE WORD RETRIEVAL PROBLEMS IMPORTANT FOR MANY STUDENTS AFTER TBI?

Students with a wide variety of disabilities are known to have word retrieval difficulties. These include specific learning and specific language disability, reading disability, attention deficit/hyperactivity disorder, fluency disorders, and brain injury. Word retrieval problems of one sort or another are associated with many types and locations of brain injury. Difficulty retrieving words can be caused by damage to several parts of the brain because word meaning information is stored in many parts of the brain. Word retrieval problems are particularly associated with the "language zones" of the left hemisphere (toward the back and bottom of the left frontal lobe and top of the left temporal lobe) and with other parts of the frontal lobes that are associated with retrieval generally.

General difficulty with *effortful or strategic retrieval* (i.e., *trying to retrieve the word*) is usually associated with damage to the frontal lobes, common in TBI. Encouraging these students to *try harder* to remember or to retrieve the word may just make their problem worse. Retrieval problems are also associated with anxiety. "Performance anxiety" is a common experience and everybody reports that it is harder to retrieve information or words when experiencing significant anxiety. Some degree of anxiety is common after TBI, possibly for specific neurologic reasons and possibly because so much in life is more difficult and frustrating after a brain injury. **[See Tutorials on Anxiety and on Performance-Oriented versus Support-Oriented (Apprenticeship) Teaching]**

WHAT ARE THE MAIN THEMES IN INTERVENTION AND SUPPORT FOR STUDENTS WITH WORD RETRIEVAL PROBLEMS?

1. Understanding the Problem: As with all problems, step one is understanding the problem. Retrieval problems are easily misidentified as lack of knowledge. Psychological or speech-language testing helps to identify specific word retrieval problems.

2. Accommodations: Accommodations need to be made for students with word retrieval problems in both testing and instruction.

Testing Accommodations: If a student has documented word retrieval problems, then test procedures should use recognition memory tasks (e.g., multiple choice or true/false) rather than or in addition to free retrieval tasks. **[See Tutorial on Retrieval]** Retrieval tasks may simply reveal what you already know – that the student has retrieval problems. These tasks will NOT tell you what you want to find out with testing – namely what the student actually knows in his head.

Instructional Accommodations: Similarly, everyday instructional tasks should not be organized around teacher questions requiring students to retrieve information. This will simply frustrate the student and little teaching and learning will be accomplished. Apprenticeship teaching procedures can be used. These procedures do not rely on ongoing demands for unassisted performance from the student. **[See Tutorial on Apprenticeship Teaching]**

Conversational Accommodations and Supports: When students face word retrieval problems in everyday conversation, the situation is not quite so clear. Students with word retrieval problems differ in how they like conversation partners to help them. Supports should be negotiated individually with the student. Supports might differ from one communication partner to another. For example, the student might want a teacher to give him a hint about the start of a desired word, whereas he might not like his little sister to act like a teacher and give the same kind of hints. What follows are possibilities to be negotiated with the student and used with sensitivity. Some students may simply want the conversation partner to give them the sought after word if the partner knows it.

Here are some possibilities:

Direct Help: The conversation partner might say, "I think the word you're looking for is 'horse' – right?"

Indirect Help: The conversation partner might say, "Do you want me to say what I think the word is you're looking for? Do you want me to give you a clue? Do you want me to wait?"

Sound (Phonologic) Cues: The conversation partner might give a phonological cue, like "I think the word is ho… (horse)"

Meaning (Semantic) Cues: The conversation partner might give a semantic cue, like "It lives in a stable"

3. Instructional Strategies to Assist Students with Word Retrieval Problems

Direct Practice of Specific Words: In cases of extremely severe word retrieval problems, there may be value in having the student practice saying specific important words over and over. These words should be produced in response to a variety of stimuli, including the object, pictures of the object, printed words, related objects, and conversational stimuli.

Indirect Practice with Meaning (Semantic) Organizers: [See Tutorial on Advance Organizers] Each meaning association for a word is a potential retrieval route to that word. Therefore, word retrieval practice should include elaborating the meanings of words. However if this is done in a disorganized way, the word retrieval problems could get worse. Therefore it is important to have a consistent system for elaborating word meanings.

Staff can use a diagram (graphic organizer or "semantic map") for this purpose. The word to be elaborated is placed in a circle in the middle of the page. From this circle there are lines that radiate out like spokes on a wheel. At the ends of the lines are boxes for associated words. At the 12:00 position is the word's category or what kind of thing it is (e.g., a horse is an animal). At about 1:30 is a box for the actions that the thing does (if any)(e.g., a horse trots and gallops and races). At about 3:30 is a box for the uses or functions of the thing (e.g., a horse is used for farm work, riding, racing, etc). At about 5:30 is a box for important attributes (e.g., a horse is big, strong, fast, etc). At about 7:00 is a box for the thing's parts (e.g., a horse has four long legs, a long snout, a mane, a long tail, etc). At about 8:30 is a box for the locations where the thing could be found (e.g., a horse can be found in a barn, race track, field, circus). At about 10:30 is a box for other associations that might be unique to that student. (E.g., My uncle Harry raises horses).

There is no special magic in this particular "map" of word meanings. However, it does serve the important purpose of organizing the elaborated meanings as the student organizes more and more associations with a specific word.

The "map" plays one more critical role. When the student is stuck, she can be encouraged to start talking about the thing, but not randomly. Rather the diagram can be used to organize this circumlocution – or talking around the word. The circumlocution may help the student to actually retrieve the word. If not, at least she will be able to communicate the concept to the listener.

After the word elaboration is complete, it is important to put the word to use. This could be done by collaboratively writing a descriptive paragraph about the thing or perhaps writing a little story.

Compensatory Circumlocution Practice with Meaning (Semantic) Organizers: Circumlocution means "talking around a word without necessarily arriving at the word". Students with word retrieval problems can use a graphic organizer or "semantic map" to guide this "talking around the word" in an organized way. (See the previous section for an example of a semantic map.

Practice Using Nonverbal Support: Some students benefit from nonverbal supports for word retrieval. For example, when stuck for a word, the student might gesture or draw on paper or in the air. These nonverbal moves might help to cue the word. Alternatively they may successfully communicate the idea without producing the word.

Practice Asking for Help: Students may need help remaining calm when stuck for a word and asking for assistance in finding the word. Asking for help is better than suffering in silence.

Fun Family Play with Words: Word games are a useful way to spend idle family hours, for example during long car rides or during bedtime book reading. The games should be fun and not drill, and the child should experience a great deal of success. Among the possibilities:

1. Read with the student. All book reading activities can be useful. Books that discuss specific categories of knowledge are particularly helpful, for example books about vehicles, wild animals,

outdoor sports, occupations, and the like. In these cases, elaborative associations are made that can facilitate word retrieval.

2. Read riddle books or other books that play with words.
3. Tell jokes that involve word play.
4. Play word classification games (Let's see how many words we can think of starting with …; Tell me as many fruits as you can think of; etc)
5. Name several things and then guess the category that they belong to.
6. Play synonym and antonym games ("What means the same as…? What means the opposite of…?").
7. Play similarity and differences games ("How are … and … alike? How are they different?").

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Tutorial: Memory and Memory Problems

WHAT IS MEMORY?

Memory is one of the central components of human cognition, including the ability to take in information, process it, store it, and subsequently retrieve it when necessary. Thus the core processes of memory are encoding, storage, and retrieval:

Encoding: Processing information, organizing it, and marking it for storage
Storage: Holding information over time in what is ideally an organized storage system
Retrieval: Calling stored information to consciousness

Following TBI, both encoding and retrieval can be significantly impaired. However, storage (i.e., keeping information in storage after it has been effectively processed) is often relatively spared. Therefore, if information can be effectively processed and encoded, it is more likely to be retained, even though it may be difficult to retrieve. **Video Illustration of Types of Retrieval**

Memory Processes and Systems

Authorities on memory typically explain human memory by drawing a variety of distinctions among different types or aspects of memory. Understanding many of these distinctions is important for staff and family members working with students with memory and learning impairments.

Voluntary and involuntary memory: Encoding: Encoding of information for storage in long-term memory can be either involuntary (incidental, implicit) or voluntary (effortful, deliberate, strategic).

- **Involuntary encoding** occurs when the goal of the activity is something other than memory or learning, and memory occurs as a bi-product. For example, a young student may remember the names of geometric figures not by trying to memorize them, but rather because he was involved in an art project in which it was important to process the names of the geometric figures in order to complete the project. Young children tend to be good at involuntary or implicit encoding and weak at voluntary or effortful encoding.
- **Voluntary or effortful encoding** occurs when the goal of the task is to learn or remember (i.e., trying to learn or remember). The procedures used to achieve success in effortful encoding tasks are memory strategies (e.g., mentally rehearsing, organizing, or elaborating). Young children as well as individuals with frontal lobe injury tend to be weak at effortful or strategic memory/learning tasks. In fact, their ability to learn and remember may be reduced when they are told to "try to remember". Learning may be less effective under these circumstances because the child does not have or does not know how to use the strategies that would need to be used when "trying to learn or remember".
- **Voluntary and involuntary memory: Retrieval:** Retrieval can also be involuntary (often referred to as implicit retrieval) or voluntary (effortful, deliberate, strategic).
- **Involuntary or implicit retrieval** occurs when stored information is brought to consciousness with no effort to retrieve the information and often with no awareness that the information was stored. The information may be retrieved automatically when a cue triggers it.
- **Voluntary, effortful, or strategic retrieval** occurs when there is an attempt to retrieve the information, that is trying to remember. Young children (e.g., preschoolers) rarely benefit from the instruction to "try to remember" because they do not use memory strategies for this purpose. The same is true of developmentally young children and many children with frontal lobe injury. Voluntary retrieval is impaired by damage to the frontal lobes, common after TBI. Involuntary or implicit retrieval may be relatively intact even in the presence of damage to the frontal lobes and to the hippocampus (one of the primary brain structures for human memory and part of the limbic system located in the medial temporal lobes of the brain). **See Tutorial on Retrieval and Retrieval Problems**.

Retrospective and prospective memory: Retrospective memory is memory for past events. Prospective memory is memory for events in the future (e.g., remembering appointments; remembering to do an assignment). Both types of memory can be impaired by TBI, with prospective memory negatively affected by frontal lobe injury.

Verbal and nonverbal memory: Verbal memory is memory for language events or events encoded in language. Nonverbal memory is memory for events not encoded in language. Verbal memory tends to be impaired by damage to language centers of the brain, typically in the left hemisphere. Nonverbal memory may be relatively impaired by damage to the right hemisphere.

Sensory modality-specific memory: Memory can also be related to each of the senses (vision, hearing, touch, smell, and taste), with specific memory stores affected by damage to that sensory system.

In addition to these memory processes, memory can be understood by distinguishing a variety of memory systems in the brain:

Sensory, short-term, and long-term storage systems: In the past, it was common to distinguish three types of memory based on length of time the memory was stored.

- **Sensory store** refers to the very brief time that a sensation remains available to sensory consciousness.
- **Short-term store** refers to the period of time, from seconds to a few minutes, that information remains in consciousness, depending on efforts (e.g., mental rehearsal) to keep it in consciousness. Short-term storage is said to be limited in capacity (e.g., 7 plus or minus 2 units of information at one time in normal older children and adults).
- **Long term store** refers to the extended – possibly indefinite – storage of information in the knowledge base. Capacity of long-term storage is unlimited. Authorities often maintain that short-term storage is physiologically an electrochemical process whereas long-term storage requires protein synthesis for maintenance of information over extended periods of time.

Working memory and the knowledge base: In recent years, the concept of short-term memory has largely been replaced by that of working memory. Working memory refers not just to a holding space (like short-term memory), but rather to the processes used to hold information in consciousness and actively attend to it, filter out that which is irrelevant, and create associations that ultimately assist in transferring information from consciousness to the knowledge base. Therefore, there is conceptual overlap between definitions of working memory, attention, and organization. Working memory enables people to keep one or more thoughts active and possibly to relate the thoughts or create associations. Thus there is a large amount of cognitive activity included within the definition of working memory. Similarly, there is a large amount of brain tissue devoted to working memory tasks, notably dorsolateral prefrontal cortex, both left and right hemispheres. The left hemisphere is associated with manipulation of verbal information and the right hemisphere with visual-spatial information.

The term “knowledge base” refers to what was once called *long-term storage*. Widespread areas of cortex (more posterior than anterior) may be connected in neural networks to support stored memories of people, things, events, or series of events.

Declarative and procedural memory: Declarative memory (i.e., remembering or knowing that such and such is the case) is memory for facts of greater or lesser generality (e.g., I remember that George Washington was the first president of the USA; I remember that e=mc2). In contrast, procedural memory (i.e., remembering or knowing how to do something) is memory for procedures that can either be physical acts (like getting dressed or riding a bike) or habits/routines (like preparing toast and eggs for breakfast). After brain injury, declarative memory can be significantly impaired, while procedural memory remains relatively intact. Procedural memory may be relatively intact both in the sense of preserved procedures/routines from before the injury, but also the learning of new procedures, motor acts, or habits. Procedural memory, especially the motor aspects, is said to rely heavily on the basal ganglia and cerebellum. Declarative and

explicit memory systems appear to rely heavily on the hippocampus which is vulnerable in TBI because of hypoxic brain injury (reduction of the supply of oxygen to brain tissue).

Explicit and implicit memory: With respect to storage of information, explicit memory refers to memories that are stored along with some awareness that the memory is stored. Implicit memories are stored without an associated awareness that there is such a memory. The explicit/implicit distinction can also be used to refer to encoding rather than storage (explicit = deliberate, voluntary encoding; implicit = involuntary encoding). Finally, the distinction can also be used to refer to retrieval (explicit = deliberate, effortful retrieval; implicit = retrieval with no deliberate attempt to retrieve).

After TBI, explicit memory is often impaired while implicit memory may be relatively spared. This is one of the important reasons for using errorless teaching/learning procedures (see below; **see Tutorial on Errorless Learning**). Implicit memory may be relatively spared because it appears not to be as dependent as explicit memory on the vulnerable hippocampus and prefrontal structures. Emotionally charged implicit memories may rely on the activity of the amygdala, while implicit procedural memories rely on the basal ganglia and cerebellum.

Episodic and semantic memory: The knowledge base can be divided into episodic and semantic memories (a subdivision of declarative memory). Episodic memories are those that have a time and place reference in the individual's life (e.g., I remember that I lost my wallet at a hotel in Stockholm several years ago). Semantic memories include knowledge of things, events, and concepts that are not tied to my autobiography (e.g., I know that the North won the Civil War).

Remote and recent memory: In the context of brain injury, the term remote memory usually refers to memories from before the injury. Recent memory refers to memories acquired recently and after the injury. Retrograde amnesia is an impairment of remote memory, that is, difficulty remembering events from before the injury. Anterograde amnesia is an impairment of recent memory, that is, difficulty remembering day-to-day events that have occurred since the injury. After TBI, it is possible to have excellent memory for events from before the injury, but relatively impaired ability to lay down new memories (anterograde amnesia). This is because existing knowledge is largely stored in posterior regions of the brain, relatively safe in TBI. New learning relies on the hippocampus and frontal lobe structures, which are vulnerable in TBI.

Meta-memory: Meta-memory refers to knowledge of one's memory functioning, knowledge of memory strategies, and possibly a disposition to use the strategies when trying to encode new information or retrieve information from storage. Thus there is a static aspect to meta-memory (e.g., I know that my declarative memory is weak and that I need to use strategies like elaboration if I hope to remember effectively) and also a dynamic aspect (e.g., I actually use the strategies in an effective manner). Meta-memory is impaired by frontal lobe injury. **(See Tutorials on Self-Awareness; Cognitive and Learning Strategies)**

Memory and other cognitive processes: (See Tutorial on Cognition.) It is clear that aspects of memory interact with other components of cognition. For example, if a student does not attend effectively to an assignment, it is unlikely that the information will be remembered. Similarly, if the student fails to make connections as new information is presented (i.e., organize, elaborate), then memory for that information will be weak. Furthermore, if a student is not aware of memory problems or is a poor problem solver, then strategic learning and memory will be negatively affected. Many more examples of inter-relationships among cognitive components could be added to this list.

WHAT MEMORY PROBLEMS ARE ASSOCIATED WITH TBI?

In the paragraphs above, several comments are made about the areas of the brain associated with specific types of memory. The vulnerable areas of the brain in TBI most closely associated with memory problems are the frontal lobes and the hippocampus. In addition, widespread microscopic damage throughout the brain can degrade storage systems and "retrieval routes", making retrieval of information more difficult. The frontal lobes are vulnerable because of their position in relation to bony prominences within the skull.

The hippocampus is vulnerable to secondary hypoxic injury (reduction in the supply of oxygen), common after severe injuries.

With these types of brain damage, the following memory challenges and profiles are commonly observed in children with TBI.

Impaired encoding and retrieval: Both encoding and retrieval are commonly impaired after TBI. Encoding for many types of memory is affected by damage to the hippocampus and surrounding structures in the medial temporal lobes. Voluntary or strategic encoding (i.e., trying to encode) is affected by damage to the vulnerable frontal lobes. Retrieval (including word retrieval) can be affected by damage to retrieval routes throughout the brain. Thus retrieval problems are associated with many kinds and locations of brain damage as well as normal aging. Voluntary or strategic retrieval (i.e., trying to retrieve) is affected by damage to the vulnerable frontal lobes.

Superior involuntary/incidental memory over voluntary/strategic memory: With damage to the frontal lobes, strategic thinking and behavior in general can be impaired. Therefore both voluntary/strategic encoding (e.g., trying to encode information effectively by rehearsing it, elaborating it, creating organizing systems, and the like) and voluntary/strategic retrieval (e.g., trying to retrieve information by using associations, mnemonic strategies, and the like) can be impaired. Despite these impairments, the student may be able to encode and retrieve information if teachers and parents provide effective organization/elaboration at the time of encoding and effective retrieval cues at the time of retrieval. That is, the student no longer has to rely on the parts of the brain involved in strategic effort. This is important for teachers and parents to remember. When students have impaired strategic processing, it can make memory problems worse by asking the student to try to remember information (encode or retrieve).

