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  – Treatment Theory Task Force

• Journal of Head Trauma Rehabilitation Topical Issue on Principles of Learning for TBI Rehabilitation

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Overview

• Introduction: TH: Why are learning principles important for rehabilitation in general, and brain injury rehabilitation in particular?
• Types of learning theories from which we can derive principles: JP
• An example: Operant learning theory: JP
• The theory of multiple memory systems, and related principles for brain injury rehabilitation: TH
• Questions, discussion
Introduction

• Rehabilitation is said to be “theory poor:” few organizing principles to guide our treatments. Why is this?
  • Pragmatic nature of rehab: We do whatever works, not what’s supposed to work
  • Each discipline brings its own theories (or its own/borrowed version of over-arching theories)
  • This can contribute strength and richness, but can also fragment approaches, impair communication across teams
Uses of Theory

• Theories are fine for research. But why do we need them in practice?
• Can unify approaches across team, keep everyone on “same page”
• Especially important for TBI rehab since
  – Problems are complex
  – Patient can’t integrate treatment for him/herself
• More systematic communication across team, with patient/family, with payers, etc.
Theories for Rehabilitation

- There are several kinds of theories that are important for rehabilitation, but the most important– and neglected– are:
  - **Treatment Theories**: *How and why* do changes take place during rehabilitation?
  - Theories that explain these changes are necessary for designing, refining, and measuring the important “ingredients” in rehabilitation.
Where Do Treatment Theories Come From?

• As noted, rehab does not have unifying theories

• The treatments in rehab are too diverse for one treatment theory ever to explain why they all work

• However, learning theories are a potentially useful “family” of theories for developing, refining, and explaining the effects of rehab treatments
Learning in Rehabilitation

• Patients (and caregivers) are routinely expected to learn facts, concepts, attitudes, skills, habits, procedures, strategies, etc., etc.

• What are the best ways to teach them all these things?

• How should our teaching approaches be modified to accommodate damage to the organ of learning (the brain)?
Examples of Learning Theories

• Behaviorism

• Cognitivism

• Constructivism
Behaviorism

• Learning results in changes in observable behaviors

• Behaviors change as a result of stimuli in the environment

• Operant learning
  – Reinforcement increases likelihood of behavior occurring again
  – Punishment decreases likelihood of behavior occurring again

• Learner can be passive participant in learning process
  – Does not need to be aware of learning process
  – Cognitive (brain-based) states and processes do not have to play a role
  – Environment controls learning
Cognitivism

- Learning takes place within the brain
- Ability to learn dependent on cognitive abilities
- Learning may or may not result in changes in observable behaviors
- Learner is active participant in learning process
Constructivism

• Learn by doing
  – Process of discovering and creating knowledge for oneself
  – Learner gathers information and integrates with previous
    knowledge and experiences
  – Learning creates a new understanding relevant to the learner

• Often involves collaborative problem-solving of real tasks

• Learner must be an active participant in learning process
  – Builds or “constructs” knowledge through learning experiences
  – Interacts with others and the non-human environment
Role of Teacher/Clinician

• Behaviorism: manipulates environment to change behavior

• Cognitivism: imparts knowledge

• Constructivism: provides opportunities for exploration, shared problem-solving at the “just right challenge” level (facilitator role)
Applying Operant Learning Theory to Brain Injury Rehabilitation
Goals of Behavioral Intervention

• Increase adaptive behaviors
• Increase positive social interactions
• Reduce frequency and intensity of challenging/undesirable/inappropriate behaviors
• Reduce likelihood of injury
• Increase participation in rehab, work, school, home
• Prevent person from learning inappropriate behaviors through inadvertent reinforcement
ABC’s of Operant Learning

• Antecedent (what comes before behavior)
• Behavior (desired or undesired)
• Consequence (what comes after behavior)

• Some management strategies focus more on consequences, some more on antecedents, some on both

• People with brain injury, especially acute, are more likely to benefit from antecedent-based approaches
Types of Consequences

• Reinforcement
  – Consequence that increases likelihood of behavior re-occurring

