Working Memory Training

General Approaches to Working Memory Interventions

One unique characteristic of successful attempts to improve working memory performance:

we may never be able to determine the actual basis of the change

improved performance may result from:

- expanded capacity
- increased efficiency
- growth in collateral processes

General Approaches to Working Memory Interventions

- such as other cognitive processing, Working memory interventions can be categorized as:
  - Remedial
  - compensatory
  - combination of remedial and compensatory

- goal of Remedial interventions: correcting a working memory deficit by directly addressing the area of weakness.

- Compensatory interventions: emphasize using the individual's cognitive or memory strengths and assets, in an effort to bypass the deficit, thereby reducing its impact on learning and performance.

WM intervention

Past attempts to address memory through a remediation approach alone have generally been unsuccessful.

compensatory approaches entail methods that focus on strengths, that typically involve strategy training, but they may include other methods such as modify the learning environment.

compensatory interventions may succeed because they focus on higher level processes.

WM intervention

The **best Intervention** for addressing working memory limitations:

both remedial and compensatory, with the general goals of improving performance in a deficient area while increasing the efficiency of the individual's normal memory processes.

Strategy Interventions

- A strategy: how an individual approaches a task; it includes dimensions such as planning, executing, and evaluating one's performance.

- Strategies themselves , are neither remedial nor compensatory; how they are classified depends on how they are used.

- Nonetheless, because the intent of most strategies is to increase efficiency, they are, by their nature, more compensatory than remedial.

- the emphasis on strategic interventions is based on the assumption that strategies can improve working memory performance, whether the origin of the poor performance is restricted capacity or a lack of strategy knowledge and strategy use

General Strategy Training Procedures

- strategy training should be explicit and intensive over an extended period of time until strategy use becomes automatic.

- So, successful strategy training requires more than the teaching of knowledge.

- Post-intervention maintenance also depends on the trainee knowing why, when, and how to use the strategy

General Strategy Training Procedures

1. Conduct training during one-on-one brief, focused sessions, held at least a couple times weekly over a period of several weeks.

2. Precede memory strategy training by informing the client of her or his memory strengths and weakness so he/she begins to recognize the personal need for adopting strategies.

3. Teach only one memory strategy at a time, at least until the student is familiar with the idea of strategy use.

4. Inform the client about the purpose and rationale for the strategy, including when, where, why, and how to use the strategy. Explain the benefits and how use will result in better memory performance.

5. When introducing a strategy, model all steps and components of the strategy while thinking aloud. Use different examples when modeling and demonstrate how your thinking progresses while implementing a strategy

General Strategy Training Procedures

6. Provide plenty of relevant practice, first with external guidance, then with the client thinking aloud, and finally while encouraging the client to internalize the strategy, such as whispering the steps while enacting them.

7. During practice provide corrective feedback on strategy usage.

8. Give positive reinforcement for using the new strategy. Also, provide data on the success of the strategy

9. Encourage the client to monitor and evaluate strategy use and to attribute his or her success to strategy use.

10. Encourage generalization by discussing applications of the strategy and practicing the strategy with different materials and under different situations.

Working memory strategies

Divided into two basic types:

- Rote strategies involve reproducing information in the same form in which it was encountered.

- Relational strategies involve transform information through recoding, organizing, or reconstructing

Rote strategies

- consist mainly of basic rehearsal strategies, such as simple repetition, that serve the primary purpose of maintaining items in pSTM.

- have the advantage of :
  - being simple to learn and apply because they do not involve any higher level processing
  - place minimal demands on working memory resources, especially after they become routine and automatic.

- But,
  - Rehearsal of information does not necessarily enhance transfer to long-term storage
  - do little to increase the overall processing efficiency and capacity of Working Memory

Relational Strategies

In contrast to rote strategies

- extend to higher level working memory processing and so
- increase the probability of long-term storage (because make the information more meaningful)

Phonological Short-Term Memory Interventions

- Most pSTM Interventions involve rehearsal training.
- The interventions are mainly intended for children who
  - demonstrate an actual deficit in the phonological store (e.g., substandard scores on a digits forward).
  - are not using a rehearsal strategy, are using one infrequently, or would benefit from a more sophisticated rehearsal strategy.
- Developmentally, children begin to employ rehearsal strategies as early as 5 years of age.
- To determine if a child is using rehearsal, observe for indicators, such as moving lips, or ask the individual what she or he is doing to remember the information.

pSTM Interventions:
Rehearsal Strategy training

- Rehearsal:
  - is the first and most basic memory strategy acquired
  - saying the material over and over to oneself

- training children to name the first item after it is presented, then the first and second items together after the second item is presented, and so on until all items in the series have been presented and rehearsed

- At first, direct client to say the stimuli aloud to make sure they are rehearsing correctly, but as the intervention progresses they should whisper the words and eventually subvocalize.

pSTM Interventions:
Rehearsal Strategy training

- For children with normal cognitive ability, lists constructed of randomly chosen similar and dissimilar words should be used. Continue practicing until the trainee is visibly failing to concentrate or fails six times at a given span length.

