
Rohling, M. L., Faust, M. E., Beverly, B. L., & Demakis, G. J.
Rohling’s Professional Experience

1st did assessment and rehab in grad school at DCH Rehab Pavilion in Tuscaloosa, AL

- TBI, Stroke, & Sub. Abuse (Robert Lyman)
- Thesis & Dissert. Tuscaloosa VAMC (C. Ward)

Internship at the Palo Alto VAMC TBI & Aging

- Brain Injury Rehab Unit (BIRU-Lynch)
- Comprehensive Rehab Center (CRC-Gong & Myers)
- Adult Day Health Care (DAT Day Tx-Katz)
- Nursing Home – Respite Program (Zeiss & Thompson)
Rohling’s Professional Experience

- Postdoc at Portland VAMC
  - Chronic Pain Management Program (L. Baker)
  - Neuropsych Assessment (L. Binder, D. Howieson)
  - Learned Meta-Analysis at the time & used it to research TBI & Pain
- Senior Therapist for the BI Rehab Program at UCP of Nassau Co., NY (Trudel & Zimmer)
- Dir. of Univ. Nebraska Geriatric Neuropsych. Prog.
  - Provided services and trained grad students in asses., treatment, and staff consultation at Neb. Vets Homes
Rohling’s Professional Experience

- Dir. of Outpt. Behavioral Health Services at Memorial Hospital at Gulfport (MHG), Mississippi
  - Conducted NP assess. in PM&R unit with Henry Stonington, MD, founder of the IBIA
- Prof. & DCT Clinical & Counseling Psych Program at University of South Alabama (USA) - Mobile
  - Teach assess., psychopath., psychometrics, evidence based behavioral practice (EBBP)
- See TBI & Pain patients in private practice
Cicerone et al. (2000 & 2005)

- American Congress of Rehabilitation Medicine
- Brain Injury-Interdiscip. Special Interest Group
- Cognitive Rehabilitation Subcommittee

Results published in December of 2000 & 2005 in the *Archives of Physical Medicine & Rehabilitation.*
Evidence-Based Cognitive Rehabilitation: Recommendations for Clinical Practice

Method
- Refinement of questions to be addressed
- Identification of the relevant literature
- Review, analysis, and classification of existing research
- Development of recommendations based on the strength of the available evidence

Keith D. Cicerone, Chair
Cynthia Dahlberg
Kathleen Kalmar
Donna Langenbahn
James F. Malec
Thomas F. Bergquist
Thomas Felicetti
Joseph T. Giacino
J. Preston Harley
Douglas Harrington
Jean Herzog
Sally Kneipp
Linda Laatsch
Philip Morse
Identification of Relevant Literature

- 258 published studies (Phase I = 171, and Phase II = 87) selected for inclusion in 7 areas of intervention
  - Attentional Disorders (AD)
  - Visuospatial Disorders (VS)
  - Language & Communication (LC)
  - Memory Disorders (MD)
  - Executive Function (EF)
  - Multi-Modal Treatments (MM)
  - Comprehensive-Holistic (CH)
Levels of Evidence

Class I: Well designed, prospective, randomized trials or ‘quasi-random’ assignment

Class II: Prospective, non-randomized cohort studies; retrospective case studies; or clinical series w/ controls conducting between-S’s comparisons

Class III: Clinical series w/o concurrent controls or case studies w/ good single-subject methods
What is the hierarchy of research studies suggesting the order of scientific reliability?

The hierarchy of studies reflecting the order of scientific reliability and is generally viewed as follows from the top as the most reliable & then down each level to the bottom. Met-analysis is considered the highest level of evidence.
What Was the Sample We Analyzed?

- # articles ID’ed by Cicerone  = 967
- # articles in both Cicerone’s  = 258 (27%)
- # articles coded by Rohling et al. after applying all exclusions  = 97 (10%)
- Coded articles included the following:
  - 115 treatment samples
  - 980 Effect sizes generated from 2,884 S’s
    - Exp S’s = 2,014  Control S’s = 870
What Did We Exclude?

- Cicerone excluded most articles = 709 (74%)
- We excluded 157 articles from Cicerone et al. which was 61% of what they examined
  - 43% excluded due to Single S’s designs ($n = 110$)
  - 16% of these were excluded due to them having uncodeable data ($n = 41$)
  - 2% of these were excluded because the data coded met our criteria for being an outlier
## Treatment Subgroups

<table>
<thead>
<tr>
<th>TBI Pts ($M, SD$)</th>
<th>Stroke Pts ($M, SD$)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Approx. 43% of sample</strong></td>
<td><strong>Approx. 57% of sample</strong></td>
</tr>
<tr>
<td>Age (yrs) = 29.1 (15.9)</td>
<td>Age (yrs) = 59.4 (7.7)</td>
</tr>
<tr>
<td>Ed (yrs) = 12.8 (1.4)</td>
<td>Ed (yrs) = 11.6 (2.5)</td>
</tr>
<tr>
<td>Outpatients = 77%</td>
<td>Outpatients = 54%</td>
</tr>
<tr>
<td>Chronicity yrs = 3.5 (3.1)</td>
<td>Chronicity yrs = 1.4 (2.1)</td>
</tr>
<tr>
<td>Neuro. Stable = 80%</td>
<td>Neuro. Stable = 19%</td>
</tr>
<tr>
<td>LOC (days) = 23 (23)</td>
<td>LOC (days) = unknown</td>
</tr>
<tr>
<td>Severity = 52% Mod-Sev. 37% Unknown</td>
<td>Severity = unknown</td>
</tr>
<tr>
<td>GCS (3-15) = 7.2 (2.3)</td>
<td></td>
</tr>
<tr>
<td>PTA (days) = 37 (17)</td>
<td></td>
</tr>
</tbody>
</table>
### Studies’ Characteristics

