Training Methods in Brain Injury Rehabilitation: Limbic Activation, Fluency and Discounting

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Persons with ABI frequently have acquired learning deficits.

Dx. of: ADHD, Bipolar, IED, ODD, ICD, Seizures, Depression, Anxiety etc. all interfere with a person's ability to attend and learn.

Memory issues have been well documented following ABI.

Training methods found to be effective with other populations (Autism, Intellectual Impairments) have also shown to be helpful in neurorehabilitation (Mozzoni & Bailey 1996).
Training Elements: Task

- Task related to outcome measures
- Use a task analysis
- Keep treatment consistent between sessions
  - Use the same steps between sessions
- Practice the skills >1X
- Take data during therapy
  - Record response/performance/ prompt data or scores permanent product following therapy.
Training Elements:

- **Prompting**
  - Clear cueing
  - Systematic prompting

- **Reinforcement**
  - Reinforce correct responses
  - Reinforce appropriate behavior

- **Learner Behavior**
  - Attend to therapist/training stimuli.
  - Therapist uses behavior management procedure specified on the client treatment plan.
  - Stay awake throughout therapy
Effects of Changing Treatment Methods on Outcomes

(Mozzoni & Bailey 1996)
Prompting Issues

• People with brain injuries may not be persistent.
• Physical prompting requires rapport, mouthwash and deodorant for constructive training.
• Error correction is problematic when working with clients who have low self-confidence/esteem and frustration tolerance.
Prompting Strategies: Least-to-Most (intrusive)

- Best for previously mastered skills.
- Prompts are used to correct errors.
- Client is allowed to make an incorrect response before least intrusive prompt is used.
- Prompts become progressively more intrusive.
- Cue - Verbal - Modeling - Physical Touch - Fade - Full Physical
Prompting Strategies: Most-to-Least (intrusive)

- Best for new skill acquisition.
- Instruction + manual guidance
- Prompts are used before the person has a chance to respond so that no error can occur early in training. **(Errorless learning)**
- Prompts become progressively *less* intrusive.
- Cue+Full Physical-Fade- Physical Touch- Shadow-Verbal-Cue
Trial Presentation

- **Masses trails** - One trial followed immediately by another. Good for physical, mechanical training. Capitalize on procedural memory capacity.

- **Distributed trails** - One challenging trial followed by an easy trail. Good for clients who are easily frustrated as it increases persistence during the session.

- **Spaced trails** - One trial followed by a definite pause before the next trial. Good for cognitive training as it allows the subject to covertly rehearse the information, helps with declarative memory.
Trial Presentation

- **Short duration high intensity treatment segments**
  - Massed trail presentations for 3-5 reps. followed by feedback and/or rest for several sets.
  - Vigorous activity can be useful with ADHD children, followed by therapy requiring attention and sitting.

- **Short duration concrete goal attainment**
  - Spaced trails where client reaches a goal followed by rest and feedback for several trails.
  - i.e., client walks 20 ft to a chair then rests, next goal set 25 ft. down the hall etc.
Treatment Session Length

- Session length treatment
  - Distributed trails to prevent boredom or consistent failure.
  - Presentation styles can vary within a session as the client becomes fatigued or frustrated.
- Get the important lessons done in the morning, fatigue is most frequent in the afternoon.
Alternative Training Methods: Fluency Training

- **Fluency training** - The combination of accuracy (or quality) plus speed ensures that the client will be able to perform easily in the presence of distractions. Fluency is “second nature” knowledge, near-automatic performance. (Haughton, 1980)

- **Composite skills** - Big 6+6 Movements (Desjardins, 1980)
  - Big 6: Point, Reach, Touch, Grasp, Place, Release.
  - +6: Pull, Push, Shake, Squeeze, Tap, Twist
  - Can include other component skills necessary to building the composite i.e., tongue movements, eye movements etc.
Fluency Training

Fluency training of gross motor skills for individuals who had upper extremity impairment secondary to a traumatic brain injury

- RM - 16 year old. High speed MVA; collision with tree.
  - Right arm/hand dominant and right arm/hand impaired
- HB - 20 year old stroke victim from sickle cell anemia.
  - Left arm/hand dominant and left arm/hand impaired
- Goal - to increase functional use in impaired, dominant extremity or to increase functional use in non-dominant extremity
1. Materials
   a. 2 large, heavy blue bowls (large dog bowls)
   b. 35 ping pong balls
   c. Count down timer
2. Fluency Aim
   a. Fluency aim was established using staff members and individuals who are not physically impaired
   b. Fluency established at 90-102 balls moved in a minute
   c. Fluency aim is established for the right/left hand and impaired/nonimpaired hand
   d. The goal is to increase functional use in impaired-dominant hand or to increase functional use in the nonimpaired-nondominant hand
3. Procedure
   a. Place bowls with the ping pong balls in front of person attempting task
   b. Place bowls with ping pong balls on right side
   c. Start timer at 10 seconds
   d. Person moves ping pong balls with right hand to the bowl on the left side as fast as possible
   e. Change bowl placement
   f. Place bowls with ping pong balls on left side
   g. Start timer at 10 seconds
   h. Person moves ping pong balls with left hand to the bowl on the right side as fast as possible
   i. The 10 second aim is 15-17 balls
R. M.
R- dominant
R impaired