Superior implicit over explicit memory: Students with apparently severe memory impairments after TBI may nevertheless encode, store, and retrieve information and skills implicitly. These are students who may have extreme difficulty answering questions like, "What did you have for breakfast?" or "What did you learn yesterday in History class?" If the information was salient at the time of encoding and if effective retrieval cues are given by adults, the student may remember the information or skill even though he did not know he knew it and cannot remember learning it. When students have this memory profile, teachers should use errorless teaching/learning procedures (See below; **See Tutorial on Errorless Learning**).

Superior remote memory over new learning: The cognitive profiles of many students with TBI are confusing because they remember information and skills acquired before the injury despite great difficulty acquiring new information and skills after the injury. For this reason, they may score at reasonably high levels on academic tests despite significant learning difficulties. Decisions about services and supports for these students should not be made on the basis of their test scores, but rather on their ability to learn **after** the injury.

Superior procedural over declarative memory: It is common for students with TBI to have difficulty learning/remembering facts and other academic information despite relatively strong ability to acquire new motor skills and other procedures, routines, or habits.

Interference in memory/learning from other cognitive deficits: Deficits in other cognitive areas like attention, organization, problem solving, and reasoning have an inevitable negative effect on memory and learning. Similarly problems in executive functioning have a negative effect on strategic learning and memory.

Interference in memory/learning from emotional impairments: Anxiety has a negative effect on memory and learning. Students who are anxious tend not to use strategies at the time of encoding or retrieving information. Similarly students who are depressed tend not to pay attention effectively or use strategies for encoding or retrieving information.

WHAT ARE THE MAIN THEMES IN INTERVENTION AND SUPPORT?

Understanding the Problem

As always, the first task for teachers and parents is to correctly understand the problem. The wide variety of types and aspects of memory listed above indicate that there are many kinds of memory problems. Different problems are typically associated with different interventions or supports. For example, both encoding problems (i.e., inefficiency in putting the information into storage) and retrieval problems (i.e., difficulty taking the information out of storage when needed) manifest themselves in retrieval problems. But approaches to intervention differ. Therefore, the problem-solving/hypothesis-testing assessment procedures offered on this web site are useful in identifying the underlying problem before proceeding with intervention and support plans. Alternatively, review of a neuropsychological evaluation will shed light on the type of memory problems experienced by the student.

Remediation of Memory Problems with Memory Exercises

Memory exercises to improve memory: Some educators and therapists have students with memory problems practice remembering with the goal of improving their underlying memory functioning. For example, they might have the student repeat back numbers in sequence or repeat lists of unrelated words. Or they might have the student hold instructions in mind for increasing periods of time and then act on the instruction. It has been shown that adults and children with memory problems can improve on such training tasks, but the improvement does not transfer to everyday functional memory tasks. Therefore there is no justification for using memory exercises of this sort in therapy or special education. Therefore, what remains are environmental compensations (including special teaching procedures) and memory strategies as the intervention procedures for students with memory problems.

Memory and Existing Knowledge

In the area of memory and learning, the rich get richer; that is, the more one knows within a domain of knowledge, the easier it is to process, comprehend, encode, store, and subsequently retrieve/use new information in that domain. For example, even very weak students may be passionate and knowledgeable about something, like football or a video game. In that case, attending to and taking in the details of a game may be easy for that person and learning new information or rules may occur with a single learning trial, despite failure to learn new information after scores of learning trials in school. The same holds true at higher levels. An expert in a profession may scan a journal article in her field, quickly filter important from unimportant details, comprehend the critical information, and readily retrieve it at a later date. A novice student in the same field may require hours to comprehend and learn what the specialist comprehends and learns in a few minutes.

Therefore, ongoing accumulation of new knowledge must be seen as an important component of “memory rehabilitation” or “cognitive rehabilitation”.

Environmental Compensations or Task Modifications

What is most important for teachers and parents to know about memory?? The following principles of memory are true for most people, including students with TBI. These principles should be used in designing learning and memory tasks for these students.

Memory interacts with other cognitive functions: For example, the better one attends to incoming information, the better it will be encoded and later retrieved. The more effectively one organizes information, the better it will be encoded (elaborated), stored, and later retrieved. The more one engages in learning as a problem-solving activity, the more effectively one will encode, store, and retrieve information. Conversely, the better one remembers and the more one knows, the easier it will be to attend, organize,

and problem solve. Therefore, teachers and parents should try to ensure attention during learning tasks, offer the student ways to elaborate or organize the information, and make learning and memory a problem-solving activity (e.g., "What do you think you could do in your head to hold onto this information?").

Memory interacts with emotion: Information that is emotionally salient tends to be remembered better than information that is not emotionally salient. Conversely, the more one remembers/knows about a domain, the greater the likelihood that emotional salience may be triggered by new information. Therefore, teachers and parents should seek ways to make new information emotionally salient; they should connect new information with something that the student already knows and is important to her.

Meaningfulness enhances memory: If students find a piece of information or a procedure meaningful, interesting, and/or important, they are more likely to encode it in an elaborative manner (i.e., with meaningful connections), store it effectively, and retrieve it when relevant. Meaningfulness can be created artificially (e.g., "You better remember this because it will be on the test!") or naturally (e.g., "Let me try to explain why this is really important for you in relation to ...."). Teachers and parents should try to ensure that students understand that it is important to attend to, think about, and remember the new information.

However, with students who are anxious about their ability to learn, teachers should be cautious in their emphasis on the importance of learning. The additional anxiety that this emphasis creates is likely to interfere with learning. Furthermore, for students with significant strategic learning problems, it may not be helpful to highlight the importance of remembering.

Organization/elaboration enhances memory: The better elaborated/organized information is at the time of encoding, the more effectively it is stored (i.e., multiple neural connections) and the easier it will be to retrieve (i.e., many retrieval routes). Elaborative encoding facilitates all three stages of memory: encoding (making connections when first taking the information in), storage (storing information in more than one place with multiple neural connections), retrieval (increasing the number of retrieval routes in the brain to the stored information). Developmentally young people – or those with executive system impairment – may need this organization created by others in ways that make sense to the students (i.e., give the students meaningful connections among the pieces of information presented). Cognitively more mature students are capable of creating their own elaboration and organization – which may be more effective organization than that imposed by a teacher. Teachers and parents should encourage this elaboration/organization process. **(See Tutorial on Organization.)**

Repetition enhances memory: For most people, including students with brain injury, repetition enhances memory and is essential for learning. Repetition includes multiple learning trials when the information or skill is first presented. It also includes regular review and cumulative review of the information or skills. Repetition and review cannot be over-emphasized in teaching students with memory impairment after TBI.

The value of repetition assumes that the student is actually paying attention during the repetition, which may not be the case if "drill" is boring. Therefore, teachers should seek ways to make repetition or practice interesting. For some students, taping of class materials for repeat review at a later point in time may enhance repetition of novel information. For many students, well designed computer programs offer adequate practice while also making the practice interesting. Therefore, interesting educational software should be explored.

The repetition principle has led many to advocate "covert rehearsal" (i.e., repeating to oneself) as a useful memory strategy. This may be true for simple memorization tasks. However, simple rehearsal may actually interfere with functional memory if it detracts from the processes that go into understanding the information. However important repetition is it should be combined with organization/elaboration and meaningfulness in designing learning/memory tasks. **(See Tutorial on Instructional Routines.)** Furthermore, in more advanced learning environments (for example, listening to lectures in high school), mental rehearsal of the teacher's words may block the processing of what the teacher is continuing to say, thereby interfering with learning. In such situations, taping of class content and replaying it at a later date may be most beneficial

External memory aids can compensate for memory problems: External aids (e.g., posted reminders, written lists, memory books, electronic storage systems, buddy systems for reminders) are the most commonly used and most effective intervention for adults and adolescents with memory impairment. External aids are also important for younger children, with the type of aid varying with the developmental level of the student. Young students might use posted reminders (words, symbols, or pictures) or buddy systems as components of their compensation for memory problems. In addition, parents and teachers should make sure that there is a tight association between types of objects and the places where they should be kept and can be found.

Older and more mature students may develop a habit of making lists when necessary and using a memory book (or at least an assignment book) or hand-held electronic organizer in which to record information that would otherwise be forgotten. When these systems are developed, maintained, and cued by somebody other than the student, they can be considered a component of environmental compensations.

In general, the simpler the external aid, the more likely it is to be used. For example, electronic storage systems may be extremely powerful, but despite their potential power, they may not be used because they are too complex. In addition, aesthetics matter to students, especially adolescents. For example, an adolescent male may tolerate a small reminder and schedule book that can fit in his pocket, but not a large notebook that he may consider stigmatizing. Furthermore, memory/schedule/assignment books need to be well organized or they may prove too frustrating to use. The student with TBI may need to rely on an adult to keep the book organized and current.

Errorless learning is important for students with severe memory impairment: As discussed above in the section on explicit and implicit memory, many students with TBI have severe explicit memory impairments; when asked to retrieve information from their recent life or recent lessons, they may say that they remember nothing, not even the fact that they had a lesson. Nevertheless these same students may encode, store, and potentially retrieve information implicitly. That is, an experience they have may leave memory traces that they are not aware of, but that may yet come to consciousness in the future when properly cued. Furthermore, these students may learn routines effectively if properly taught, including academic routines like arithmetic operations and reading decoding.

The key to teaching for these students is to ensure that their learning is errorless, that is they do not make errors as they learn new information or skills. Teachers and parents must ensure that sufficient supports are in place so that the student's responses are correct. At the outset, this may mean that the student simply listens to the teacher give the response; subsequently the student can respond along with the teacher; then respond with ample cues. The teacher should systematically pull back the cues only when confident that the student can respond correctly.

The opposite of errorless learning is "trial and error" learning, which might be most efficient for students who are generally accurate in their responses and who remember their mistakes and try to avoid making the same mistake twice. In fact, for students with reasonably good memory, trial and error learning may be preferable, particularly when understanding of complex material is the goal. However, when students with severe memory impairment make a mistake, the emotionality that is often associated with mistakes can easily make the mistake memorable, that is "drive it into the memory bank". Later the student will have forgotten the teaching episode, but the mistake still remains in memory and may easily be elicited by future cues. Unfortunately, the student does not remember that it is a mistake. Thus errors for students with severe memory impairment can be very insidious in their effects on future performance; for this reason, teaching should be as errorless as possible.

The optimistic message is that students with severe memory impairment can nevertheless learn new information, skills, and routines, if properly taught. However, the learning that these students acquire tends to be superficial, lacking in depth of understanding, and dependent on specific cues for retrieval.

Errorless learning procedures should also be considered for students with significant anxiety associated with learning. For reasonably confident students, a little anxiety can heighten attention and retentiveness; therefore it may facilitate learning. However, serious anxiety can substantially interfere with acquisition and

retention of information. Some students with TBI are anxious because they are perplexed about what they can do and what they can't do after the injury. Others are anxious because of large amounts of unexpected failure after the injury. Still others are anxious because of changes in brain function. In any of these cases, teaching/learning routines designed to minimize errors are important to reducing anxiety and enhancing overall performance.

Finally, errorless learning procedures are also important for students who are discouraged or frankly depressed about their overall abilities after the injury. Because of all the losses they may have experienced (e.g., loss of abilities, loss of activities, loss of friends), many students with TBI experience depression at some stage of their recovery in reaction to the changes in their lives. In these cases, teachers should work hard to ensure as much success as possible. Errorless learning procedures are one tool to achieve this goal.

Memory/Learning Strategies That Can Be Used by the Student as Compensation for Memory Impairments

Context sensitivity in teaching the use of memory strategies: If memory strategies are to be taught to the student, whether external memory aids or internal strategies, they should be taught within the context of everyday home and academic routines to avoid the likelihood that strategies taught in isolated settings will not transfer to functional settings and activities. Transfer of new skills or procedures from a training context to a real-world context should never be assumed and rarely occurs without considerable effort.

External memory aids: External aids were discussed above as part of environmental compensation. In some cases, the student can be taught to take responsibility for managing and using the external aids. For students with ongoing memory impairment, it is critical to develop a habit of using external aids. This is often a life-long need.

Internal (mental) memory strategies for encoding: Students who are aware of their memory impairment and sufficiently mature to actively compensate for their memory problems may be taught to use the following strategies to encode information more effectively. Internal memory strategies have not been shown to be particularly effective in memory rehabilitation. One reason is that people with memory impairment often forget to use the strategies that they have been taught. They also might have limited "space" in working memory; therefore it is hard to think about strategies and the task at hand at the same time. Furthermore, most of the studies have been conducted with adults who rarely have to learn or memorize large amounts of new information. However, in an academic setting, it is worth encouraging students to do at least some of the following at the time of encoding to enhance their memory:

- Tell myself, "pay attention; focus";
- Highlight the information that seems most important;
- Organize the information into natural groups;
- Create association links to information that I already know;
- Generate my own examples;
- Think about how I might apply this information;
- Repeat the information;
- Summarize and review;
- Take notes;
- Speak the information out loud; tell or explain it to some other person;
- Create visual images of the new information;
- Create diagrams or flow charts of the information;
- Test myself on the information;
- Take in reasonably small amounts of information at a time

Internal (mental) memory strategies for *retrieval*: Books on how to improve memory often advocate the use of mnemonic strategies to increase the likelihood of retrieving information. Mnemonics have limited usefulness in memorizing discrete information for tests, but should never replace understanding the

information as the ultimate goal of learning. Because mnemonic strategies are often associated with superficial understanding of the material, they may even interfere with deeper understanding. For example, students can memorize the colors in the color spectrum with the first-letter mnemonic “Roy G Biv” (i.e., red, orange, yellow, green, blue, indigo, violet) without understanding any of the physical properties of the colors. If students overuse mnemonics, they can spend too much time on generating and learning the mnemonics and too little time on real understanding of the material.

With these important qualifications as background, what follows are mnemonic strategies sometimes used to facilitate memorization:

Rhymes: Example, "Id is the kid!" for part of Freud’s personality theory

Acronyms: Example: Roy G Biv for the colors in the spectrum

Visual Images: Associating information with striking visual images sometimes facilitates retrieval.

Method of Loci: Items to be remembered are placed in a series of location that can then be mentally reviewed at the time of retrieval.

Catch phrases: Each word in the catch phrase begins with the first letter of a different key word.

In addition, retrieval practice (for example, practicing taking an exam) helps many students. Mentally retracing the steps taken at the time of encoding or imaginatively placing oneself where the event/learning took place might jog memories. For many people, simply relaxing and turning off the effort to remember may assist retrieval.

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Tutorial: Cognition

See Tutorials on Attention, Memory, Retrieval, Organization, Problem Solving, Reasoning, Self-Regulation/Executive Functions

WHAT IS COGNITION?

In general, the word "cognition" refers to all of the mental activities involved in receiving information, comprehending it, storing it, retrieving it, and using it. Thus cognition includes:

1. The sensory and perceptual processes that enable us to receive information from the world (e.g., vision, hearing, smell, taste, and tactile sensation/perception);

2. All of the mental processes involved in attending to the information, recognizing it as something meaningful, making sense of the information, relating it to what is already known, organizing the information, deciding what is important and what is not important, storing the information for later retrieval, retrieving it when useful;

3. Using the information to make decisions about what to do, to solve problems, to communicate, and the like.

There are two importantly different ways to think about cognition. First, cognition may be considered a collection of processes and systems (see lists below) that are relatively independent of one another, independent of emotion and volition, and independent of the individual's contexts of action. Alternatively, cognition can be understood in a more functional and integrated way as an inter-related set of mental processes that guide action and problem solving in the real world (see below). In this sense, cognitive processes are not independent of one another, of emotion and volition, or of the individual's contexts of action.