- For those with a very low memory span, start with words from the same semantic category, and stop adding words to the list when the first failure occurs.

- Verbal rehearsal may also be supplemented by providing pictures of the words as they are presented.

- children may benefit from rehearsal training sessions of only 10 minutes per day over a period of 10 days, but daily training over a period of several weeks may produce better long-term change

other Interventions for pSTM

- listening nursery rhymes (highlight the phonological structure of language)
- Rhyming games
- naming letters and objects
- repeating spoken sentences
- listening to stories

Verbal WM Interventions:
Semantic Rehearsal

- rehearsal go beyond rote repetition by associating meaning with the stimuli

- clients are directed to create a brief sentence using the to-be-remembered word. After they create the sentence, have them say it aloud and then keep repeating it until the next item is presented.

- A potentially more powerful technique is to present all of the words at once. Then have the learner create a story with all of the stimulus words embedded sequentially. This approach should be more effective than trying to remember a sequence of unrelated sentences.

Verbal WM Interventions:
Chunking

- refers to the pairing, clustering, grouping, or association of different items into units that are processed and remembered as a whole (For example, instead of separately remembering the digits 8 and 6 it is easier to recall them grouped as the multi-digit number 86).

- Like sub-vocal rehearsal, most children acquire basic chunking strategies without any specific training.

- Chunks:
  - simple surface chunks: temporarily linking together 2 or 3 digits that follow each other
  - more elaborate chunks: correspond to representations stored in long-term memory

Paraphrasing

- a strategy that builds off of both rehearsal and chunking.
- Having clients restate information in their own words requires that they reorganize and condense a large amount of linguistic information into smaller, well-integrated, and more personally meaningful units
- To train, begin with short, single sentences, and emphasize that clients should use their own words, not simply repeat what they hear. The paraphrased statement should convey the same meaning as the original sentence. Once clients can successfully paraphrase a sentence, increase the length of the information by one sentence at a time.

Visuo-spatial WM Interventions

- For normal children, progression for visually presented information is increasingly rely on verbal rehearsal strategies. So, young children who have not yet adopted recoding of visuo-spatial material into a verbal code can be trained to do so

- For individuals with severe limitations in verbal WM, such as those with language and literacy disabilities, training them to more effectively utilize their typically normal visuospatial WM may prove extremely beneficial.

Visuo-spatial WM Interventions

- for individuals with severe verbal working memory deficits, transforming visuospatial input into verbal storage may not be a viable option

- in such instances, visual mnemonics is recommended. visual mnemonics recode verbal information into visuospatial information.

- clients can be trained to mentally create a visual image of a to-be-remembered word or words. When conducting this training, allow students ample time to create an image and then ask them to describe it. After they have described the image in detail, tell them to keep thinking of it for as long as they can. For children who have difficulty generating helpful images, suggest images. For those who have difficulty recalling the images later, have them draw a picture of each image they create.

Executive WM Interventions

- many of the interventions for other working memory components may be beneficial for executive component. Moreover, training designed to improve attentional processes and general executive processing (such as training designed to maintain the focus of attention and inhibit irrelevant information)

- Above all, executive working memory should profit most from training programs designed to improve self-regulation (meta-cognitive training such as giving feedback and discuss about the participant's performance, including dealing with their frustration and how to improve their strategies)

Executive WM Interventions: **Dual Encoding**

- Any strategies that involve visuo-spatial and verbal processing in conjunction involve executive working memory

- dual encoding should be encouraged whenever possible. If the material presented is verbal, visual imagery should be added, and when the material is visual, a verbal mnemonic should be employed

- Once a learner spontaneously uses a verbal rehearsal strategy, they can be taught to visualize instructions as an additional way of keeping the information active.

Executive WM Interventions: **Organizational Strategies**

- One of the key principles of learning is that organized material is easier to remember, especially when the learner recognizes the organization or reorganizes the information in a more meaningful way

- One method of organizing input is to group items by category, usually by semantic category

Keep in mind:

- appraise a Client's working memory capacity prior to intervention and select strategies
- Assessment should continue during intervention to evaluate the efficacy of the treatment.
- base your final determination of effectiveness on measurement of related cognitive processes and academic skills; some clients maybe don't show post-intervention improvement in working memory processes but have found improvement in related areas of achievement

Keep in mind:

- The Importance of Early Interventions: Change is more difficult once neural structures are established and myelination is complete

- Metacognitive Training: The conscious use of executive control processes (self-awareness and self-control)

Despite its importance, special efforts to teach metacognition are usually unnecessary, as metacognitive thinking and control are embedded in most cognitive strategies, including working memory strategies.

Keep in mind:

In general, success is not guaranteed, even with well-established, evidence-based interventions and faithful adherence to training procedures