• Punishment
  – Consequence that decreases likelihood of behavior re-occurring

• Either can be:
  – Positive (adding stimulus) OR
  – Negative (remove, reduce, postpone stimulus)
Reinforcement

• Positive reinforcement
  – Social (attention, hugs, smiles, verbal praise)
  – Participatory (opportunity to engage in favored activity)
  – (Consumables such as food, candy, coffee not a good choice in TBI rehab)

• Negative reinforcement
  – Escape from/avoidance of unwanted task demands, social contact, aversive situation/stimuli
  – Having to leave undesirable activity (e.g., therapy session) due to unacceptable behavior can reinforce (increase) the problem behavior
Punishment

- Social (scolding, criticism)
- Noxious stimuli
- Reduced access to desired activity or social interaction/contact, pleasant stimuli
Antecedents

• Internal and external conditions influencing behavior that occur before the behavior of interest

• Also called setting events (Ylvisaker & Feeney, 1998)

• Antecedent events include:
  – External event *immediately before* behavior (e.g., specific instruction, action of another person)
  – Internal states of the person
  – External events *removed* in time
Key Internal States and External Events

• Internal states
  – Physiological states (e.g., fatigue, hunger, pain)
  – Cognitive states (e.g., orientation, understanding)
  – Emotional states (e.g., anxiety, anger, depression)

• External events
  – People
  – Previous interactions
  – Environment (including level of stimulation)
  – Time of day
Steps of Applied Behavioral Analysis

• Identify and quantify target behaviors
  – Identify positive behaviors that could be reinforced
  – Identify and describe undesirable behaviors without labeling
  – Establish baseline frequency

• Identify current antecedents
  – What appears to elicit/trigger target behaviors

• Identify current consequences
  – Determine the effect (not just intent)
  – Cajoling, scolding, arguing may be increasing rather than decreasing challenging behaviors (through social reinforcement or delay/avoidance of undesired, anxiety-provoking activities)
Steps of Applied Behavioral Analysis, cont.

- Develop plan for increasing adaptive behaviors and/or decreasing problem behaviors
- Implement behavioral plan
- Evaluate change in behavior
- Modify plan as needed
Managing Challenging Behaviors

• Control antecedents to reduce frequency of challenging behaviors

• Combine with proactive reinforcement of desirable behaviors (Wood, et al., 2011)
  – Reinforce incompatible behavior
  – Reinforce other positive or constructive behaviors
Decreasing Undesirable Behaviors

• Ignore non-dangerous behaviors such as verbal abuse
  – Do not argue, reason, or discuss
  – Neutral emotional response

• Punishment may suppress behavior, but often does not completely eliminate
  – Important to combine with reinforcement of desired behaviors
What to Do When There is a Low Rate of a Desired Response

- **Modeling**
- **Prompting**
- **Shaping**
  - Begin with current behavior(s) closest to goal behavior
  - Break down into steps that can be easily (but not too easily) achieved
  - Reinforce until stable; then move on to next one
- **Chaining (establishing a series of behaviors)**
  - Forward chaining
    - Establishing first behavior in series, cue/assist with the rest
    - Add second behavior, cue/assist with the rest, etc.
  - Backward chaining
    - Same process, reverse order, starting with last step
Do

• Identify and use reinforcer (or punisher) that works for that individual for that behavior
  – Not everyone responds to the same things
  – Identify participatory reinforcers through activities person chooses to engage in most frequently

• Give sufficient time and care to effective reinforcement of desirable behaviors
  – Don’t just focus on behaviors that are problematic
  – Identify what person is doing well and give specific feedback that is reinforcing to that person (“Good job” is not specific)

• Allow adequate time for responding

• Remain calm in behavioral crisis to avoid inadvertently reinforcing problem behaviors
Don’t

- Don’t intermittently reinforce behavior trying to decrease
  - Intermittent reinforcement is most effective intervention schedule
  - Often occurs through social attention
  - Everyone (rehab team, family, friends) needs to follow same behavioral plan

- Don’t threaten future punishments
  - After TBI, often not able to reflect on possible consequences
  - May not remember original behavior at time of punishment