The first view of cognition underlies many tests of cognitive functioning as well as cognitive training and retraining programs that isolate specific cognitive processes and target them with discrete cognitive "exercises". The second and more functional view of cognition underlies cognitive intervention programs that target cognitive processes within the context of meaningful academic and everyday activities. Both views of cognition serve their respective purposes. The functional view supports cognitive intervention plans that have been shown to be more effective in producing functional outcomes for a variety of disability populations. **(See Tutorial on Cognitive Intervention/ Rehabilitation)**

COGNITION AS A COLLECTION OF RELATIVELY INDEPENDENT PROCESSES AND SYSTEMS FOR ACQUISITION AND USE OF KNOWLEDGE ("Faculties of the Mind")

Information processing theories of cognition – developed out of complex and ever-changing analogies between human cognition and the operation of a computer – often offer operational definitions of cognition via lists of components of the cognitive "mechanism". Typically lists of this sort are accompanied by models of cognitive functioning depicted as flow diagrams: boxes and connecting arrows and feedback loops depicting information stores and processes acting on the flow of information. What follows is a **typical list of aspects of cognition:**

COMPONENT SYSTEMS OF COGNITION

Working Memory

- Structural Capacity (normal adults: 7 plus or minus 2 units of information held in consciousness at one time) and Functional Capacity (how much information can be held in WM when well organized; varies with type of information)

- Phonological Loop (auditory-verbal information) and Visual-Spatial "Holding Space" versus Supervisory Control System
- Processes that enable information to be held in consciousness and that act on that information discriminate between important and unimportant information, to organize the information, and the like

Knowledge Base (Long-term Memory)(For elaboration, See Tutorials on Memory; Retrieval; Word Retrieval)

- Episodic Memory (autobiographical information) versus Semantic Memory (depersonalized information)
- Declarative Memory (remembering that… such and such is the case) versus Procedural Memory (remembering how to … do something)
- Explicit Memory (possessing a memory trace and also an awareness that one has the memory) versus Implicit Memory (possessing a memory trace, but no sense that one has the memory)
- Remote Memory (Retrograde Amnesia = difficulty remembering events stored before neurological damage) versus Recent Memory (Anterograde Amnesia = difficulty remembering events that have occurred more recently and after the neurological damage)

Executive System (See Tutorial on Self-Regulation/Executive Functions)

- *Metacognition:* Executive functions applied to cognition. Two aspects:
  - *Static:* knowing about cognitive processes; knowing about one's own cognitive strengths and weaknesses; knowing procedures (strategies) to improve cognitive functioning
  - *Dynamic:* deliberate strategic/executive control over cognitive processes like attending, learning, organizing, reasoning; using strategies to improve cognitive functioning
- *Executive Functions:* Those functions involved in deliberately pursuing any type of goal in the face of difficulty or stress (especially novel, non-routine tasks or complex, organizationally demanding tasks)
  - Self-awareness of strengths and limitations
  - Ability to set adequately reasonable goals
  - Ability to plan and organize goal-directed behavior
  - Ability to self-initiate goal-directed behavior
  - Ability to self-inhibit competing behaviors
  - Ability to self-monitor behavior
  - Ability to self-evaluate behavior in relation to goals
  - Ability to solve problems and think and act strategically in the face of obstacles
  - Ability to flexibly shift focus of attention, strategies, behaviors, and perspectives as required by context and goals, and as dictated by feedback from previously unsuccessful behavior and strategies

Response System

- *Output modalities* (e.g., verbal, manual)
- *Control/coordination* of output (e.g., coordinated execution of motor movements)

COMPONENT PROCESSES
Attention (For elaboration, see Tutorial on Attention)

- *Arousal and Alertness*
- *Preparing* attention
- *Maintaining/Sustaining* attention
- *Selecting* a focus of attention (concentrating)
- *Suppressing/Filtering* distractions
- *Shifting/Switching* focus of attention

- *Dividing/Sharing* attention

Perception

- *Recognizing and Identifying* objects received via sensory stimulation
- *Discriminating* among objects perceived

Memory and Learning (For elaboration, see Tutorials on Memory; Retrieval; Word Retrieval)

- *Encoding* (putting information into memory), *Storage* (holding information in storage over time), and *Retrieval* (bringing information from storage into consciousness)
- *Involuntary, incidental, implicit* memory (remembering when the goal of the activity was other than to remember) versus Deliberate, Effortful, Strategic memory (the goal of the activity was to learn or remember)
- *Retrospective* memory (memory for past events) versus *Prospective* memory (memory for appointments, remembering to do planned activities)
- *Verbal and Nonverbal* memory
- *Sensory Modality-Specific* memory

Organization (For elaboration, see Tutorial on Organization)

- *Identifying* features
- *Classifying/Categorizing* information
- *Sequencing* information
- *Analyzing* information
- *Integrating/Synthesizing* information into main ideas, themes, and scripts

Reasoning and Problem Solving (For elaboration, see Tutorial on Problem Solving)

- *Deductive* versus *Inductive* versus *Analogical* reasoning
- *Evaluative* reasoning
- *Convergent* versus *Divergent* thinking

Inter-relationships among components of cognition: Even if there are separable components of cognition, it is clear that they interact. For example, if a student does not attend effectively to an assignment, it is unlikely that the information will be remembered. Similarly, if the student fails to make connections as new information is presented (organize, elaborate), then memory for that information will be weak. Furthermore, if a student is not aware of memory problems or is a poor problem solver, then strategic learning and memory will be negatively affected. Many more examples of inter-relationships among cognitive components could be added to this list.

Cognition, context, and action: Typically information-processing theories of cognition (like 19th century faculty psychology theories) divorce in-the-head cognitive processing from the specifics of an individual's domains of action contexts and specific actions. Obviously cognitive processes exist in part to drive intelligent action. However, within this tradition cognitive processes and systems are not defined in relation to domains of action as they are in more functional theories of cognition. Therefore, it was commonly believed until recently that one can improve cognitive processes (with cognitive exercises) and these improvements will automatically improve performance across all contexts of action. This approach has been called a "bottom up" approach to addressing cognitive challenges. Studies of transfer of cognitive skill have called this view into question.

Cognition and emotion: Information processing theories differ in their handling of the emotional/affective aspects of experience and action. Some separate cognition and emotion sharply. Others offer integrated

theories of social-emotional cognition and nonsocial cognition. A few place affective processing at the heart of all human information processing. Neuro-imaging studies of the brains of people engaged in cognitive tasks suggest that emotional/affective processing is typically involved in activities that are considered cognitive.

Cognition and culture: Historically, information processing theorists have not recognized fundamental differences in thinking and cognitive processing based on cultural differences. Studies of individuals from diverse cultures tend to show some fundamental differences in cognitive processing.

COGNITION AS GOAL-DIRECTED PROBLEM SOLVING

In contrast to the theories outlined above, a variety of theories of cognition and cognitive development tie cognitive functioning tightly to practical problem-solving activity in the world. These theories include those associated with Lev Vygotsky, Alexander Luria, John Dewey, and others. These theories have more recently been grouped under the heading "Situated Cognition". The understanding of cognition as ultimately practical problem solving is the central theme. Problem solving includes all ordinary activities that have a cognitive aspect (e.g., playing a game, planning an activity, exploring an idea, conversing, remembering, etc.). According to situated cognition theorists, what most people consider relatively separate components of cognition (e.g., attending, remembering, organizing, etc) are really integrated aspects of problem solving. Cognition includes the processes of intelligent adaption to interpersonal and practical problems. This definition also blurs the distinctions among cognitive, emotional/affective, and social processes – problem solving involves emotion, social relations, and social structure.

Cognition and Context: Within these theories, mental processes exist to guide action in pursuit of goals in social and physical contexts. The context that is associated with cognitive processing includes at least:

(1) the goal of the activity;
(2) the domain of knowledge involved in the activity;
(3) specific features of the task;
(4) the interpersonal/social context, including social values, socially transmitted problem-solving tools and technologies.

Thus an individual's cognitive skill is predicted to vary with each of these four factors.

Cognition and Emotion: These theories also blur the distinction between cognitive, emotional, and social processes. Human problem solving involves emotion, social relations, and social structure. For example, at fundamental levels, people from markedly different cultural backgrounds think and organize their worlds differently.

WHY IS COGNITION IMPORTANT FOR MANY STUDENTS WITH TBI?

For many individuals, it is during the school years that the greatest demands are placed on cognitive functioning. Students need to pay attention effectively, organize information for thorough comprehension and effective expression (e.g., reading books, writing papers), remember the information and retrieve it for tests, reason effectively, and apply strategic thinking to the many academic problems that arise in school. Thus effective cognitive functioning is critical for all students to learn and profit from their educational experiences.

Unfortunately, cognitive impairment is one of the most common outcomes after TBI in children of all ages. Virtually any cognitive function or combination of cognitive functions can be damaged. However, because certain parts of the brain are more vulnerable than others, there are common profiles of cognitive

impairment. Vulnerable parts of the brain include the frontal lobes (especially prefrontal areas) and the limbic system.

Damage to the frontal lobes can impair control of attention, even in students who appear to be quite alert. Attention span may be short, distractibility may be severe, and shifting and dividing of attention may be difficult. **(See Tutorial on Attention.)** Controlled memory/learning and retrieval may also be difficult. Thus, studying (i.e., trying to put information into memory) may be inefficient and deliberate retrieval (e.g., searching memory during a test) may be weak. **(See Tutorials on Memory; Retrieval.)** Organizing information and events may also be weak. This includes relating pieces of information for purposes of deeper comprehension, paying attention to the most important parts of a story or text book, and effectively organizing information when reciting in class or writing themes and stories. **(See Tutorial on Organization)**

Damage to the frontal lobes also reduces the effectiveness of problem solving and strategic studying and learning. Thus students whose cognitive processes may be weak also have specific difficulty compensating effectively for that weakness. This deficit requires intensive efforts to teach compensatory strategies so that the student can succeed at school. **(See Tutorial on Cognitive and Learning Strategies.)** Students with frontal lobe injury may also be impulsive, so they do the first thing that comes to mind, which may not be strategic. They may also think and say or write the first thought that comes to mind and therefore make many errors in their school work. Impulsiveness may also block the student from checking her work (self-monitoring) and making necessary adjustments in response to errors. **(See Tutorial on Impulsiveness/Disinhibition.)**

Damage to parts of the limbic system – especially the hippocampus – impairs those processes involved in declarative memory (i.e., remembering that such and such is the case) and episodic memory (i.e., remembering events in one's life). In contrast, procedural memory (i.e., remembering/learning how to do something), routine learning (e.g., developing habits of thought or action), and implicit memory (i.e., certain memories "stick", but the student has no awareness of the memory) may be well preserved even if the hippocampus is damaged. **(See Tutorials on Memory; Retrieval; Explicit and Implicit Memory; Errorless Learning.)**

WHAT ARE THE MAIN THEMES IN INTERVENTION AND SUPPORT FOR STUDENTS WITH COGNITIVE IMPAIRMENT?

See Tutorials on Cognitive Intervention/Rehabilitation; Memory; Retrieval; Organization; Problem Solving; Instructional Routines.

Historically, three approaches to helping children and adults with cognitive impairments have been described in the rehabilitation and special education literatures.

- **Restoration/improvement of underlying cognitive processes:** For well over 100 years, educators and therapists have explored the possibility of improving cognitive functioning by engaging the student in cognitive exercises that target components of attention, memory, organization, reasoning, problem solving, and the like. From the 1970s through the 1990s, cognitive exercises of this sort were popular in TBI rehabilitation. Recent summaries of this large intervention literature indicate that it is possible to improve performance on the training tasks, but that transfer of those improvements to everyday academic and social tasks and activities is severely limited. **(See Tutorial on Cognitive Intervention/ Rehabilitation.)**
- **Student strategies used to compensate for ongoing cognitive impairments:** Some students with ongoing cognitive impairments are able to learn strategies that compensate to some degree for the impairments. For example, students with memory impairments may learn to use external aids (e.g., memory book, electronic storage system) or internal mental strategies (e.g., rehearsing information to be remembered, organizing or elaborating the information in special ways). **(See Tutorials on Cognitive Intervention/ Rehabilitation; Memory; Retrieval; Organization.)**
- **Environmental compensations, including modified teaching routines and adjustments in expectations for the student's performance:** For some students with ongoing cognitive

impairments, it is critical to modify teaching routines and other aspects of the student's environment. For example, students with memory problems may need teachers to organize, highlight, and repeat information in ways that go beyond standard teaching procedures. Similarly they may need posted reminders, the use of tape recorders, or buddy systems to compensate for memory problems. (**See Tutorials on Cognitive Intervention/ Rehabilitation; Memory; Retrieval; Organization; Instructional Routines.**)

There have also been differences of opinion with respect to the sequence of these categories of intervention. A traditional approach has been to first attempt to improve underlying cognitive functions with exercises or pharmacologic interventions (i.e, a bottom up approach). In the case of students with TBI, this was typically done in rehabilitation centers or other special training centers. In the event that students continued to have cognitive impairments, therapists or educators would next attempt to teach the student compensatory strategies, again often in special training settings. Finally, in the event that the student continued to have cognitive difficulties, environmental compensations would be explored in the student's community school and home.

An alternative to this traditional sequence reverses the sequence. In this case, the student is placed in as natural an educational environment as possible and environmental/instructional modifications and compensations are made that enable the student to participate in the curriculum in that setting (i.e., a top down approach). Within this participation, the student might then be taught strategies to compensate for ongoing cognitive impairments. Finally, with habituation and routinization of these strategic procedures, the procedures might be internalized, thereby reducing the underlying cognitive impairment.

The latter sequence is more consistent with the philosophy of inclusion implemented in most educational settings. It is also designed to avoid the common pitfall of failure of transfer from a training setting and activities to functional settings and activities.

All of these themes are elaborated in the **Tutorial on Cognitive Intervention/ Rehabilitation.**

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TUTORIAL: SLOW INFORMATION PROCESSING

WHAT IS SLOW INFORMATION PROCESSING?

Speed of information refers to how quickly students can react to incoming information, understand it, and think about the information, formulate a response, and execute that response. Speed of information processing is not the same as intelligence. It is possible to be very bright, yet process information slowly. Similarly, speed of information processing is not the same as physical quickness. It is possible to have complete physical recovery and yet process information slowly.

Speed of information processing is influenced by a variety of factors. Neurologically, speed is affected by neurotransmitters in the brain and their balance, by the fatty covering of neurons (myelin) that speeds transmission, by the size of synaptic spaces (unusually large synaptic gaps slowing information processing), by the organization of neural networks that support a concept or procedure, and by the efficiency of the frontal lobes in organizing and directing information flow. A person with slowed information processing may also be physically slow, for example with slow speech production or slowed arm and leg movements. However, it is possible to have intact physical movements that are normally fast, but nevertheless to process information slowly.

Speed is also affected by knowledge and experience. The more a person knows about a topic, the easier it is to process new information about that topic quickly. The more experience a person has with a phenomenon, the easier it is to react and think quickly. For example, children and adults alike playing a new game – board game, card game, video game, or sport – take a great deal of time to do what takes very little time once the game is mastered. Similarly, foreign languages that one does not know seem to be spoken very rapidly. But once the language is mastered, it seems to slow down. Therefore, "familiarity with the game", including thorough familiarity with routines in school and increasing content knowledge, is very important for individuals who process information slowly.

WHY IS SLOW INFORMATION PROCESSING IMPORTANT FOR MANY STUDENTS AFTER TBI?

From a neurologic perspective, generally slowed information processing can be a consequence of widespread diffuse axonal injury (DAI), frontal lobe injury, damage in any of the circuits that support storage and retrieval of information, or damage to multiple sites in the brain. **[See: Tutorials on Diffuse Axonal Injury; Frontal Lobe Injury]** Furthermore, a variety of medications, including anti-convulsants, can slow information processing. DAI, which is common in closed head injury, has been strongly linked to slow information processing. DAI results in shearing of white matter pathways in subcortical brain regions. These pathways are often important linkages between cortical areas. Damage to these pathways therefore interferes with interconnections within the brain, thereby slowing all types of complex information processing. Significant amounts of DAI may be manifest as enlarged ventricles on images of the brain (e.g., CT or MRI scans).

From a cognitive perspective, students with TBI may respond slowly as a result of difficulty controlling attention, inefficient access to stored knowledge and skills, or breakdowns in the systems that support organized thinking and processing. Furthermore, impaired self-regulation (or executive dysfunctions) can result in slowed processing because of weak control over attention, organization, memory, and other cognitive processes. All of these possible causes of slowed processing are commonly seen in students with TBI; therefore, slowed processing is a common phenomenon and should be anticipated. Slowed processing can also be a consequence of mild TBI.

Conversely, slow processing can underlie problems that may be identified as attention, memory, organization, language, or executive function problems. For example, slowed processing is known to result in difficulties on shifting and dividing attention tasks, on memory and retrieval tasks, on tasks that require cognitive flexibility, and on problem-solving tasks.

From an emotional perspective, slow processing can be a consequence of depression or anxiety, or simply a focus on unrelated issues as a result of emotional struggles.

Slowed processing can generally be observed in all types of tasks, particularly those that are cognitively demanding (e.g., academic tasks in school; social activities like chatting with peers). However, when tasks or activities become increasingly routine or automatic, even slow processors of information may appear to be unimpaired. For example, a student who normally processes information slowly may repeatedly practice a video game to the point at which he plays the game at normal speed. Because slow processing has a lesser effect when tasks are routine, instructional activities should become as routine or automatic as possible for students with TBI. **(See: Tutorial on Instructional Routines.)**

It is additionally important to understand slowed information processing because it is easily misunderstood as a behavior problem. For example, students who do not respond to teachers' questions or instructions within a usual time frame may be considered defiant or manipulative. Alternatively, teachers may interpret their behavior as attention seeking.

WHAT ARE THE MAIN THEMES IN INSTRUCTION AND SUPPORT FOR STUDENTS WHO ARE SLOW PROCESSORS OF INFORMATION AFTER TBI?

Understanding the Problem

As always, the first task for teachers and parents is to correctly understand the problem. Slow processing can easily be misidentified as a behavioral problem, an emotional problem, or a specific cognitive problem. In most cases, slow processing interacts with these other areas of functioning in complex ways. But it is important to recognize the role played by slow processing and to implement intervention and support strategies specifically designed to address slow processing.

If processing is slowed as a result of medications, consultation with the prescribing physician might be needed to arrive at the best balance between pharmacologic effectiveness and processing efficiency.

Accommodations and Environmental Supports

1. Well established and understood daily routines: Students who process information slowly should thoroughly understand the sequence of activities that comprise their daily routines at home and at school. If they also have organizational or memory impairments, the daily routine should be graphically represented (e.g., a sequence of photographs, drawings, or written outline) for easy viewing and understanding. **[See Tutorial on Organization]** The greater the routine or automaticity of activities, the easier it is for slow students to keep up.

2. Well understood instructional routines: Teachers should ensure that all components of the instructional routine are well understood – that is, become "background information" – so that the student's limited processing resources can focus on the new, to-be-learned information. **[See Tutorial on Instructional Routines]** Again, tasks that are "routinized" or "automatized" help students with processing speed impairments perform best.