Rate per Minute

Trial

Eastridge & Mozzoni 2005
Autobiographical Questions

- **Materials:** SAFMEDS (Graf, 1994) 40 cards with 10 autobiographical questions, timer, tape recorder, graph paper.
- **Data:** Number of questions answered, and number of errors per minute
- **Method:** Teacher shuffles cards and instructs student to answer questions as quickly as he can. Teach reads card and David answers. Dave practices cards with residential staff in AM and PM as well as with teacher who conducts timing
- **Steps:**
  - Practice SAFEMEDS for the first 10 minutes of the session
  - Tutor on incorrect answers
  - Go through SAFEMEDS again after tutoring
  - Conduct 1 minute timing trial.
Autobiographical Questions

1. What was the name of your elementary school?
2. What city and state were you living in during elementary school?
3. What is your shoe size?
4. What high school do you attend?
5. What city and state is your high school located?
6. What is your SS#?
7. Have you ever lived in Europe?
8. What kind of car does your Dad drive?
9. What is your mom’s maiden name?
10. What does your dad do for a living?
Successive Calendar Days (by weeks)

Count Per Minute

Name of Behaver: Movement Cycle:
Method

Materials
- A data recording sheet, a timer, a pencil, and the two SAFMEDS decks.

Participant
- The participant was a 42-year-old male who suffered a severe brain injury. The participant post-injury suffered from both anterograde and retrograde amnesia which resulted in an increase in disorientation.

Design
- The PT intervention operated on two AB designs to present data on orientation and disorientation for the two SAFMEDS decks used in the procedure. Data was converted into percentage of orientation (corrects) and disorientation (errors).
Method

SAFMEDS Decks

- Probes were conducted prior to the creation of the SAFMEDS.
- **Deck #1** contained questions that related to the participant’s orientation to time, place and personal history.
- **Deck #2** contained pictures of staff and residents to assess the participant’s orientation to the individuals within his present surrounding.
Orientation to Time, Place and Personal History
(Erin Young 2008 St. Lawrence College)
Pictures of Staff and Residents

[Graph showing trials and percentage changes for orientation and disorientation during baseline and precision teaching phases.]
Facial Recognition of Emotion

Social Skills: Interpreting social cues, asking questions, and contributing to conversations are often areas of difficulty for persons with TBI. (Dahlberg et al., 2006)

Damage to the frontal cortices, temporal lobe, and amygdala can affect a person’s ability to analyze facial expressions, and are especially instrumental in the recognition of negative emotions. (Ylvisaker et al., 2007; Croker & McDonald, 2005; Radice-Neumann et al., 2007; McDonald & Flanagan, 2004)

There have been few studies that utilized fluency techniques to teach emotion recognition, and virtually no studies that use fluency training to teach emotion recognition within the TBI population.
R.C.

Participant:

- R.C.: 45-year-old male, three years post-injury
- Damage primarily to left temporal and bilateral frontal lobes, extensive DAI.
- Frequently misinterpreted facial expressions and social cues
- R.C. stated that he relied solely on the content of a person’s speech to determine what the sender meant to communicate.

Hypothesis:

- Fluency training would increase the rate of correct responses to stimuli depicting facial expressions in an individual with a TBI.
**Method**

**Materials:**
- standardized deck of 144 emotion recognition flashcards (Ekman), emotion place cards, digital timer, pencil, and table.

**Emotion Recognition Flashcards:**
- Pictures from Ekman and Friesen’s FACS (1978) that depicted clear facial expressions of happy, sad, angry, and surprised were used.
- Six pictures were chosen for each emotion. The pictures were copied to comprise a deck of 144 cards; 36 cards per emotion.
- The corresponding emotion was printed on the back of the card.

**Standardization of Flashcards:**
- Flashcards were standardized with unimpaired volunteers.
- Ten staff members each completed five one-minute trials.
- The standardized rate of fluency was determined as 28 to 38 correct responses per minute.
Decision-Making

- Making a decision between two or more alternatives
- Calculate the value of one alternative compared to the value of another alternatives in order to make a decision
- Many factors can affect decision-making
  - delay until outcome
  - value of outcome
  - probability of receiving outcome
# Discounting

- Studies how delay and reinforcer affect value of the reinforcer
- Delay of gratification procedure (discounting):

<table>
<thead>
<tr>
<th>Choice A</th>
<th>Choice B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smaller</td>
<td>Larger</td>
</tr>
<tr>
<td>more immediate</td>
<td>More delayed</td>
</tr>
<tr>
<td>$10 in 10 minutes</td>
<td>$100 next week</td>
</tr>
<tr>
<td>One chip now</td>
<td>5 chips in 30 seconds</td>
</tr>
<tr>
<td>Spend your money</td>
<td>Put in bank/Invest</td>
</tr>
<tr>
<td>Work full time</td>
<td>Finish college degree</td>
</tr>
</tbody>
</table>

- People who choose the smaller, more immediate reward are considered impulsive (not necessarily worst choice)
- People who choose the larger, more delayed reward are seen as using self-control (not necessarily best choice)
Why Discounting

- Discounting embodies response suppression. A person must inhibit the impulsive response in order to gain access to a higher valued alternative.