- Don’t engage in power struggles and confrontations
  - Social attention can reinforce undesirable behavior

- Don’t use token economies if memory is insufficient
Theory of Multiple Memory Systems
Multiple Memory Systems

• Increasing evidence that memory is not a unitary phenomenon
• Multiple memory systems that are distinct with respect to:
  – the neural substrate
  – the types of information they handle during the learning process
  – the types of behavior change (learning) they support
Multiple Memory Systems

• These systems do not operate independently under normal circumstances…

• …but they *can* be dissociated in pathological conditions, such as
  – Korsakoff’s syndrome
  – Encephalitis (e.g., patient HM)
  – TBI, especially in acute stages
  – Other acquired brain injuries
2 Memory Systems Compared

**Explicit Memory**
- Tested with memory tests
- Phylogenically new, linked with language
- FAST learning
- Verbalizable (facts, events)
- Localized (medial temporal/hippocampus)
- Vulnerable to injury

**Implicit Memory**
- Usually not tested at all
- Phylogenetically old, more primitive
- SLOW learning
- Not verbalizable (skills, procedural data)
- Diffuse (cortical), with redundancy
- Resistant to injury
2 Memory Systems - Treatment Implications

Explicit Learning
- Fast, verbalizable learning = generalizes well across situations
- Can be retrieved out of context
- Type of learning used to answer questions, remember names and schedules, recall “rules” (“lock your brakes before you stand up”)

Implicit Learning
- Slow, experience-based learning = highly task specific
- Does not generalize well across contexts
- Needs lots of repetition to work well
- Most effective when errors are minimized during practice
The Special Role of Error

Explicit Learning
- Benefits from error
- “I did it wrong this time / last time; I know what not to do now!”
- Discovery learning (trial-and-error, feedback on errors) is a useful approach

Implicit Learning
- Sabotaged by error
- Can’t process facts or events; there is no “this time/last time,” rather a gradual buildup of experience
- Errorless learning (prevention of error, immediate correction) is a useful approach
Implications for Brain Injury Rehab

• In general*, patients with better explicit memory will benefit from error-processing approaches

• In general, patients with worse explicit memory will benefit from error-prevention approaches

• Luckily, explicit memory is easy to test, so we should always know where our patients stand on this one!

• Depends partly on the type of task, etc.
Indications of Poor Explicit Memory

• Patient does poorly on memory tests AND has significant memory difficulties in everyday life*
• Patient may be disoriented to time, place, circumstances
• If in acute stages of TBI, patient may be in post-traumatic amnesia

*if compensations are taken away
Post-Traumatic Amnesia

TIME

TBI

Duration of Unconsciousness

Normal recall

Normal or impaired recall

“Last thing I can remember before the accident”

(Coma )

Disorientation

Post-Traumatic Amnesia

“First thing I can remember after the accident”

Retrograde Amnesia
During Post-Traumatic Amnesia

- Patient is disoriented and may exhibit bizarre behavior (akin to delirium)
- Explicit memory is very impaired (or absent)
- Implicit memory is less impaired, so patients can still learn:
  - Routines
  - Procedures
  - Motor skills
  - Conditioned responses, such as fear
Do

• Establish habits & routines
  – Same sequence, same way every time
  – S-R links (chaining) to train procedures
  – Teach them habitual compensatory strategies

• Help them avoid making errors
  – Saturation cueing
  – Modeling, prompting

• Evaluate their learning by what they do (not what they say)

• Give them information (instead of asking for it)
Don’t

• Don’t quiz them for explicit information
  – Reinforces the probability of error
  – Conditions anxiety responses
• Don’t encourage them to “guess” or “try” unless you’re pretty sure they’ll get it
• Don’t expect them to remember “what they’ve been told”
• Don’t use lengthy verbal explanations/debriefings
Conclusions

• Learning theories can be translated into useful strategies for brain injury rehabilitation

• We’ve used 2 examples here—operant learning and multiple memory systems—but there are many more, e.g., motor learning, theories related to goal attainment….

• Questions? Discussion?