3. A pace of instruction and interaction that is as rapid as the student can process: It might seem natural to slow the pace of instruction and interaction for students who process information slowly. In some cases, this slowing is necessary. In every case, the pace should be no faster than the student can tolerate and there should be appropriate pauses between the presentation of separate units of information. However, slowing the pace too much may result in difficulty maintaining attention and certainly results in fewer learning trials. If the instructional routine is well understood, the pace of instruction may be increased to ensure continued attention to task. This may require some experimentation with the student. **[See Instructional Pacing]**

4. Organizational supports: Students who process information slowly often have organizational problems as well – or in some cases the organizational problems are a cause of the slowness. **[See Tutorial on Organization]** These organizational problems are often more serious than they appear on the surface to be. Therefore, students usually benefit from advance organizational support. Advance organizers can be as simple as a checklist or outline of a task. Often the advance organizer is a graphic organizer for the task (e.g., a series of photographs that indicate the sequence of an activity; a series of boxes and connecting arrows depicting the key elements of a story and their organization). In some cases the organizer can be as explicit as a series of photos of the student moving through the steps of the task.

5. Nonverbal supports: Spoken language may be experienced as coming too fast for students who process information slowly. Even when teachers do not speak rapidly, students must be able to process the spoken language quickly in order to comprehend what the teacher says. Therefore it may be critical to repeat information and provide nonverbal supports to help the student comprehend. Nonverbal supports can include pictures, symbols, written words, written outlines, gestures, and the like.

6. Verification of student comprehension: Teachers and parents should verify that students have understood instructions or other information before proceeding to new information. Verification may include asking the student to repeat instructions or summarize new information.

7. Peer support: Students who process information slowly sometimes benefit from peer buddies or cooperative learning groups in which other students may take responsibility for some aspects of the academic tasks.

Interventions for the Student

There is no specific training program designed to improve processing speed across all domains if content if speed is negatively affected by diffuse axonal injury. Interventions are directed at addressing co-existing problems that may be making the processing speed worse or teaching the student how to advocate for himself.

1. Other primary problems: If information processing is slow because of attention problems, organization problems, memory problems, or other cognitive problems, staff and family should use intervention and support procedures that target the underlying problem. **[See Tutorials on Attention, Organization, Memory]**

2. Automatic routines: As routines become more and more automatic, speed of processing can increase. Thus there is a great advantage in automatizing routines for individuals who process information slowly. This includes routines of everyday living at home, instructional routines at school, social routines, and the like.

4. Content knowledge: The more students know in a domain of knowledge, the easier it is to process new information in that domain. Therefore, basic teaching of content knowledge can be understood as an intervention for individuals who process information slowly.

5. Request for help: Students who process information slowly should be taught to advocate for themselves, possibly saying with confidence and comfort, “Could you slow that down please? I need time” or “Could you repeat that for me please?” (or words to that effect). Students might also be taught to ask for organizational supports.

6. Additional time to complete tasks: Students who process information slowly and work slowly need additional time to complete tasks. They should be encourage to create a habit of starting assignments and projects early so that they do not get rushed to complete the task. They may need to advocate for additional time to complete timed tasks. Rushing will only increase errors for the student.

Tutorial: Transfer of Training or Generalization

(See Tutorials on Social Perception; Social Competence; Friendship and Peer Acceptance)

WHAT IS TRANSFER OF TRAINING (GENERALIZATION)?

Transfer of training, or generalization, refers to the degree to which a learned behavior will be repeated correctly in a new situation, or a learned skill or principle will be applied in a new situation. Transfer is sometimes referred to as *generalization or carry-over*. In many respects, transfer is the most critical concept in teaching. However effective instruction might otherwise be if a learned behavior or skill does not transfer to relevant functional application contexts and/or is not maintained over time, then the instruction has failed.

Types of Transfer

Transfer can be understood as falling somewhere on four continuous dimensions:

- Near versus far transfer: *Near transfer* occurs when the training context and trained behavior are almost identical to the application context and application behavior. For example a student learns an arithmetic rule with problems on a worksheet and then applies the same rule in the same way on the same day to similar problems in a math workbook. However, he becomes confused when expected to use the rule in a word problem. With *far transfer*, the two situations are interestingly different. For example, the student who has learned a basic arithmetic rule proceeds to apply it later in a variety of word problems with no cues. Or knowledge of Spanish facilitates the learning of French. Far transfer (sometimes referred to as "high-road" transfer) often requires insight or judgment not required by near transfer.
- Specific versus general transfer: *Specific transfer* occurs when the contents of learning are transferred. For example, a student who is taught the basic organizational components of a narrative uses exactly those components later in writing an organized and elaborated story. In the case of *general transfer*, general skills or underlying principles are transferred. For example, the same student may recognize that there is an organized structure that needs to be imposed on other types of writing as well, not just stories.
- Surface versus deep transfer: In *surface transfer*, the student transfers learning to a similar set of circumstances. For example, having learned about the items present on a car dashboard, the student driver applies that learning to a different-looking dashboard. In *deep transfer*, the student might transfer that learning to an airplane dashboard that looks very different.
- Maintenance over time: *Maintenance* of a behavior or skill is a type of transfer. In this case, the learned skill or behavior is maintained from one time to another. In transfer experiments, maintenance is often tested one or more months after the original learning.

Transfer can also be positive or negative. In *positive transfer*, previous learning facilitates performance in the transfer task. In *negative transfer*, the opposite is the case: previous learning interferes with the transfer task. For example, students who have significant cognitive limitations and are concrete thinkers may be taught safe street crossing in their school gymnasium using masking tape on the floor to represent streets and pushed chairs to represent vehicles on the streets. Mastering the safe crossing tasks under those unreal stimulus conditions may actually interfere with learning safe street crossing on real streets with real vehicles. The stimulus-response associations learned in the gym may have to be "unlearned" before safe street crossing can be learned in the real world. For example, "Stop, look both ways" needs to be a learned response to real streets, not to masking tape on the gym floor.

The Importance of Transfer

In certain cases, transfer that is near, specific, surface, and maintained over time is adequate. This might be true of automatic motor acts like tying shoes, or basic academic skills like reading decoding and basic math facts. In other cases, transfer is most meaningful to the extent that it is far, general, deep, and

positive, and the learning is maintained over extended periods of time. For example, in a vocational training context, transfer is typically tested by determining if the trainee applies the learned skill in a variety of on-the-job tasks and if the skill is maintained several months later. Because hundreds of billions of dollars are spent annually on worker training and past studies have shown that failure of transfer from the training setting to the real job is common, employers are increasingly demanding that training yield measurable and meaningful transfer and maintenance (i.e., an adequate return on their investment). Furthermore, on-the-job training has grown in popularity because of the frequency with which out-of-context training fails to transfer to on-the-job performance.

Similarly, educational and clinical interventions are meaningful only to the extent that they yield reasonable transfer and maintenance. There was a time when special education consultants and related services providers in schools (i.e., occupational therapists, speech-language therapists, and the like) could justify their interventions by showing that the student improved on the therapists' specialized measures in their instructional settings. Fortunately, those days have passed in most schools. Increasingly the demand is for measures of improvement that show positive change on core academic tasks or everyday functional tasks in everyday settings. This demand is based on the frequency with which specific interventions have produced changes in behavior in the training settings, but then did not transfer to natural contexts and /or were not maintained over time. For example, a student may learn to produce grammatical sentences given the cues present in the speech-language therapy room, but return to agrammatical habits when back in the classroom, on the playground, or around peers. This observation is one of the reasons for special services being increasingly integrated with general education services in the schools.

Transfer of learning is difficult and therefore should not be assumed, even in the case of intelligent adults. For this reason, most training programs in applied fields (like teacher and therapist training programs) move systematically from classroom instruction to closely supervised application in student teaching or clinical practicum assignments, and then to increasingly independent application in real work settings, but with some degree of ongoing support. That is, transfer of learning is facilitated by this process of systematically decreasing supports and increasing the real-world nature of the application contexts. Thus, transfer of training is important for all students who must learn new information. Transfer should never be assumed, but rather systematically planned for in the design of teaching and training of new information, skills, and behaviors.

In addition, transfer is facilitated by teaching future practitioners using realistic case matter from the earliest stages of the training program. Increasingly, transfer is a focus of training programs from the beginning of training. Even experienced teachers and clinicians who have attended advanced training sessions often complain that they have difficulty transferring what they have learned back to their work situations despite a possible desire to do so.

WHY IS TRANSFER OF TRAINING IMPORTANT FOR MANY STUDENTS AFTER TBI?

Students who have experienced brain injury, especially damage to the vulnerable frontal lobes, are often more "stimulus bound" than other students. That is, their behavior tends to be controlled by the stimuli around them – the events and conditions under which they are currently operating. The terms "concrete thinker" and "concrete learner" are often applied to these students. Students who are stimulus bound or concrete thinkers in this sense may create concrete associations between what they are learning and the conditions under which they are learning it, which then interfere with transfer. As a result, these students need a special focus on transfer of training. **(See Tutorials on Learning Trials; Instructional Routines.)**

For example, if a middle or high school student with organizational impairment is taught to use advance organizers for reading and writing in a special education resource room using special education materials, it is unlikely that she will transfer these use those organizational supports to her in English or Social Studies classes where the same advance organizers need to be used. However, if the student is taught to use the advanced organizer supports in the context of her general education curricular materials and assignments, with possible cuing from all of her general education teachers, transfer is much more likely to occur.

Transfer is additionally important for students with TBI because they often receive their early rehabilitation in hospitals or clinics where the conditions and materials for training may bear little resemblance to the conditions and materials present in school or on the playground where the skills are required. Therefore, there exists a strong argument for making the environment of pediatric rehabilitation as natural (e.g., school-like) as possible and for using the student's educational tasks and materials in their rehabilitation activities. Using school materials in rehabilitation has the added effect of orienting the rehabilitation staff to the tasks and demands that the student will face when returning to school.

WHAT ARE THE MAIN FEATURES OF TEACHING OR TRAINING THAT ARE IMPORTANT FOR STUDENTS WHO HAVE DIFFICULTY TRANSFERRING?

Understanding the Problem

As always, the first task for teachers and parents is to correctly understand the problem. Difficulty transferring what has been learned can easily be misidentified as a behavioral problem. For example, a student who has learned a strategy in therapy but does not use it in class might be thought to lack motivation or to be manipulative. Alternatively, the student might be thought incorrectly to have a general intellectual problem that makes learning and transfer impossible. In most cases, difficulty transferring interacts with these other areas of functioning in complex ways. But it is important to recognize the role played by transfer problems and to implement training and instructional strategies specifically designed to address the transfer problem

Training and Instructional Strategies for Transfer of Training

Traditional theories of instruction have often presented a hierarchical or stage-wise approach to teaching or training: First, help the student to acquire the behavior or strategy in a controlled training context using specific training materials. Next, ensure that the student practices the behavior or strategy in the training context until it is produced fluently. Finally, implement transfer procedures so that the behavior or strategy is used in functional application contexts.

Assuming adequate emphasis on procedures used during the transfer stage, this approach to teaching is useful for many teaching targets, especially motor acts, like swinging a golf club or tennis racket. Unfortunately, the transfer stage has often been neglected in this hierarchical approach. Furthermore, investigators have shown that most behaviors and skills are best taught with a focus on transfer from the earliest stages of teaching.

Because of the theoretical challenges to the traditional model of transfer and the many studies that show that knowledge or skills taught out of context frequently fail to transfer to functional application contexts, an alternative model to enhance transfer of new skills has gained popularity in recent years. Within this alternative framework, teaching begins in meaningful contexts with functional application activities. Adequate supports are available to ensure that the student can be successful. Supports are gradually withdrawn as the student gains competence. From a behavioral perspective, the stimulus conditions that support the learning during acquisition of the behavior or skill are the same as application conditions; thus transfer is guaranteed. **(See Tutorials on Traditional Training versus Apprenticeship; Instructional Routines.)**

The following instructional strategies have been found to facilitate transfer:

1. Similarity of training and transfer/application tasks and contexts: Transfer is facilitated to the extent that there is similarity between the tasks and contexts that are part of the instruction, on the one hand, and the transfer or application tasks and contexts on the other. Thus it is valuable to use a variety of tasks and conditions during the instructional phase, with some of the tasks and conditions resembling application tasks and conditions as much as possible – or actually being application tasks in application settings.

Ideally transfer is facilitated from the beginning of training, rather than waiting for Phase 3 in the traditional three-phase hierarchy: acquire the skill - gain fluency in the skill - transfer the skill.

On the job training and context-sensitive coaching are examples of instruction that is sensitive to this condition of transfer. A respected rule in developmental disabilities instruction is that new behaviors or skills must be taught in at least three different settings, with at least three different people, and in the context of at least three different activities. **(See Tutorial on Traditional Training versus Apprenticeship)**

2. Ability to discriminate application opportunities: Transfer is facilitated to the extent that the learner knows when to use the behavior or when to apply the procedure or rule that has been learned. Thus parents and teachers should use many examples or illustrations of the behavior or rule in the teaching process and highlight what about that situation requires the behavior or procedure that is being learned. To facilitate discrimination, the training should include situations in which the new behavior or skill should not be used as well as situations in which it should be used.

For example, social skills instruction might include practice in telling jokes or teasing, but also practice in discriminating when not to tell jokes or tease. In addition, teaching might include discussion of when to apply the behavior or procedure in various application contexts, when not to apply it, and why there is a difference.

3. Organization of the instructional tasks: Transfer is facilitated to the extent that the instructional tasks are organized as much as possible like the application tasks. For example, this might mean learning the organization of narratives while reading and writing stories using the organizational supports. For teachers in training, this principle recommends acquiring teaching strategies in the context of case application, not strict pedagogy. **(See Tutorial on Errorless Learning)**

4. Practice to fluency or automaticity: Transfer is facilitated to the extent that the behavior or skill is practiced enough that it becomes automatic. For example, in the case of a student learning a basic skills like reading/decoding and arithmetic operations, the student will require a great deal of practice to make basic decoding skills and math operations automatic. Higher levels of reading comprehension will not be achieved without basic fluency in decoding. Similarly, higher levels of mathematical ability will not be achieved without making the basic facts and arithmetic operations (e.g., adding, subtracting, and the like) automatic.

5. Motivation to transfer: Transfer is facilitated to the extent that students know that it is important to transfer what they have learned to application contexts and they want to do so. For example, students should know that the knowledge or skill being taught will be required to learn a more advanced skill or on a future exam, and that the tasks might look somewhat different from what they have practiced. In addition, students should know that the knowledge or skill relates in some meaningful way to issues or activities that they consider important now or in the future.

6. Practice teaching others: Teachers often observe that they did not come to understand their subject matter fully until they were required to teach it. Similarly, students gain understanding of material they are learning when asked to explain or teach the material to other students or family members.

7. Goal setting and self-management strategies: With adult learners, transfer has been shown to be facilitated by engaging the learners in setting goals for themselves (including transfer goals) and participating in managing their learning. This participation can include identifying the difficulty level of tasks, creating plans or strategies to overcome the difficulties, setting goals, monitoring progress, self-reinforcing and the like. **(See Tutorial on Self-Regulation/Executive Functions)** These strategies have been shown to be useful for adolescent as well as adult learners.

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Tutorial: Reading Comprehension

WHAT IS READING COMPREHENSION?

Reading comprehension includes all of the processes related to deriving meaning from written language (including books and other forms of written language) and constructing meaning from written language. "Deriving meaning" indicates that there is meaning in texts and that meaning needs to be understood. "Constructing meaning" indicates that often readers go beyond the meaning explicitly contained in the text and add to that meaning based on their own experience and their ability to infer additional or deeper meaning. Thus reading comprehension is much more than the ability to read individual words and know what those words mean. To comprehend what one reads is to understand the meaningful message sent by the author.

The following knowledge, skills, and dispositions are all brought to bear in comprehending a text:

Literacy Awareness

- *Literacy awareness:* Literacy awareness includes knowing that written language has meaning and purpose, and that there are conventions in printed language (e.g., left-right and top-down progression of words on the page; sequence of pages; title page; table of contents; index; etc).

Decoding Skill

- *Decoding skill:* Decoding skill includes knowledge of the alphabetic code (i.e., that there are systematic relations between the sounds of the language and written letters and combinations of letters on a page); ability to attack and decode ("sound out") familiar and unfamiliar words; and reasonable fluency (ease and speed) of decoding. Fluent decoding is critical for effective comprehension; students who do not decode fluently exhaust their limited cognitive resources on decoding and are therefore unlikely to comprehend effectively what they read.

Language Factors

- *Language knowledge: Phonological awareness:* Phonological awareness refers to awareness of the sound system of the language. This includes awareness of words that rhyme (end the same) and alliterate (start the same); ability to break words into component syllables (e.g., blackboard = black + board) and component sounds (mat = m+a+t). The latter is known as phonemic awareness and is critical for fluent decoding.
- *Language knowledge: Word knowledge:* Word knowledge includes knowing the meaning of words (e.g., understanding them when they are spoken), including multiple meanings of ambiguous words. Good readers have a broad vocabulary.
- *Language knowledge: Discourse structures:* Discourse structures are the conventional ways in which people organize stories, descriptions, explanations, and the like. For example, a simple story (or an episode in a longer story) typically begins with the characters, place and time; then moves to some event that starts the action of the episode; then describes how the main characters react to that event; then describes how they plan to deal with the issue; then presents the unfolding of the actions; then offers a resolution. This standard way to organize a story is called narrative organization, narrative discourse structure, or story grammar.
- *Language knowledge: Syntax rules:* Reading comprehension also assumes syntax knowledge and an ability to infer meaning from the order of words (e.g., "John hit Tom" means something different from "Tom hit John").