- People with brain injuries typically exhibit impulsive behaviors which places them at risk for further injury and interferes with their social, residential, vocational and educational functioning.

- We wanted to see if discounting (learning to wait) would generalize to other impulsive behaviors (classroom disruptions, out of seat)
DM. Discounting Protocol

- **Target Behavior:** Increase self-control (decrease impulsivity)
- **Function of Inappropriate Behavior:** Social Reinforcement/Escape Demands
- **Materials:** Timer, 2 desert plates, potato chips, M&Ms, corn chips, fish crackers, data sheet.

**Proactive Procedure**
- Run sessions during reading class (45 min).
- Place 3-4 potato chips on two small plates on the table: one with only 1 chip and one with the remaining 2-3 chips.
- Ask DM to identify the pile with the most chips.
- Set the timer for ___ seconds.
- Preteach DM that he has a choice: he may have 1 potato chip now OR if he waits until the beep, he may have the plate with more.
- Allow him 5-10 seconds to process this information.
- REPEAT the instruction for him: “DM, you may have one chip now, or if you wait until the timer beeps you may have the plate with more.”
- Place the plate with more within his sight but out of reach (signifying unavailability of that choice), leaving plate with one potato on the upper left corner of his desk.
- Start the timer.
- When the timer beeps, IMMEDIATELY PRAISE for waiting and give him the plate with more.
- Tell DM that because he waited until the beep (showed self-control), he earned more potato chips.
DM. Discounting Protocol... 

- **Reactive Procedure**
  - If DM chooses the 1 potato chip, tell him that because he did not show self-control and wait for the beep, he earned the smaller outcome.

- **Reinforcement of Appropriate Behavior**
  - Be sure to praise DM for waiting and controlling himself in addition to giving him the chips.

- **Data Collection**
  - Response latency and IBAS.

- **Criterion for change**
  - 3 consecutive trials in which he waits for the clock to beep (shows self-control). Gradually increase the delay: 5”, 10”, 20”, 30”, 45”, 60”, 90”, 120”, 180”, 300”, 360”, 600”, 900”.
Limbic System Memory

- Heightened states of arousal can result in durable and detailed memories. E.g., Where were you when you heard about 9/11? What do you recall about 9/10? Or the death of a loved one?
- Could limbic system activation be used to improve recall of autobiographical information in persons with amnesia?
- How can one activate the limbic system in an ethical way? Pain, fear, tragic loss, putrid smell, DBS, can activate but inducing those states is problematic, complicated and traumatic.
- How can limbic system activation be measured simply and reliable? Pupillary dilation? Heart rate? Skin conductance?...
Limbic System Activation via Exercise

- During Baseline, participants were asked autobiographical questions (AMI) plus a recall question taken from the MMSE. If the participants answered incorrectly they were corrected and rehearsed the correct responses until they could independently answer (in the immediate condition), then the next question was asked. In the delayed condition prompt correct 1x was used.

- During Treatment participants were asked to cycle for a short duration while minute pulse checks were implemented to see if they had reached their target heart rate of 125% rest rate. Once the target heart rate was obtained participants continued to cycle for 2 minutes.

- After 2 minutes, participants were asked the selected questions. After the immediate responses were completed a timer was set for the remaining intervals, 3, 5, 10, and 20 minutes.
Participants

- Participant 1 (P1): 48 y/o male diagnosed with TBI, CVA, depression and psychosis. He had impaired visual-spatial skills, including agnosia, ADD, and global amnesia.

- Participant 2 (P2): 39 y/o female, history of anoxia, seizure disorder subsequent of a motor vehicle accident during adolescence, polysubstance abuse and anxiety disorder.
Effects of Increased Heart Rate on Memory
(Shrontz, UNT)

Immediate 3-min. delay  
5-min. delay  
10 min. delay  
20 min. delay

Baseline1  
T1-Target Heart Rate  
Baseline 2

Effects of Increased Heart Rate on Memory
(Shrontz, UNT)
Training Considerations

- Speed of performance and accuracy is necessary when considering true mastery.
- Tool skills must be mastered before complex components can be built.
- Competition, even beating one’s last score, can serve to motivate the learner.
- Outcomes are heavily dependent upon therapists training skills.
- We tend to plateau in our ability to teach before our clients plateau's in their ability to learn. We need to continuously examine our training methods.
References:


