Principles of Learning for Traumatic Brain Injury 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 team

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

Constructivsm

- 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

- 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 redundnancy
- 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

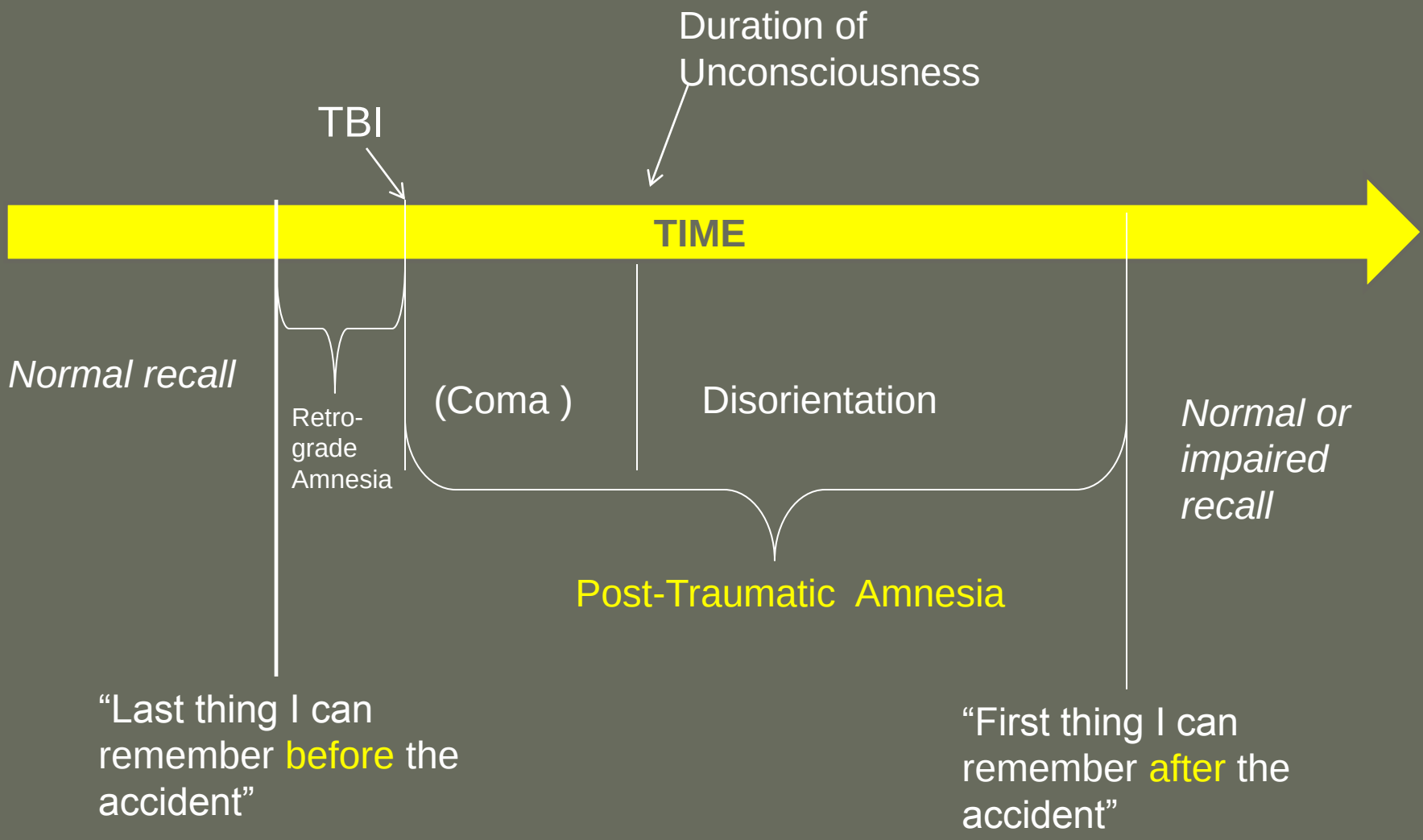
- In general*, patients with better explicit memory will benefit from error-processing approaches
- In general, patients with worse explicit memory will benefit from error-prevention approaches
- Luckily, explicit memory is easy to test, so we should always know where our patients stand on this one!
- 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



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?