Cognitive Factors

- *Cognition: Knowledge of objects and events in the world:* Reading comprehension assumes some knowledge about the world that is described by the text. If the student is completely ignorant about the topic of a text, then comprehension will fail despite good decoding ability. Ignorance of the topic is not a reading problem per se, but certainly affects comprehension in a dramatic way for all readers. Good readers have broad world knowledge.
- *Cognition: Attentional ability:* Ability to comprehend extended text assumes the ability to maintain attention over time. When the mind wanders, comprehension falters. **[See Tutorial on Attention.]**
- *Cognition: Organizational ability:* Reading comprehension assumes an ability to relate sentences (actions and themes) presented in the text and to create a unified whole out of the parts of a text. Reading comprehension also assumes an ability to relate the information presented in a text to what the student already knows about the world. These abilities to relate or make connections are organizational skills.
- *Cognition: Memory:* Reading comprehension assumes the ability to hold many units of information in mind at one time (working memory). It also assumes the ability to encode into memory what one has read, store those memories, and later retrieve them in order to understand later parts of the text. **[See Tutorial on Memory.]**
- *Cognition: Reasoning ability:* Effective reading of a text assumes an ability to distinguish between what is important and what is unimportant, to make predictions, to interpret events, to draw inferences, and the like.

Self-Regulatory/Executive Function Processes

- *Self-regulatory/executive function processes:* Preparation for reading: Good readers know why they are reading a text, preview the text, ask themselves questions to be answered by the text, and in other ways preset themselves for comprehension. Young children may do a "book walk", that is, page through a picture book to get a sense for what the story is about. Older students will survey a text before reading, for example looking at chapter and section headings, looking at chapter comprehension questions, and the like.
- *Self-regulatory/executive function processes:* Interpretation of text as problem solving: Good readers ask questions of the text as they read. They try to summarize and get the main ideas. If there are parts of the text they do not fully understand, they take that as a problem to be solved rather than simply accepting their lack of comprehension. **[See Tutorial on Problem Solving.]**
- *Self-regulatory/executive function processes:* Comprehension monitoring: Good readers pay attention to how well they understand what they read. If there are gaps in comprehension, they do something about it, for example, by rereading sections of the text. **[See Tutorial on Self-Monitoring.]**
- *Self-regulatory/executive function processes:* Seeking help: Good readers seek help when they need it, for example by asking others for explanations, using a dictionary, and the like.
- *Self-regulatory/executive function processes:* Sense of self: Good readers have a sense of themselves as good readers and enjoy reading. **[See Tutorial on Sense of Self.]**
- *Motivational/emotional factors:* Value of reading: Good readers value the activity of reading. They take pleasure in reading and love to read. **[See Tutorial on Motivation.]**
- *Motivational/emotional factors:* Desire for improvement: Good readers constantly seek to improve their reading ability.
- Motivational/emotional factors: Goals: Good readers have goals (e.g., acquisition of more knowledge; preparation for a test) that reading will help them to achieve.
- *Motivational/emotional factors: Self-confidence:* Good readers have confidence in their ability to read and understand what they read.

In light of the wide variety of skills, knowledge, and dispositions that come together to support reading comprehension, it is not surprising that reading comprehension is an academic difficulty for many students, including many students with TBI.

Reading comprehension has many parallels with listening comprehension. For example, a listener must understand the words that are spoken, the connections among the utterances, the connections with their knowledge of the world, and the like. The most obvious difference is that with reading, the words must be

decoded from print. However there are other differences in addition to this obvious difference. For example, when one is listening, the speaker normally pays attention to whether or not he is being understood and if not, does something to improve the listener's comprehension. In the case of reading comprehension, the writer cannot modify the text to fit each reader. The text is fixed. Similarly, readers cannot ask for explanations from the writer whereas listeners can ask speakers for clarification. Thus there is a comprehension burden on readers that is greater than on listeners.

WHY IS READING COMPREHENSION IMPORTANT FOR MANY STUDENTS AFTER TBI?

Depending on age and location of the brain injury, students with TBI can have a variety of problems with components of reading and reading comprehension. For example, young children are often impaired in areas that are developing rapidly at the time of injury. At ages 6, 7, and 8, children are mastering reading decoding and decoding fluency. Therefore, an injury at that time may disrupt the process and cause persisting problems with decoding. However, most students who have learned to decode before the injury do not lose that skill after TBI.

More commonly, however, students with TBI have difficulty in areas of reading affected by cognitive and executive, self-regulatory impairments. **[See Tutorials on Cognition, Attention, Organization, Memory, Problem-Solving, Strategic Thinking and Learning, Self-Regulation/Executive Function Routines.]** Problems with attention, organization, memory, and problem solving affect reading comprehension in ways suggested by the lists above. Organizational and memory problems are particularly hard on reading comprehension. A text is typically composed of a large number of sentences expressing a large number of distinct ideas. These ideas have to be related to each other and to what one already knows about the topic if the text is to be comprehended. Relating ideas in these ways requires organizational and memory skills that are often impaired in TBI, especially frontal lobe injury.

Consider the following short narrative: "John went to a ball game yesterday. He caught a foul ball. He's happy despite the pain in his hands." Understanding this story requires bringing to bear some background understanding of baseball. It also requires perceiving the relations among the sentences. For example the happiness and pain referred to in the third sentence relate to catching the ball referred to in the second sentence. Reading is an ongoing process of "making connections" of this sort, connecting ideas in the text to one another and to background knowledge of the world. Making these connections is difficult for students with organizational and memory impairments.

Executive function/self-regulatory problems in the areas of planning, self-monitoring, problem solving, and strategic behavior also contribute to problems with reading comprehension. Learning how to comprehend what one reads is a process of acquiring and automatizing the use of reading comprehension strategies (described below). Reading in a strategic way is difficult for students with executive, self-regulatory impairments. These cognitive and executive function/self-regulatory problems are commonly observed after TBI, especially frontal lobe injury. Therefore, reading comprehension problems are also common and require special attention.

Fortunately two of the most important contributors to reading comprehension are not especially vulnerable in TBI: vocabulary and knowledge of objects and events in the world. Often students with TBI retain the knowledge of the meanings of words and their general knowledge of the world acquired before the injury. However, if the student has new learning problems, then over time vocabulary knowledge and world knowledge may become relatively weak; that is, the student may fall progressively further behind. Thus attention to these two areas of reading comprehension may be important for students with TBI.

WHAT ARE THE MAIN FEATURES OF INTERVENTION AND SUPPORT THAT ARE IMPORTANT FOR STUDENTS WITH READING COMPREHENSION PROBLEMS AFTER TBI?

Understanding the Problem

As always, step one in helping students with complex disability is understanding the problem. For example, difficulty with reading comprehension could be a consequence of weakness in any of the domains (outlined above) that contribute to successful reading. The problem exploration steps on this web site should help staff and family identify the factors associated with the student's reading difficulties. Intervention can then be targeted to the set of problems known to contribute to the student's difficulty with reading comprehension

Environmental Compensations

Students with reading comprehension problems should receive some combination of the intervention strategies outlined below to improve their reading. However, there are also compensatory procedures that might be useful in addition to more direct intervention strategies.

- *Books on tape:* Students with relatively superior listening comprehension can listen to books on tape (commercial or created for that student), possibly in combination with reading the text.
- *Condensed content:* Parents, teachers, special education specialists, or speech-language pathologists could write condensed and simplified versions of assigned readings that the student can read prior to or instead of reading the assigned text.
- *Highly condensed content and discussion:* Parents, teachers, special education specialists, or speech-language pathologists can distill main ideas from assigned readings, print them on 3X5 cards, and read the cards with the student while discussing the meaning.

Teaching Word Knowledge and World Knowledge

Critical to comprehending what one reads is an understanding of the words on the page and at least a general understanding of the topics included in the text. Students with TBI often retain their word knowledge (vocabulary) and general knowledge of the world acquired before the injury. Knowledge of this sort is stored in posterior brain regions, which are not especially vulnerable in TBI closed head injury.

However, because of problems with new learning, the student may fall progressively further behind in vocabulary knowledge and world knowledge over the years after the injury. Therefore attention to both types of knowledge may be a component of the student's comprehensive reading comprehension program. What follows are some common suggestions regarding vocabulary acquisition and acquisition of world knowledge.

Vocabulary Practice: Words from the Curriculum: Given the many thousands of words that exist in any language, teaching vocabulary can seem to be a daunting task. The most reasonable way to simplify and organize the task is to select words from the student's academic curriculum. Thus the words to be focused on by teachers, speech-language pathologists, special educators, and parents should be words that student needs to learn in order to comprehend texts and lessons in the classroom. These include words from reading books, and from science, social studies, and other content classes.

Teaching the meaning of a word includes exploring the many associations that comprise the word's meaning. In the case of a noun, for example, it is not sufficient for the student to point to a picture of the item when named. She should know what category the item falls into, what it does (if anything), what it is used for, what parts it has, what features it has, what it is made of, where it is commonly found, and other common associations. This broad and deep understanding is true knowledge of a word's meaning. Thus teachers and therapists should teach word meaning in this organized associative manner. Furthermore,

context is important in the teaching. Students should have exposure to a variety of contexts in which the word can be used, especially contexts relevant to the classroom curricula.

Parents can use and explore targeted words and their meanings during dinner time and other relaxed conversational times. Teaching word meaning at home need not be a boring "school-like" activity, but rather conversational use and exploration of the word, using language at the student's level of comprehension and connected as much as possible to the student's interests.

In addition, the more students read, the faster their vocabularies grow. Therefore there is a strong rationale for encouraging students to read as much as they can. Homes should have interesting and engaging reading materials at an appropriate reading level for the student. For example, topically interesting magazines are available at many reading levels, including sports, current events, and popular culture magazines.

World Knowledge: Themes from the Curriculum: Given the infinite extent of possible knowledge of things, places, events, and people in the world, teaching world knowledge is a genuinely daunting task. Again, the most reasonable way to simplify and organize the task is to select themes from the student's academic curriculum. General education teachers, special educators, therapists, and parents can focus on and discuss themes and issues that are found in reading texts or in the student's content classes.

As in the case of word meanings, parents can help the child acquire relevant world knowledge by knowing what is being taught at school and then weaving those curricular themes into dinner time and other relaxed conversations. In addition, discussion of daily events presented in the newspaper or on TV can help the student broaden his horizons and learn about events occurring in the world. Furthermore, the more the student reads, the more she learns about the world; therefore fun reading beyond school assignments should be encouraged.

Teaching Reading Comprehension Strategies

A great deal of research has shown that acquisition of reading comprehension strategies improves comprehension. Two separate issues are involved: selecting strategies to teach and selecting teaching procedures to teach the strategies.

Reading Comprehension Strategies: There is a relatively small set of strategies that tend to be used by good readers and taught in varying combinations in both regular and special education classrooms. They can be divided into strategic procedures used before reading, procedures used during reading, and procedures used after reading.

Strategies used before reading: Before reading a text, good readers do some combination of the following:

- *Clarify the purpose of reading:* The propose of reading might be: "I want to enjoy this; I need to find out .....; I need to understand .....; or I need to answer the following questions:....."
- *Preview or survey the text:* In joint book reading with preschoolers, parents and children might page through the book, looking at pictures and wondering out loud what the book might be about. In high school text book reading, the student might first look at the chapter questions, at the teacher's assignment, or at the section headings. In these ways, the student is surveying the text and gaining a general orientation to the content of the text much like the preschooler's "book walk". In both cases, reading comprehension is facilitated because the reader is oriented to the content of the reading.
- *Predict the content or outcome:* Predicting what will occur in the text or what will be learned from the text helps the reader attend to the material in a focused manner.

Strategies used during reading: While they are reading, good readers pause and do some combination of the following:

- *Summarize:* They try to summarize to make sure they comprehend.
- *Image:* They create a mental image of what they have read.
- *Organize:* They organize the information – make connections – possibly filling in a graphic organizer **(See Tutorial on Organization)**.
- *Elaborate:* They connect what they are reading to what they already know. This can be facilitated by routinely asking "why" questions or other questions while reading.
- *Reread:* They reread parts that they know they did not properly understand. This of course assumes that they are monitoring their comprehension. Students should be taught to routinely ask themselves, "Does this make sense?"

Strategies used after reading: After completing a text, good readers do some combination of the following:

- *Summarize:* They try to summarize what they have read to make sure they comprehend it.
- *Review:* They review in their minds the main points of the text.
- *Answer questions:* They answer questions that may have been provided by the teacher or parent.
- *Apply the content:* They try to apply the content to other domains they are familiar with or to their own experience.
- *Make judgments:* They make judgments about how good the reading was, how much they liked it, whether the reading met its purpose, and the like.

Teaching the Strategies:

1. *Select useful texts:* For example, to teach narrative organization, select a story that has an obvious organization that fits nicely into a picture of narrative organization described above.
2. *Select strategies at an appropriate developmental level:* For example, first and second graders can be taught the strategy of completing a "book walk" before reading; middle and high school students can learn how to survey a text in more sophisticated manner.
3. *Select an appropriate number of strategies to teach:* For example, young grade schoolers might learn one before-reading, one during-reading, and one after-reading strategy. Older students may be capable of acquiring a larger number of strategies and using them as a package.
4. *Explicitly teach strategies:* Students should be explicitly taught the strategies, why they are important, and how to use them, rather than assuming that they will "pick them up" with repeated exposure (e.g., observing the teacher or parent using strategies).
5. *Model strategic reading (teachers, parents, and peers):* In addition to explicit instruction, teachers and parents should show students how to use strategies and that they are helpful in comprehending texts. In a group setting, peers can model the use of strategies.
6. *Model good oral reading (teachers, peers):* Teachers and good readers should also model for other students what fluent reading sounds like, with appropriate emphasis, pauses, self-questioning, and the like.
7. *Make strategies salient (e.g., graphic organizers):* Strategies should be a salient part of the classroom environment. For example, they should be printed on posters on the wall of the classroom. Narrative organization should be represented by clear graphic (pictured) representations of that organization.
8. *Encourage deliberate, successful use of strategies:* Students should practice using strategies in a way that demonstrates their usefulness for understanding text.
9. *Encourage student self-monitoring:* Students should develop a habit of monitoring comprehension ("Do I understand what I just read?") and also monitoring the effectiveness of strategies ("Is this strategy helping?") **[See Tutorial on Self-Regulatory/Executive Function Routines.]**
10. *Gradually transfer control, with ongoing coaching:* Initially the teacher or parent should model and cue the use of strategies. Gradually, control of strategy use should be turned over to the student.
11. *Ensure transfer of strategies:* Strategies should be taught in the context of a variety of types of reading, in a variety of places, and with a variety of people.
12. *Use reading groups and discussion:* Reading groups are a useful context to practice the deliberate, out-loud use of strategies. Whether discussion takes place in reading groups, in class, or at home with parents, the level of language should match the students' abilities.

13. *Continue strategy instruction over several years of schooling:* To make strategies routine – to become a habitually effective reader – strategies should be taught and encouraged over several years of schooling.

Special Considerations for Specific Cognitive Problems after TBI

Attention: Students whose reading comprehension is negatively affected by fluctuating attention should use strategies known to be effective for attention problems. **[See Tutorial on Attention]** This might include a series of short reading sessions rather than one long session, markers in the text designed to prompt self-monitoring of attention and comprehension, and other procedures outlined in the tutorial on attention.

Organization: Students whose reading comprehension is negatively affected by organizational problems should use strategies known to be effective for those problems. **[See Tutorial on Organization]** This might include reading short passages during each reading session, placing the information into a graphic organizer, routinely asking the question, "How do these ideas go together?", and other procedures outlined in the tutorial on organization.

Memory: Students whose reading comprehension is negatively affected by memory problems should use strategies known to be effective for those problems. **[See Tutorial on Memory]** This might include frequently reviewing what has been read before proceeding with new passages, stopping to take notes while reading (and later reviewing the notes), possibly reading shortened abridged versions of longer texts, and other procedures outlined in the tutorial on memory.

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Tutorial: Concrete vs. Abstract Thinking

WHAT ARE CONCRETE AND ABSTRACT THINKING?

Abstract thinking is a level of thinking about things that is removed from the facts of the "here and now", and from specific examples of the things or concepts being thought about. Abstract thinkers are able to reflect on events and ideas, and on attributes and relationships separate from the objects that have those attributes or share those relationships. Thus, for example, a concrete thinker can think about this particular dog; a more abstract thinker can think about dogs in general. A concrete thinker can think about this *dog on this rug*; a more abstract thinker can think about *spatial relations*, like "on". A concrete thinker can see that this ball is big; a more abstract thinker can think about size in general. A concrete thinker can count three cookies; a more abstract thinker can think about *numbers*. A concrete thinker can recognize that John likes Betty; a more abstract thinker can reflect on *emotions*, like affection.

Another example of concrete thinking in young children is a two or three year old who thinks that as long as he stays out of his bedroom, it will not be bed time. In this case, the abstract concept of time (bedtime) is understood in terms of the more concrete concept of place (bedroom). The abstract idea of bedtime comes to mean the concrete idea of being in my bedroom.

Another example that applies to two or three year olds is the following. One of the favorite Dr. Seuss books is Green Eggs and Ham, which ends with the narrator changing his mind from rejecting green eggs and ham under any circumstances to trying them and actually liking them. At a *concrete* level of understanding, the story is about a stubborn person changing his mind. At a more *abstract* level of understanding, it is about people in general being capable of modifying their thoughts and desires even when they are convinced that they cannot or do not want to do so. This more abstract level of understanding can be appreciated by two and three year old children only if the higher level of meaning comes out of a discussion of the book with a more mature adult. At older ages and higher levels of thinking, this same process of more mature thinkers facilitating higher levels of abstraction in less mature thinkers characterizes the process of teaching abstract thinking. For example, this is how great philosophers, like Socrates and Plato, taught their pupils how to think abstractly.

An example of concrete versus abstract thinking in adolescence is the following. A *concrete thinking* adolescent can recognize that a good strategy in football is to make maximal use of the team's most talented players. An *abstract thinking* adolescent can recognize that this strategy in football is the same as using ones cognitive strengths in studying for an exam. In general, abstract thinkers are able to perceive analogies and relationships that others may not see and thereby understand higher levels of abstraction.

