Traumatic Brain Injury (TBI) & Metamemory Adjustments Over Time

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Abstract: Awareness of and ability to compensate for cognitive deficits impact the ability to predict new learning. Twenty adult survivors of traumatic brain injury (TBI) and 16 healthy controls studied and were tested on lists of noun-pairs, making predictive judgments of learning (JOLs) for each item. Regression analyses of trends in JOL and recall considered each item as a separate time step, in order to explore change over time. Analyses revealed that TBI individuals were more likely to increase or decrease their JOLs over the course of the experiment and were especially more prone to increase JOL predictions than controls.

Background Information
- New learning often requires strategies, and self-monitoring is necessary to decide whether or not memory strategies are required and which strategies are most appropriate to the situation. Unfortunately, survivors of TBI can experience difficulty with both self-monitoring and learning.
- One method for exploring self-monitoring accuracy employs judgments of learning (JOLs). Participants predict their likelihood of recalling what they have learned after studying, either immediately or after a delay. Nelson and Dunlosky (1991) first described the delayed JOL effect, in which delaying JOLs for a short time leads to significantly improved accuracy.
- TBI survivors with focal frontal injury are less accurate at predicting recall than TBI survivors without frontal injury, but both groups benefit from the “delayed JOL effect” (Kennedy & Yorkston, 2004). Kennedy, Carney, and Edwards (2003) found that TBI survivors used JOL predictions to make strategy decisions, and that decisions based on delayed JOLs resulted in the most improvement in learning.
- However, earlier studies say nothing about how individuals adjust or change their predictions while a learning task unfolds. This question is especially important because implementing compensatory strategies for new learning often relies on real-time internal feedback.

Research Questions
1. Did the magnitude of TBI or control participants’ predictions generally increase (or decrease) from the beginning of the task to the end? Did this differ for delayed or immediate JOLs?
2. Did recall performance correspond to changes in JOLs?
3. Were patterns of change different for individuals with frontal and non-frontal TBI?

Hypothesis: Non-brain-injured individuals and participants with non-frontal TBI will show greater correspondence of changes in JOL and recall than participants with frontal TBI.

Procedures
Participants were 20 adults with acquired brain injury (10 frontal, 9 non-frontal, and 1 unknown) and 16 healthy controls. The experimental procedure included initial study, delayed and immediate JOLs, and recall tests for two 40-item lists of unrelated word pairs (e.g. lake – pencil). After initial study, participants saw each word pair again (e.g. lake – lake) and were asked to make a judgment (either immediately or after a delay) of how well they had learned the word pair.

How confident are you that in about 10 minutes you will be able to recall the second word that went with this first word when you see it appear on the screen?
0 = definitely won’t recall; 20 = 20% sure; 40 = 40% sure; etc.

Analysis
- Raw JOL ratings and recall scores were examined for trends over time. Each item was assigned a time value (1-36), and parametric regression analysis was performed in which JOL ratings were regressed over time.
- Trends in JOLs and recall (increasing, decreasing, or no change) over time were considered. Did participants whose JOLs increased over the course of the experiment show a parallel increase in recall, and vice versa?
- Were there group differences between TBI and control participants, or among frontal TBI, non-frontal TBI, and controls, in the number and types of change in recall and JOL?

Results/Discussion
1. TBI participants were more likely than controls to change their predictions as the experiment proceeded, independent of change in recall. Main effect for group collapsed across the immediate and delayed conditions (Figure 1) (p < 0.05). Presence of increasing JOL ratings by TBI group, not control group.
- Group means over time (Figure 2): significant decrease in immediate JOL for control group (p = 0.05); increase in delayed JOL for TBI group (p = 0.01). This contrasts with findings from previous studies, which compared means of JOL ratings rather than changes in ratings as the task unfolded (e.g. Kennedy & Yorkston, 2000).
2. Results do not support the hypothesis that TBI individuals with frontal lobe have poorer correspondence between JOL and recall changes than those without frontal lobe injury and without brain injury. Only one participant from each group showed such correspondence.
- However, the two groups had different patterns of changing JOLs over time: six TBI participants, but no controls, adjusted predictions upward.
- Some increases in JOL occurred in the delayed condition suggests that some individuals (erroneously) believed their performance to be improving over time, even with the advantages of delayed controls.
- Therefore, some TBI participants do not base JOL predictions on retrieval attempts or evaluation of performance as described by Koriat (1997); rather, they may incorporate idiosyncratic external or autobiographical cues that are not affected by a delayed response.
3. The control group had significantly fewer changes over time than both the frontal and non-frontal groups, but the two TBI groups’ patterns of change were not significantly different from each other (Figure 3). However, a post-hoc analysis revealed differences in overall distribution of JOL predictions: the JOLs of individuals with frontal TBI were skewed higher than controls and those with non-frontal injury (Figure 4), a difference that may be due to the “fan effect.”

Clinical Implications: Findings suggest using TBI clients to consider extrinsic cues such as past performance, study strategies and their effectiveness, and how much has already been studied. Explicitly linking these considerations to learning predictions would be a necessary part of this type of therapy.

Future research could include similar studies with more participants; analyses of errors and item-by-item JOL; recall, treatment efficacy studies; evaluations of the functional relevance of metacognitive accuracy; and exploration of the effects of fatigue on metamemory adjustments over time.

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