The term *abstraction* also applies to uses of language. Abstract language is said to include terms that refer to entities other than physical objects and events, for example, "justice" and "freedom" as opposed to terms that refer to actual physical things, like "chair" and "car". Abstract language also includes indirect uses of language, such as metaphors and figures of speech. For example, a concrete thinker would interpret "People who live in glass houses should not throw stones" to refer literally to breakable panes of glass. An abstract thinker, in contrast, would understand that the figure of speech means that people who have faults of their own should not criticize others. One should be careful, however, not to equate metaphor with abstract. Metaphors that were well understood before the injury (e.g., "Go take a hike") may be just as concrete and easy to understand as their literal equivalents ("Please leave"). Sometimes metaphors come to be so commonly used and easy to understand that we forget that they are metaphors, like "He's a barrel of laughs."

The terms concrete and abstract are also used to suggest how *practical or impractical* an idea might be. In this sense, concrete ideas are those that have relevance to action (e.g., a recipe is concrete because it states how to cook a dinner; a differential equation is abstract because it is not tied to action in this way). This connection to action offers teachers and parents a way to make abstract ideas more concrete (and therefore more understandable) by showing their relevance to action. For example, chemistry can be

connected to cooking or medicine; mathematics can be connected to construction. These connections with practical activity help concrete thinkers understand and appreciate abstract concepts.

Abstraction is a *relative* concept, related to the age of the child. For a two year old, "the day after tomorrow" is a highly abstract concept. For a college student, the day after tomorrow is relatively concrete, as opposed to highly abstract ideas like Heisenberg's Indeterminacy Principle. And of course there are many degrees of abstraction between these two extremes. A major component of intellectual development is this process of gradually moving from extremely concrete thinking to increasingly abstract thinking in an ever increasing array of content areas.

To some extent, concrete and abstract are *domain specific* For example, for a mathematician; concepts like exponent and equation are second nature and relatively concrete in their meaning. However, that same mathematician might find concepts like value as used in political economy to be quite abstract. The reverse might be true for a political economist. Familiarity with the content in a given domain or specialty area dictates to some extent what will be considered concrete (and therefore easy to understand) and what will be considered abstract (and therefore hard to understand).

The ability to think concretely and abstractly is also associated with the ability to transfer what is learned from one context to another. For example, a student who is a reasonably abstract thinker might learn the organization of an essay in English class and then transfer that learning to her writing in social studies class. In contrast, a concrete thinker might need to be specifically taught in both classes.

WHY ARE CONCRETE AND ABSTRACT THINKING IMPORTANT FOR MANY STUDENTS AFTER TBI?

It is often said that individuals with TBI have difficulty with abstract levels of thinking. Frontal lobe injury is typically identified as the source of this difficulty. In students with brain injury, impaired abstract thinking is frequently associated with reduced foresight, judgment, insight, reasoning, creativity, problem solving, and mental flexibility.

Indeed, one popular theory of frontal lobe function maintains that many of the symptoms associated with injury to the frontal lobes can be grouped under the general heading "stimulus-bound". In addition to the difficulties listed in the last paragraph, these individuals tend to be impulsive (directed in their actions by whatever is most salient in the here and now) and distractible (attending to events in the here and now, however irrelevant). They have difficulty with multi-step activities and in general have difficulty sustaining goal-directed activity. Within this theory, difficulties at the level of abstract thinking have the same underlying cause as impulsive behavior and difficulty modifying behavior as a result of experience.

There are other theories that account for difficulty with abstract thinking after TBI. However, most investigators agree that these difficulties are common and need to be attended to in rehabilitation and special education. Brain injury-related difficulties must, of course, be distinguished from normal developmental phenomena. In section 1 above, emphasis was placed on gradual development in childhood and adolescence from very concrete to increasingly abstract thinking. The concrete thinking of a child with brain injury may be developmentally normal, not a result of the injury.

WHAT ARE THE MAIN FEATURES OF TEACHING OR TRAINING THAT ARE IMPORTANT FOR STUDENTS WHO HAVE DIFFICULTY WITH ABSTRACT THINKING?

There are no simple solutions to the problem of concrete thinking. Indeed, many intelligent and successful adults would probably be classified as concrete thinkers in many areas of functioning. Despite their intelligence and many abilities, the likelihood that they could be trained to be theoretical physicists or philosophers is not large. With these common sense observations as background, staff and parents should enter the world of facilitating a student's abstract thinking skills with modest expectations. **(See Tutorials**

on Cognitive Rehabilitation, Attention, Memory and Memory Problems, Organization, Problem Solving, Transfer of Training, Conversation and Cognition.)

Understanding the Problem

As always, the first task for teachers and parents is to correctly understand the problem. The concrete thinking associated with brain injury can easily be misidentified as mental retardation or a general problem with learning. Students with abstract thinking problems might be reasonably effective learners and processors of information in select domains.

Having identified the difficulty with abstract thinking, parents and educators should become familiar with the compensations they can implement and procedures to gradually improve the student's ability to think abstractly.

Environmental Compensations and Strategies

Competent and Sensitive Communication Partners: Knowing that a student is a concrete thinker, communication partners, including teachers and parents, should adjust their language accordingly. They should either avoid the use of language that is at too high a level of abstraction, or link abstract language with its concrete equivalent. For example, in encouraging a student to study hard, a parent might say, "You've got to give it your best shot – study real hard." "Give it your best shot" is a metaphor that might be too abstract; "study real hard" is a literal or concrete equivalent.

Using Concrete Meanings to Support Comprehension of Abstract Concepts: When learning to add and subtract, first graders commonly rely on their fingers or other physical objects to represent the abstract numbers. The children's conceptual transition into the world of abstract numbers is supported by the representation of those numbers in physical things that can be seen, held, and moved. Similarly, concrete thinking high school students might be able to understand an abstract social arrangement, like the caste system in India, by comparing it to social cliques they are familiar with in their school. Discussing similarities and differences between that which is unfamiliar and distant (i.e., abstract) and that which is familiar and close to home (i.e., concrete) is a valuable way to help students grasp the abstract concept.

Facilitating the Development of Abstract Thinking

There are no known "exercises" in abstract thinking that have the effect of turning a concrete thinker into an abstract thinker across domains of content. Sometimes practice with "brain teasers" or math and logic problems is suggested as a means to facilitate more abstract thinking. However, there is no evidence that practice of this sort enhances abstract thinking in a generalizable way. That is, a person can improve performance with brain teasers, math problems, and logic problems with no transfer to other domains of thinking. This failure of transfer is connected with the theme of "domain specificity" introduced earlier: a person can be a reasonably flexible and abstract thinker in one area (e.g., sports) and remain a concrete thinker in another area (e.g., literature). Therefore, attempts to facilitate increasingly abstract thinking should be made within all relevant academic areas (e.g., math, literature, science, social studies), without expecting that improvements in one area will yield improvements in another area. If possible, similar language and analogies should be used (e.g., by parents and teachers) across areas so as not to overwhelm students with too much information or too many comparisons. Schools should not expect that exercises in abstract thinking in a therapy context (e.g., a speech-language therapist using workbook exercises in abstract thinking) will transfer to other academic or social domains.

An alternative to "exercises" (like brain teasers) is to consider how the great thinkers of the past successfully taught their students how to think more deeply and abstractly, and how parents of young children facilitate the development of their child's thought processes. In the latter case, there is considerable evidence showing that parents who think out loud with their children in ways suggested by the following list facilitate their child's cognitive development. That is, parents who think out loud with their children in these ways have children who, other things being equal, develop organized, deep, and abstract thinking more quickly than comparable children who do not spend time with adults who think out loud with them in these ways. Teachers can play the same thinking-out-loud role with students. In effect, adults are taking children on as "apprentices in thinking" as they think out loud with the children. As adults think out

loud with children, they should routinely seek feedback from the student to ensure that the adult's "out-loud thinking" is being understood and perhaps even triggering the student's thought processes.

- *Think out loud with the student:* Great teachers of thinking, like Socrates, spend much of their time thinking through issues with their students, leading them gradually to ever higher levels of understanding and abstraction. Similarly it is known that parents who think out loud in an organized and compelling way with their young children facilitate the child's development of systematically higher levels of thinking, better organized thinking, and better problem solving. In home and classroom discussions, this out-loud thinking about important topics can be organized around the following thought processes:
    - searches for *explanations* (e.g., *why* and *how* questions)
    - searches for *analogies* to make the subject matter more understandable (e.g., "Let's think about what this might be like in your life; what are other examples of this?")
    - searches for *alternative perspectives* (e.g., "Are there other ways to think about this? How might other people think about this?")
    - ways to *organize* the topic and make connections (e.g., "I think there are three separate issues here that we should consider in order"; "Let's try to think about what this might be connected to")
    - ways to *evaluate* (e.g., "How can we decide if this is a good thing or not?")
    - ways to *draw inferences* (e.g., "If this is true, then what else must be true?")

- *Think out loud with the student about issues that are interesting and important:* Issues that can be jointly thought about include topics from the student's curriculum and school books as well as issues of personal importance. There are few issues that do not lend themselves to thinking about at a somewhat higher or more abstract level. These think-out-loud sessions can be lively and enjoyable dinner time conversations.

- *Highlight the thinking process:* In connection with abstract thinking, discussions with adolescents should highlight the words *concrete and abstract* (e.g., "That is how the story might be interpreted in a concrete way…. But now let me give you a more abstract understanding."). Similarly, adults should not only explore explanations, but also explicitly describe this explanatory thought process as a way to derive explanations; they should not only explore analogies, but also explicitly describe this analogical thought process as a way to see connections; they should not only make organized connections, but also explicitly describe this organizational thought process as a way to become more organized in thinking. Talking about the thought processes and giving them a name facilitates an understanding of those thought processes, how to use them, and when to use them.

- Use *illuminating and motivating analogies*: Just as finger counting makes abstract numbers and arithmetic operations more concrete for six year old children, so also meaningful analogies make abstract material more concrete for older students. For example, in explaining the three branches of government to a concrete thinking high school student, a teacher might say, "When your parents create rules for you, they are functioning like the legislative branch of government. When they enforce those rules, they are functioning like the executive branch. When they try to resolve conflicts between you and your sister, they are functioning like the judicial branch." This use of analogies connects the unfamiliar with the familiar, thereby making the abstract and unfamiliar more concrete and understandable.

- *Use external supports as needed:* In logic, Venn diagrams (overlapping circles) are used to "concretely" represent logical relationships among propositions. Similarly, a time line flow chart might be used to represent relationships among events in time. Models of the solar system are used to represent relationships among the sun, planets, and moons. When a product that needs assembly is opened, there is usually a sequence of pictures showing exactly how to put the object together. Each of these two- or three-dimensional representations of the organization of that which is represented can be considered a "map" – a concrete representation of more abstract relationships. The map guides one through unfamiliar territory and if you don't know the territory, you need a map!

- Other graphic organizers can be used to represent other relationships and organizational systems. **[See Tutorials on Organization; Advance Organizers; Reading Comprehension; Written Composition.]**

- *Gradually remove the supports:* Just as primary grade teachers try to gradually remove their students' reliance on fingers and other objects as they do simple adding and subtracting problems, so also teachers at every level – and parents – should gradually remove the concrete supports that they use to facilitate the child's more abstract thinking skills. For example, a graphic organizer with boxes and connecting arrows, used to represent narrative organization for elementary school students, might be gradually transformed into a simple outline for middle schoolers.

Specialists in cognitive development and intervention may be able to assist school staff in their attempts to facilitate development of abstract thinking in students with brain injury.

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Tutorial: Written Composition

WHAT IS WRITTEN COMPOSITION?

Writing a composition is a complex activity that includes the mechanics of writing, including handwriting (or keyboarding, using an adaptive device, etc.), spelling, and the basics of language knowledge (i.e., word morphology, syntax, and vocabulary). In addition it includes the following cognitive, meta-cognitive, self-regulatory, and motivational aspects:

- generating ideas to put into print
- planning what to say and how to say it
- organizing the ideas into a coherent whole
- recognizing the needs of readers and how to meet those needs
- translating these plans into a written text, including a style of writing and word choice appropriate to the writing task and projected readers
- remembering all of the components that need to be included in producing the composition
- self-monitoring the process and reviewing the content, organization, and mechanics and then editing as needed
- possessing the cognitive capacity to deal with all of these aspects of complexity
- possessing the confidence, motivation, and perseverance to engage in the hard work needed to create a well written product

Written composition also includes all of the processes related to reading comprehension. **(See Tutorial on Reading Comprehension)** Reading comprehension includes a large number of linguistic, cognitive, strategic/self-regulatory, and motivational processes involved in deriving meaning from written language (including books and other forms of written language) and constructing meaning from written language. Problems in any of these areas may contribute to writing difficulties.

Because of the complexity of its demands, writing is considered by many students with and without disability to be their most challenging academic task. College and university professors often comment on the inadequate writing proficiency of their undergraduate and even graduate students. Therefore it is no surprise that writing is among the major concerns for students with learning and other cognitive and language disabilities.

WHY IS WRITTEN COMPOSITION IMPORTANT FOR MANY STUDENTS AFTER TBI?

The writing of students with learning problems, regardless of their cause, tends to be short, comprising a list of topic ideas versus a coherent and effectively elaborated discussion. The writing tends to be done with little or no planning and with little or no monitoring, evaluating, revising, and editing. Students with learning problems tend to have difficulty sustaining the effort needed to write well, a problem that is worsened if the student has difficulty with writing mechanics (e.g., handwriting, spelling). Generally these students produce more output when allowed to dictate their assignment rather than write it.

If the student with TBI was competent with writing mechanics (e.g., hand writing and spelling) before the injury, it is likely that this competence will return. However, the characteristic problems encountered after TBI may make the other writing problems listed above even worse. For example, associated with frontal lobe injury are the following difficulties that negatively affect writing: difficulty generating ideas; difficulty planning and organizing a multi-faceted task; reduced insight into the needs of others, including the readers of one's writing; reduced space in working memory, thereby making it difficult to hold in mind all of the components of a writing task; reduced self-awareness of impairments and inefficient self-monitoring, thereby reducing the likelihood of reviewing, revising, and editing; and reduced perseverance. **(See Tutorials on Organization, Memory, Attention, Egocentrism, Self-Awareness)**

Students who are injured in the early grades when writing skills are being developed may be seriously impaired in all of the skills that go into proficient writing, including writing mechanics.

Specifically related to the executive function/self-regulatory aspects of writing (associated with frontal lobe injury), students with TBI may not:

- understand the nature of their difficulties **(See Tutorial on Self-Awareness.)**
- know that there are special procedures (strategies) that help them to succeed in difficult writing tasks **(See Tutorial on Cognitive and Learning Strategies.)**
- use the procedures and supports available to them as they plan their writing and then execute the writing plan
- consider their writing from the perspective of the reader **(See Tutorial on Egocentrism.)**
- monitor their successes and failures **(See Tutorial on Self-Monitoring.)**
- persevere in planning, executing, and monitoring their writing
- attribute their successes and failures correctly to their own effort
- take responsibility for doing what they need to do to succeed with their writing

For all of these reasons, writing (written composition) tends to be a serious difficulty for students with TBI.

WHAT ARE THE MAIN FEATURES OF INTERVENTION AND SUPPORT THAT ARE IMPORTANT FOR STUDENTS WITH WRITTEN COMPOSITION PROBLEMS AFTER TBI?

Understanding the Problem

As always, step one in helping students with complex disability is understanding the problem. For example, difficulty with written composition could be a consequence of weakness in any of the domains (outlined above) that contribute to successful writing. In addition, the student might have difficulty with writing because of attention problems, poor orientation to task, behavioral resistance, discouragement as a result of a history of failure with writing, or other underlying problem. The problem exploration steps on this web site should help staff and family identify the factors associated with the student's writing difficulties. Intervention can then be targeted to the set of problems known to contribute to the student's difficulty with writing.

Environmental Compensations

Students with writing problems should receive some combination of the intervention strategies outlined below (under "Improving Writing") to improve their writing. However, there are also environmental compensatory procedures that might be useful while also implementing intervention strategies.

- Dictation: Students with relatively superior oral composition skills can dictate their compositions to another person or into a tape recorder. Their dictation can then be written (by the student or others), with coached revising and editing to follow. Alternatively the student can use software designed to transcribe dictation into a written product (e.g., Dragon Naturally Speaking). This option has the advantage of potentially facilitating the student's independence, but may require considerable effort to gain facility with the software.
- Models: Models of finished products can be shown to the students so that they know what their composition should generally look like when it is finished.
- Time lines, checklists, editing "cheat sheets": Students with and without disability tend to benefit from time lines for their writing, a checklist of components to include in the writing, and an editing "cheat sheet" that highlights likely editing needs and how to edit.

- Graphic Organizers: Teachers can show students a graphic organizer (e.g., a series of boxes and connecting arrows) that illustrates the content and the organization for a piece of writing. **(See Tutorial on Advance Organizers.)**
- Oral Advance Organizer: Many students with difficulty generating and organizing ideas for written composition benefit from pre-writing of points made during a conversation in which the teacher (or parent) asks questions that prompt thinking and organizing. These questions would include: "What topic would you like to/are you supposed to write about?" What do you know about that topic… make a list." "What do you have to find out… make a list." "What would be important to say first to introduce your topic… write that down." "After the introduction, what would be important to say next?" "Let's think of something really interesting to say about this" and so on.
- Collaborative Writing: Collaborative writing is a component of the instructional program described in the next section. But it could also be considered an environmental compensation. Using this approach, students with significant writing problems who are unlikely to produce anything resembling effective written compositions may work collaboratively for an extended period of time with teachers and parents as they work to master basic skills and strategies related to writing. With this approach, there will be meaningful written products during an extended period of basic skill development, thus facilitating motivation to write.

Improving Students' Writing: Process and Product

The goals of a comprehensive writing program designed to improve written composition, elementary school through high school, include the following

- to improve the written products, including mechanics (handwriting, spelling, grammar), elaboration of topics, organization of topics, word choice, and general style of writing
- to improve the students' planful, strategic manner of writing
- to increase the students' knowledge of writing as a process
- to improve all executive function/self-regulatory aspects of writing, including self-awareness, goal setting, planning and organizing, self-instructing, self-monitoring, self-correcting, and self reinforcing
- to enhance motivation and improve perseverance – and in general to improve self-concept as a writer

Therefore writing instruction should be organized within a broadly focused instructional approach that teaches mechanics, writing strategies, self-regulation of strategies and of the writing process, and correct attribution of success and failure. The instructional process should also explicitly address motivation and self-concept as a writer.

It is known that the writing of students with learning problems improves when the "self-regulatory" aspects of writing are "scaffolded", that is cued and supported by the teacher or parent. For example, when students are given a selection of evaluation statements about their writing (e.g., "This paragraph is complete and says everything I want to say") and a selection of revising statements to apply to their writing (e.g., "I need to say this more clearly; I need to say more."), their writing improves. Furthermore, programs of intervention designed to teach writing strategies and self-regulation through the writing process have been shown to be very successful for a variety of students with learning, cognitive, emotional, and other disabilities.

The writing instructional program with the most substantial body of research support is called "Self-Regulated Strategy Development" (SRSD, Steve Graham and Karen Harris). The approach has been shown to be effective with students from grade two through high school. It has been effectively used with regular education students, at risk students, and students with environmentally challenged backgrounds, learning disabilities, attention deficit/hyperactivity disorder, and emotional and behavioral problems. Because the approach has this extensive evidence base and is consistent with the needs of many students with TBI, it will be used to structure this section of the tutorial on instructional strategies. SRSD is sometimes

integrated within – and supplements – the Writer's Workshop, a popular approach to writing in the schools. SRSD has also been used in other instructional domains, including reading and mathematics.

SRSD has five interacting goal areas, which are integrated in the instructional process:

- Improve written products (behavior)
- Improve planful/strategic manner of composition (cognition)
- Increase knowledge about writing and the writing process (meta-cognition)
- Improve all aspects of self-regulation related to writing (e.g., self-assessment, goal setting, self-instructing, self-monitoring, self-reinforcing, managing the environment)
- Enhance motivation and sense of self as a writer (affect)

Consistent with the **Tutorial on Executive Function/Self-Regulation Routines**, self-regulation goals are integrated throughout the instructional process. This process of instruction avoids isolated skills training, decontextualized learning of sub skills, or passive learning of any sort. In contrast, students are engaged at every stage and there is meaningful writing at every stage, while at the same time explicit instruction of strategies and other processes is provided.

Stages in SRSD instruction for written composition:

Stage 1: Develop background knowledge and skills. For example, in order to write a good story, the student may need to learn the components of a typical story. At this stage, the self-regulatory component of goal setting might be introduced.

Stage 2: Explicitly teach and discuss the strategy. At this stage, a specific writing strategy is taught, for example SPACE for story writing: S: setting (characters, place and time); P: purpose (what starts the action?); A: action (how does the action unfold?); C: conclusion (how does the story end? how is the action resolved?); E: emotions (how do the main characters feel about the events of the story?) At this stage, the self-regulatory components of self-instructing and self-monitoring might be introduced.

Stage 3: Model the process of strategic writing: At this stage, the teacher demonstrates for the student how the strategies work in producing a good product. The teacher also models and reinforces goal setting, self-instructing, and self-monitoring.

Stage 4: Memorize the strategy mnemonics: The strategy must be practiced until it is memorized.

Stage 5: Engage in supported collaborative practice: At this stage the teacher and student practice writing together and jointly use their strategies and self-regulatory scripts (now including self-reinforcing), with the teacher fading support for both as it becomes possible to do so.

Stage 6: Demonstrate independent performance: Strategy procedures and self-regulation scripts are reinforced, and the student is encouraged to fade their explicit use as they become automatic.

Composition Aspects of Writing

To improve the length, organization, and completeness of the student's writing, composition strategies are taught. Some of these strategies relate to the general process of writing, others to the components and organization of specific genres of writing (e.g., narrative versus persuasive writing). For example, within the SRSD instructional process, there are two possible shorthand strategies for the general process of writing. Students are encouraged to memorize the abbreviations.

POW

P: Pick a topic to write about.

O: Organize possible ideas into a plan.

W: Write and keep planning.

THINK – PLAN – WRITE

Think: Who will read it? Why am I writing?

Plan: What will I say?

Write: Write and say more!!

Strategies for specific genres (or types) of writing include the following:

For narrative (story) writing: **WWW What 2 How 2**

W; Who are the main characters?

W; When does the story take place?

W; Where does the story take place?

What; What do the characters want to do?

What: What happens when they try to do it?

How: How does the story end?

How: How do the main characters feel?

Also for narrative (story) writing: **SPACE**

S: Setting: characters place and time

P: Purpose: What starts the action? What is the problem or issue that leads to the action?

A: Action: How does the action unfold?

C: Conclusion: How does the story end; how is the action resolved?

E: Emotions: How do the main characters feel about the events of the story?

For persuasive essays: **TREE**

For young writers

T: Tell what you believe (State your topic sentence)

R: Give two or more reasons (Why do I believe this?)

E: End it (Wrap it up right)

E: Examine it (Do I have all of my parts)

For older writers, **TREE** shifts to:

T: Tell what you believe (State your topic sentence)

R: Give two or more reasons (Why do I believe this?)

E: Explain the reasons

E: End it

For students who are concrete in their thinking, graphic organizers (e.g., boxes connected in a certain order) can be added to illustrate visually the components of a genre of writing and how those components relate to each other. Please see the **Tutorial on Advance Organizers** for details about graphic organizers.

Self-Regulatory Aspects of Writing

As outlined earlier, facilitating the self-regulatory dimensions of writing is embedded throughout the instructional process. SRSD assumes that good writing not only requires the use of effective writing strategies (and good mechanics), but also requires mature self-regulation throughout the process of writing. These self-regulatory processes include:

- Self-Awareness: To succeed with writing, students need to know that writing is difficult for them and, specifically, what their weak areas are so that they can compensate effectively.
- Goal Setting: To succeed with writing, students need to know what they are trying to accomplish with their writing, who the audience is, and what the audience needs.
- Planning and Organizing: Written compositions are complex products with many components. To succeed, students need to know how to plan and organize their writing process.
- Self-Instructing: To succeed with writing, students need strategies, but also need to acquire a habit of instructing themselves to use their strategies.
- Self-Monitoring: To succeed with writing, students need to pay attention to the process and notice when they are missing a component or making mistakes.
- Self-Correcting: To succeed with writing, students need to edit their work for mechanics (handwriting, spelling, grammar), elaboration, organization, and style.
- Self Reinforcing: To develop a positive sense of self as a writer and to maintain motivation, students need to reward themselves when they complete aspects of their writing and especially when they receive positive feedback from teachers.

See the **Tutorial on Executive Function/Self-Regulatory Routines** for more information on self-regulation.

Motivational Aspects

Writing is hard for most students. Even professional writers freely admit that writing is hard. Students with learning and information processing problems, including those with TBI, have particular difficulty with writing and easily become discouraged. This leads to resistance with writing and, in turn, to written products that are short and inadequate in many ways. Writing is complex and time consuming, thus requiring high levels of motivation and perseverance.

How is this motivation achieved? (See Tutorial on Motivation) Stages 3 and 5 of the SRSD instructional process outlined above emphasize a collaborative approach to writing. Teachers and parents can model the writing process and then work collaboratively with the students before they are expected to produce a good piece of writing independently. This collaboration ensures that frustration is minimized and that the student experiences at least a modest level of success, one of the keystones of motivation.

In addition, students are explicitly taught writing strategies that, if followed, guarantee that the written product will include the necessary components in their correct order. This additional support also contributes to success and a feeling of accomplishment. Furthermore, students are encouraged to work together in pairs or groups of writers, thereby adding to the contributors to success as well as the motivation that (often) comes with group work.

Like most good instruction, SRSD is criterion based rather than time based; that is, the students don't move on until they achieve adequate mastery of each step in the instructional process. And the students are encouraged to monitor and reinforce themselves as they proceed successfully through the steps of writing. The students' writing should also be shared with others so that there is the feeling of accomplishment associated with completing a project that has a purpose and good outcome.

Motivation is enhanced when some of the writing assignments have a larger purpose, for example letters to congressman about issues in which the students take an interest. Teachers and parents should model enthusiasm as they write with the student (e.g., "We did it! This sounds terrific! I feel great when I'm able to say what I want to say and say it clearly!").

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Tutorial: LANGUAGE COMPREHENSION

(See also Tutorial on Reading Comprehension

WHAT IS LANGUAGE COMPREHENSION?

Understanding what other people say and write (i.e., language comprehension) is more complicated than it might at first appear. Comprehending language involves a variety of capacities, skills, processes, knowledge, and dispositions that are used to derive meaning from spoken, written, and signed language. In this broad sense, language comprehension includes reading comprehension, which has been addressed in a separate tutorial, as well as comprehension of sign language. **(See Tutorial on Reading Comprehension)** Deriving meaning from spoken language involves much more than knowing the meaning of words and understanding what is intended when those words are put together in a certain way. The following categories of capacity, knowledge, skill, and dispositions are all brought to bear in fully comprehending what another person says.

Communication Awareness

- *Communication awareness* includes knowing (1) that spoken language has meaning and purpose, (2) that spoken words, the organization of the words, their intonation, loudness, and stress patterns, gestures, facial expression, proximity, and posture all contribute to meaning, (3) that context factors need to be taken into consideration in interpreting what people mean to communicate, (4) that it is easy to misinterpret another's communication, and (5) that it often requires effort to correctly interpret another person's intended meaning and that correct interpretation is worth the effort!

Hearing and Auditory Processing

- Understanding a spoken utterance assumes that the listener's hearing is adequate and that the spoken sounds are correctly perceived as phonemes of English (or whatever language is spoken). Phonemes are the smallest units of spoken language that make a difference to meaning – corresponding roughly to the letters in a word (e.g., the sounds that 't', 'a', and 'n' make in the word 'tan'). Auditory processing of language also includes the ability to integrate the separate sounds of a word into the perception of a meaningful word and of sequences of meaningful words.

Word Knowledge and World Knowledge

- *Word knowledge* includes knowing the meaning of words (e.g., understanding them when they are spoken), including multiple meanings of ambiguous words. Knowing the meaning of a word is more than knowing what (if anything) that word refers to. Rather it is possession of a large set of meaning associations that comprise the word's full meaning. For example knowing the meaning of the word "horse" includes knowing that horses are animals, that they engage in specific types of activities, that they have many uses, that they have specific parts, that they have a certain size, shape, and other attributes, that they are characteristically found in specific places, and the like. Understanding spoken language requires an adequate vocabulary, which is a critical component of the semantics of a language. Word meanings may be concrete (e.g., "ball" refers to round objects that bounce) or abstract (e.g., "justice" refers to fairness in the pursuit or distribution of various types of goods and services).
- ***World knowledge*** includes understanding the realities in the world – objects and their attributes, actions and their attributes, people, relationships, and the like – that words refer to and describe. For example, if a student has no knowledge of computers, then it is impossible to fully understand the word 'computer'.

Knowledge of Word Organization

- *Syntax* (or grammar) refers to the rules that govern the organization of words in a sentence or utterance. Comprehending an utterance requires an ability to decipher the meaning implicit in the organization of words. For example, "Tom fed the dog" and "The dog fed Tom" have different meanings despite containing exactly the same words.
- *Morphology* (a component of grammar) refers to rules that govern meaning contained in the structure of the words themselves. Changes within words (e.g., adding an 's' to 'dog' to get 'dogs', or adding an 'ed' to 'kick' to get 'kicked') affects meaning. Comprehending an utterance requires an ability to decipher the meaning associated with such modifications of the words.

Discourse

- Just as there are rules that govern how speakers put words together in a sentence to communicate their intended meaning, there are also rules that govern how sentences (or thoughts) are organized to effectively tell stories, describe objects and people, give directions, explain complex concepts or events, influence people's beliefs and actions, and the like. These are called **rules of discourse**. Effective comprehension of extended language (e.g., listening to a story or a lecture) assumes that the listener has some idea of what to listen for and in what order that information might come.

Social Knowledge and Pragmatics

Pragmatics refers to the rules governing the use of language in context (including social context) for purposes of sending and receiving varied types of messages, maintaining a flow of conversation, and adhering to social rules that apply to specific contexts of interaction. On the comprehension side of communication, the first of these three types of rules is most critical. For example, comprehending the sentence, "I will do it" requires deciding whether the speaker intends to make a promise, a prediction, or a threat. Similarly "We'd love to have you over for dinner" could be an invitation, a statement of an abstract desire, or an empty social nicety. Or "Johnny, I see you've been working hard at cleaning your room" could be a description of hard work or a mother's ironic criticism of Johnny for not working on his room. In each case, correct interpretation of the utterance requires consideration of context information, knowledge of the speaker, understanding of events that preceded the interaction, and general social knowledge. **(See also the Tutorials on Social Competence; Social Perception.)**

Indirect Meanings include metaphor (e.g., "He's a real spitfire"), sarcasm and irony (e.g., "You look terrific" said to a person who appears to be very sick), idioms or other figures of speech (e.g., "People who live in glass houses shouldn't throw stones"), hyperbole (e.g., "The story I wrote is about a million pages long!"), and personification (e.g., "Careful! Not studying for a test can jump up and bite you!"). Comprehending indirect meanings often requires abstract thinking and consideration of context cues. Students with brain injury often have significant difficulty deciphering the meaning of such indirect communication unless the specific use of words was familiar before the injury. Understanding new metaphors, figures of speech and the like makes significant demands on cognitive processing (e.g., working memory, reasoning), discussed next.

Cognitive Functions that Support Language Comprehension

- **Attention:** Comprehending spoken language requires the ability to focus attention simultaneously on the speaker's words and nonverbal behavior (e.g., gesture, facial expression, body posture), to maintain that focus over time, to focus simultaneously on one's own response, and to flexibly shift attentional focus as topics change.
- **Working Memory:** Comprehending spoken language requires the ability to hold several pieces of information in mind at the same time, possibly including the words that the speaker just uttered, previous turns in the conversation, other information about the speaker, the topic, and the context, and the like.
- **Speed of Processing:** Because the units of spoken language arrive in rapid succession, comprehension requires the ability to process information quickly.

- **Organization:** Comprehending spoken language requires that the listener put together (i.e., organize) the various comments that the speaker makes, together with the listener's own comments, background information, and the like. This assumes considerable organizational skill.
- **Reasoning:** Comprehending a speaker's intended meaning is often a reasoning process. For example, if a speaker says, "I'm really busy today" and later in the conversation says, "I can't come over to your house after school today," the listener should be able to reason that the speaker is not being rude in rejecting an invitation, but rather is unable to come over because of his busy schedule.
- **Abstract thinking ability:** Comprehending abstract language, metaphors, figures of speech, and the like often requires a reasonable level of abstract thinking ability. (See Indirect Meanings, above.)
- **Perspective Taking:** Comprehending the intent underlying a speaker's message critically relies on the ability to take that person's perspective. For example, when a speaker says, "Don't worry; it's not a problem," he just might intend to communicate that it is a huge problem! Correctly interpreting this message requires "mind reading" – getting inside the speaker's frame of reference and understanding the issues and the words from that person's perspective.
- **Comprehension Monitoring and Strategic Behavior:** Effective comprehension of spoken language requires routine monitoring of comprehension, detection of possible comprehension failures, a desire to fix breakdowns, and a strategic ability to repair the breakdown, for example by saying things like, "I'm not sure I understand what you mean; could you explain?"

In light of the wide variety of skills, knowledge, and dispositions that come together to support language comprehension, it is not surprising that language comprehension is a communication difficulty for many students, including many students with TBI.

WHY IS LANGUAGE COMPREHENSION IMPORTANT FOR MANY STUDENTS AFTER TBI?

Depending on age and location and severity of the brain injury, students with TBI can have varied profiles of strengths and weaknesses with components of language comprehension and language expression. Often, basic language knowledge and skills acquired before the injury, including word meanings, are recovered after the injury. However, children are commonly impaired in areas that are developing rapidly at the time of injury. For example, at ages 6, 7, and 8, children are learning vocabulary related to success in the classroom (e.g., the words that teachers use in giving instructions) and success in social life (e.g., the language of peer interaction, compliments, teasing, and the like). The transition into adolescence is similarly a time when new and abstract vocabulary and a new and complex social code are being learned. Therefore, an injury at those times may disrupt the process of learning and cause persisting problems with language comprehension in school and social life.

More generally, students with TBI often have problems with memory and new learning, related to damage to the vulnerable hippocampus and also to the frontal lobes. **(See Tutorials on Memory, Retrieval)** Therefore, students injured at a relatively young age may have difficulty learning new words, rules of grammar, rules for organizing discourse, and pragmatic/social rules typically learned at older ages. The student may appear increasingly delayed in these areas over time. This gap between language knowledge and developmental expectations may become increasingly obvious in adolescence. Adolescents are expected to comprehend increasingly abstract and academic language, and also to comprehend increasingly subtle social language and nonverbal cues. A student injured before adolescence or in the early adolescent years may have difficulty in these domains and may therefore require intensive teaching and considerable support to meet these later developmental expectations as effectively as possible. **(See Tutorials on Concrete versus Abstract Thinking; Social Perception, Social Competence)**

Because procedural learning tends to be better preserved after TBI than declarative memory, learning rules of grammar is often less problematic than learning new and abstract word meanings, and considerably less problematic than succeeding in the discourse and social pragmatic domains. **(See Tutorial on Memory)** Both discourse and social pragmatic competence presuppose effective organization, reasoning, social perception and cognition, and working memory. Each of these cognitive domains is vulnerable following TBI.

Students with TBI also frequently have difficulties with other components of cognition and self-regulation that influence language comprehension. These include problems in the areas of attention, organization, reasoning, abstract thinking, perspective taking, and comprehension monitoring. (**See Tutorials on Attention; Organization; Concrete versus Abstract Thinking; Egocentrism; Self-monitoring**) Each of these areas of difficulty is associated with damage to the vulnerable frontal lobes. It is also extremely common for students with TBI to process information slowly. Slow processing can be caused by damage to the structure that connects the two halves of the brain (i.e., the corpus callosum), to the long axons that connect nerve cells (neurons) and networks of neurons throughout the brain, or to the frontal lobes themselves. (**See the Tutorial on Slow Processing.**)

Comprehending spoken language might not seem to be an organizational task, but consider what needs to be done to understand the following little story: "I went to a game yesterday with my dad. I caught a foul ball. I'm really happy to have the ball, but my hands still sting!" Understanding this story requires bringing to bear some background understanding of baseball. It also requires perceiving the relations among the sentences. For example the happiness and pain referred to in the third sentence relate to catching the ball referred to in the second sentence. Language comprehension is an ongoing process of "making connections" of this sort, connecting ideas to one another as the speaker expresses them and also to background knowledge of the world. Making these connections is difficult for students with organizational, memory, and reasoning impairments, common after TBI. (**See Tutorials on Organization; Memory**)

Difficulty with the social aspects of language and language pragmatics, for effective expression and comprehension alike, is also common after TBI. In some cases this is due to the fact that the child was injured at a young age and may not have matured sufficiently to engage in effective social interaction with peers later in development. In other cases, difficulty with the social and pragmatic aspects of language is a direct result of damage to parts of the brain that facilitate processing of social information. Damage to vulnerable prefrontal areas, in association with the amygdala, parietal lobes, insula, anterior cingulate gyrus, and basal ganglia (possibly right hemisphere more than left) results in difficulty interpreting the emotional states of others and "reading" the non-literal aspects of their communication. (**See Tutorials on Social Perception; Social Competence; Cognitive Egocentrism/Theory of Mind**)

WHAT ARE THE MAIN FEATURES OF INTERVENTION AND SUPPORT THAT ARE IMPORTANT FOR STUDENTS WITH LANGUAGE COMPREHENSION PROBLEMS AFTER TBI?

Understanding the Problem

As always, step one in helping students with complex disability is understanding the problem. For example, difficulty with comprehension of language could be a consequence of weakness in any of the domains (outlined above) that contribute to successful comprehension. The problem exploration steps on this web site should help staff and family identify the factors associated with the student's difficulties. Intervention and support can then be targeted to the set of problems known to contribute to the student's difficulty with language comprehension

Environmental Compensations

Students with language comprehension problems should receive some combination of the intervention strategies outlined later in this tutorial to improve their comprehension. However, there are also compensatory environmental procedures or accommodations that might be useful in addition to more direct teaching strategies.

- **Understanding:** Parents, teachers, other relevant adults, and possibly even peers should understand the nature of the student's language comprehension weakness so that they will be in a position to make appropriate adjustments as they speak to the student, without speaking in a condescending or infantilizing manner.

- **Adjustments in the rate of speech:** For students who process information (including language) slowly, adjustments should be made. This does not mean speaking each word slowly in a drone-like manner. Rather it means speaking clearly and allowing greater than normal pause time (processing time) between meaningful units of information (phrases or short sentences). However, for students with a significantly reduced attention span, slowing the rate of speech input may be counter-productive; the student's attention may be lost. Lengthy instructions should be accompanied by simple written instructions or possibly picture cues to which the student can refer when necessary (assuming adequate reading ability for written instructions). If lecture notes are available in advance, the student can be "primed" for the content of the lecture in order to comprehend more effectively.
- **Adjustments in the amount of speech:** For students who process information slowly or have difficulty organizing information, reasonable limits should be placed on the amount of information given at one time. After a few units of information, it may be useful to have the student summarize what she has understood of the information already given. Then the speaker can proceed. Lengthy instructions should be broken into parts and also accompanied by simple written instructions that the student can refer to when needed (assuming adequate reading ability), or pictured instructions. High school or college students who are required to take lecture courses may need condensed versions of the lectures – organized summaries – in written form or notes taken by an assistant teacher.
- **Adjustments in the abstractness of language:** For students who are concrete thinkers and who have difficulty processing abstract meanings and abstract or indirect forms of language (e.g., metaphor, sarcasm), reasonable adjustments should be made. This does not mean eliminating abstract and indirect language from the speech directed to the student. Rather it means some combination of the following adjustments: (1) Use metaphors and figures of speech that you know the student understands, or accompany an unfamiliar metaphor or figure of speech with a simple embedded explanation (e.g., "John, you're going to fall flat on your face if you don't study… you know what I mean… you'll fail and then be very unhappy"). (2) Similarly, words with abstract meanings should be accompanied by simple definitions built into the speech directed to the student (e.g., "The judicial branch of government is responsible for interpreting the laws, that is, judges and courts must decide exactly what a law means and whether a person or organization has broken the law").
- **Supports for understanding social interaction:** As explained in the tutorial on Social Perception, students who have difficulty understanding the intent of a speaker's message may need to have that intent made explicit. For example, a communication partner may need to say "Let me tell you a joke…" rather than just telling the joke; or the communication partner may routinely add "Just kidding" after a tease rather than leaving it up to the student with social perception impairment to figure out that it is teasing. In these and other ways, communication partners can make their mental states known to the student with social perception and comprehension deficits.
- **Visual supports:** Visual supports are useful for students with impaired comprehension of spoken language. These supports can range from visual schedules and ample gestural support for young students to written instructions and lecture summaries for older students. Some experimentation may be required to determine the appropriate mix of spoken language and visual supports.

Instructional Procedures

Teaching Word Knowledge and World Knowledge

Critical to comprehending the language that one hears is an understanding of the words that are spoken and at least a general understanding of the topics included in that language directed to the child. Students with TBI often retain their word knowledge (vocabulary) and general knowledge of the world acquired before the injury. Knowledge of this sort is stored in posterior brain regions, which are not especially vulnerable in TBI (closed head injury).

However, because of problems with new learning, the student may fall progressively further behind in vocabulary knowledge and world knowledge over the years after the injury. Therefore attention to both types of knowledge may be a component of the student's comprehensive language and reading comprehension programs. What follows are some common suggestions regarding vocabulary acquisition and acquisition of world knowledge.

Vocabulary Practice: Words from the Curriculum: Given the many thousands of words that exist in any language, teaching vocabulary can seem to be a daunting task. For example, during the preschool years, typically developing children learn on average 8 to 10 words per day! The most reasonable way to simplify and organize the task of teaching vocabulary is to select words from the student's academic and social curricula. Thus the words to be focused on by teachers, speech-language pathologists, special educators, and parents should be words that the student needs to learn in order to comprehend the language used in the classroom, on the playground, and at home. These include words that teachers use in giving instructions, words that peers use in play and other social interaction, and words from reading books and from science, social studies, and other content classes.

Teaching the meaning of a word includes exploring the many associations that comprise the word's meaning. (See below for principles of vocabulary teaching.) In the case of a noun, for example, it is not sufficient for the student to point to a picture of the item when named. She should know what category the item falls into, what it does (if anything), what it is used for, what parts it has, what features it has, what it is made of, where it is commonly found, and other common associations. This broad and deep understanding is true knowledge of a word's meaning. Thus teachers and therapists should teach word meaning in this organized associative manner. Furthermore, context is important in the teaching. Students should have exposure to a variety of contexts in which the word can be used, especially contexts relevant to the classroom curriculum.

Parents can use and explore targeted words and their meanings during dinner time, car time, and other relaxed conversational times. Teaching word meaning at home need not be a boring "school-like" activity, but rather conversational use and exploration of the word, using language at the student's level of comprehension and connected as much as possible to the student's interests. Home-school communication should include lists of words that are currently focused on in school. However, these lists should not be so long that the student and family are overwhelmed!

In addition, the more students read, the faster their vocabularies grow. Therefore there is a strong rationale for encouraging students to read as much as they can. Homes should have interesting and engaging reading materials at an appropriate reading level for the student. For example, topically interesting magazines are available at many reading levels, including sports, current events, and popular culture magazines. And students should be encouraged to request a definition when they encounter words they do not understand.

World Knowledge: Themes from the Curriculum: Given the infinite extent of possible knowledge of things, places, events, and people in the world, teaching world knowledge is a genuinely daunting task. Again, the most reasonable way to simplify and organize the task is to select themes from the student's academic curriculum. General education teachers, special educators, therapists, and parents can focus on and discuss themes and issues that are found in reading texts or in the student's content classes.

As in the case of word meanings, parents can help the child acquire relevant world knowledge by knowing what is being taught at school and then weaving those curricular themes into dinner time, car time, and other relaxed conversations. In addition, discussion of daily events presented in the newspaper or on TV can help the student broaden her horizons and learn about events occurring in the world. Furthermore, the more the student reads, the more she learns about the world; therefore fun reading beyond school assignments should be encouraged.

Principles of Vocabulary Instruction: The following eight principles of vocabulary instruction are paraphrases of principles of vocabulary instruction published by Roth (2002). These principles capture the best

evidence-based practices known to language specialists at that time for teaching vocabulary to children who have language-learning difficulties, regardless of the cause of that difficulty. However, it may be that effectiveness of specific vocabulary teaching procedures is more dependent on the student's age, nature of the impairment, and specific vocabulary objectives than this general list of procedures suggests.

Principle 1: Teach organized systems of word associations (i.e., semantic knowledge). Common word associations for a noun include what category the item falls into, what it does (if anything), what it is used for, what parts it has, what features it has, what it is made of, where it is commonly found, and other common associations. (See the Tutorial on Graphic Organizers for a description of an organizer used in teaching word meanings.)

Principle 2: Teach the student word-learning strategies. For a young student, this may mean asking "What's that?" when encountering something unfamiliar. For a somewhat older student, this may mean getting into the habit of asking "What does _____ mean?" when encountering an unfamiliar word. For an older student, routine use of a dictionary should be added to these strategies.

Principle 3: Teaching vocabulary should include direct and explicit instruction as well as everyday incidental word learning.

Principle 4: Teaching vocabulary should involve relevant context associations and active child engagement with the to-be-learned meanings. A variety of activities and examples of the meaning should be included in the teaching.

Principle 5: Students need to learn the meanings of both common (high frequency) words and rare (low frequency) words.

Principle 6: Students need to learn both core definitions and also relevant context information. For example, when learning that "weird" means strange or unconventional, a student should also learn that it is offensive to apply the word to people.

Principle 7: To fully understand a word's meaning students should be given both examples and non-examples of that word's meaning. For example, to understand the meaning of "red", students should know what shades of color are called red and what shades are not called red; similarly, to understand the meaning of "legislative responsibilities", students should know what the legislative branch of government is responsible for (e.g., writing laws), but also what it is not responsible for (e.g., interpreting the laws and determining their constitutionality).

Principle 8: Students typically learn most efficiently from a multidimensional approach, appealing to all of their senses and to their activity as they learn the word's meaning. For example color words can be learned while finger painting; words related to government functions can be learned while having mock legislative and judicial sessions.

Roth also offers additional teaching suggestions: (1) Use adult-child shared book reading as a context for teaching vocabulary; (2) Incorporate new vocabulary into stories to heighten comprehension; (3) Use graphic organizers to facilitate comprehension; (4) With young children, focus on the physical action dimensions of meaning.

Improving Listening Comprehension By Teaching Strategies

The Tutorial on Reading Comprehension lists a number of strategies that students can use to improve their understanding of what they read. Some of these strategies can also be used by well selected students to improve their listening comprehension. However, teachers and clinicians should exercise caution in attempting to teach any of these listening comprehension strategies to students with restricted space in working memory. Thinking about strategies or using strategies may distract the student with brain injury,

causing a reduction rather than an improvement in comprehension. Furthermore, some of the strategies, like requesting clarification, may be resisted by students who understandably do not want to call attention to their disability. Sensitive counseling may be a necessary component of this strategy instruction.

With these qualifications as background, listening comprehension strategies include:

- Clarifying the topic or theme in what the communication partner is saying. This is analogous to the reading comprehension strategy of doing a "book walk" or in other ways orienting to the topic before reading.
- Summarizing – out loud or silently – the main points in what the person is saying. This is analogous to the summarizing strategy in reading comprehension.
- Elaborating – out loud or silently – on what the person is saying. This is analogous to the elaboration or self-questioning strategy in reading comprehension.
- Creating a visual image to associate with the main point made by the person. This is analogous to the visual imagery strategy in reading comprehension.
- Requesting repetition or clarification of what the other person has said. This is analogous to the reading comprehension strategy of re-reading a passage or requesting help.
- Making a judgment about the meaningfulness or value of what the person has said. This is analogous to the parallel strategy in reading comprehension.

Teaching Rules of Grammar

In most cases of pediatric TBI, grammar is less problematic than vocabulary or the social/pragmatic domains of language. However, a child with TBI may also have a congenital language-learning disorder, or may be one of the few with specific language impairment (or aphasia) caused by the injury. Therefore we include in this tutorial the following principles of grammar instruction.

Principles of Grammar Instruction: The following ten principles of grammar instruction are paraphrases of principles published by Fey, Long, and Finestack (2003). These principles capture the best evidence-based practices known to language specialists at that time for teaching grammar to children who have language-learning difficulties, regardless of the cause of that difficulty. However, it may be that effectiveness of specific grammar teaching procedures is more dependent on the student's age, nature of the impairment, and specific grammatical objectives than this general list of procedures suggests.

Principle 1: Make sure that the grammar being taught serves a communication purpose (e.g., in story telling giving a description, and the like).

Principle 2: Do not focus teaching sessions only on grammar.

Principle 3: Choose a class of grammatical forms (e.g., past tense, rather than highly specific words) and ensure that there is environmental support for the meaning of the component of grammar being taught. For example, in teaching past tense, there should be meaningful conversation about events that took place in the past.

Principle 4: Choose developmentally appropriate forms of grammar. This requires consultation with a speech-language pathologist who knows in what developmental order children typically acquire aspects of grammar.

Principle 5: Create many natural opportunities throughout the day for supported practice.

Principle 6: Use varied linguistic contexts for practice of grammar, including conversation, descriptions, and stories (spoken and written).

Principle 7: Make the target aspect of grammar salient and meaningful. For example, in teaching helping verbs, create an argument like the following: "He is running" … "No he isn't" … "Yes he is" … "No he isn't" and so on.

Principle 8: Make sure that relevant adults know how to use systematic recast procedures. For example, if the child says, "He goed to school", the adult follows that utterance by saying, "He went to school".

Principle 9: All adults should use grammatical language models, not "baby talk" or telegraphed models. Furthermore, relevant adults should know what specifically the child is working on so they can make a point of modeling those aspects of grammar.

Principle 10: Adults should use the traditional "You say what I say" imitation procedure sparingly. That is, avoid over-use of the following teaching procedure, "John, say after me, 'He kicked the ball' … John imitates … the adult says "Good job! He kicked the ball." And when this imitation procedure is used, it should be supplemented by more natural language teaching procedures.

EVIDENCE REGARDING INTERVENTION FOR CHILDREN WITH LANGUAGE DISORDERS

This summary of evidence is written for teachers and others who may be required to support their intervention practices with evidence from the research literature or who may simply be curious about the state of the evidence. This summary was written in early 2008. Evidence continues to accumulate.

A search of the literature revealed no studies of the effectiveness of language intervention for students with a diagnosis of TBI, other than those that focus on the behavioral dimensions of language. The summaries of vocabulary and grammar teaching procedures presented earlier (Fey et al., 2003; Roth, 2002) are taken from general reviews of state-of-the-art professional practice, not based on systematic reviews of the experimental literature. Therefore these summaries represent a useful point of departure in choosing teaching procedures, but they cannot be considered evidence reviews.

Specific evidence supporting language intervention for students with TBI can, therefore, only be drawn – with great caution – from studies of other populations of students. Cirrin and Gillam (2008) identified 21 studies of language intervention for school-age children with primary spoken language disorders (versus disorders of reading and writing, and disorders of language secondary to other disabilities) published since 1985. Each study met high standards of experimental rigor. No studies of middle and high school students were found. Six studies focused on vocabulary, three on grammar, five on phonological awareness and metalinguistics, five on general language processing, and two on pragmatics. Effect sizes were moderate to high for the majority of studies. Therefore the authors conclude that there is an unfortunately small but solid body of evidence for language intervention for elementary-age students with primary language disorders.

Jitendra and colleagues (2004) systematically reviewed the evidence supporting specific procedures for teaching reading vocabulary to students with learning disabilities, grades 4 through 12. They found 19 articles that included 27 separate experimental studies. The following vocabulary teaching procedures were supported by experimental evidence: cognitive strategy instruction (e.g., semantic feature analysis), visual imagery, direct instruction, error-free learning (i.e., gradually increasing the time delay between presenting the word and requesting a definition)(only one study), and activity-based methods (only one study). Computer-assisted instruction yielded mixed results. The respected evidence review of the National Reading Panel (2000) summarized the results of a large number of successful experimental studies that support the use of explicit instruction in teaching both reading vocabulary and comprehension, with a focus on strategy intervention in the case of comprehension.

Other reviews of language intervention for specific populations of students with disability include Goldstein (2002, autism), and Sigafoos and Drasgow (2003, developmental disabilities). The Goldstein review is relevant in that it identified many successful experimental studies in which the social dimensions of

language were targeted or positive communication alternatives to negative behavior were taught. Although there are differences in central tendencies between autism and TBI, those two dimensions of communication intervention are also important for many students with TBI. The systematic evidence review of Ylvisaker and colleagues (2007) summarized several studies in which social language and positive communication alternatives were successfully taught to children and adults with TBI.

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