<table>
<thead>
<tr>
<th>Class of Study (%) Studies</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Class I ((n = 30) = 26.1%)</td>
<td></td>
</tr>
<tr>
<td>Class II ((n = 35) = 30.4%)</td>
<td></td>
</tr>
<tr>
<td>Class III ((n = 50) = 44.5%)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Study Design by Metric</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Single-group pre-post = 61% ((n = 70))</td>
<td></td>
</tr>
<tr>
<td>Indep group pre-post = 39% ((n = 45))</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tx Domains (%) Studies</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Visuospatial (= 25%)</td>
<td></td>
</tr>
<tr>
<td>7% TBI ((2/29))</td>
<td></td>
</tr>
<tr>
<td>Language (= 30%)</td>
<td></td>
</tr>
<tr>
<td>12% TBI ((4/34))</td>
<td></td>
</tr>
<tr>
<td>Comprehensive (= 21%)</td>
<td></td>
</tr>
<tr>
<td>67% TBI ((16/24))</td>
<td></td>
</tr>
<tr>
<td>Memory (= 12%)</td>
<td></td>
</tr>
<tr>
<td>57% TBI ((8/14))</td>
<td></td>
</tr>
<tr>
<td>Attention (= 12%)</td>
<td></td>
</tr>
<tr>
<td>79% TBI ((11/14))</td>
<td></td>
</tr>
</tbody>
</table>
# Descriptive Statistics

## Unweighted Treatment Effect Sizes

<table>
<thead>
<tr>
<th>Meas. of Central Tendency</th>
<th>Meas. of Variability</th>
</tr>
</thead>
<tbody>
<tr>
<td># of studies</td>
<td>115</td>
</tr>
<tr>
<td>Mean ES</td>
<td>.31</td>
</tr>
<tr>
<td>Median</td>
<td>.24</td>
</tr>
<tr>
<td>Mode</td>
<td>.35</td>
</tr>
<tr>
<td>10% trimmed</td>
<td>.28</td>
</tr>
<tr>
<td>SD</td>
<td>.43</td>
</tr>
<tr>
<td>Min.</td>
<td>-.51</td>
</tr>
<tr>
<td>Max.</td>
<td>1.35</td>
</tr>
<tr>
<td>Range</td>
<td>1.86</td>
</tr>
<tr>
<td>Skewness</td>
<td>.62</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>.23</td>
</tr>
</tbody>
</table>
Unweighted Effect Size for all samples ($n = 115$)
Overall Study Results
Inter-rater reliability ES & moderators = .96 to .98

Weighted Mean Study ES
- Effect sizes are weighted by the inverse of the estimated sampling variance
- Effect sizes adjusted for small sample size
- All ES’s estimates of treatment effect size using a random effects model

Mean wt ES = .30, SE = .04
- 95% Confidence Interval = .22 - .37
- Statistically significant at $p < .0001$
- Results are heterogeneous
Results of Cognitive Rehabilitation for Stroke and TBI

Single Group Pre-Post ES Treated Pts

$ES = .71 \ (n = 115)$

Single Group Pre-Post ES Controls

$ES = .41 \ (n = 45)$

Treated Pts

$ES = .71 \ (n = 115)$

Independent Groups Pre ES

$ES = .00 \ (n = 45)$

Control Group

Post-Treatment

Pre-Treatment

Treatment Group

Independent Groups Pre-Post ES

$ES = .30 \ (n = 115)$

Tx Indep. Grp Pre-Post ES

$ES = .34 \ (n = 45)$

Tx Single Grp Pre-Post ES

$ES = .30 \ (n = 115)$

All Stroke & TBI Patients

Control Group

Pre-Treatment

Post-Treatment
Results of Cognitive Rehabilitation for Stroke

Single Group Pre-Post ES Treated Pts
$ES = .76 \ (n = 48)$

Independent Groups Pre ES
$ES = .01 \ (n = 24)$

Treatment Group
Post-Treatment

Control Group
Pre-Treatment

Treatment Group
Pre-Treatment

Tx Single Grp Pre-Post ES
$ES = .40 \ (n = 24)$

Tx Indep. Grp Pre-Post ES
$ES = .48 \ (n = 24)$

Control Group
Post-Treatment

Single Group Pre-Post ES Controls
$ES = .36 \ (n = 24)$

Stroke Patients Only
Results of Cognitive Rehabilitation for TBI

- Control Group Pre-Treatment
- TBI Patients Only

- Treatment Group Post-Treatment
- Single Group Pre-Post ES Treated Pts
  $ES = .61$ ($n = 32$)

- Independent Groups Pre ES
  $ES = -.02$ ($n = 45$)

- Control Group Pre-Treatment

- Treatment Group Pre-Treatment
- Single Group Pre-Post ES Controls
  $ES = .52$ ($n = 16$)

- Tx Single Grp Pre-Post ES
  $ES = .09$ ($n = 16$)

- Tx Indep. Grp Pre-Post ES
  $ES = .08$ ($n = 16$)
### Treatment Domain Effect Sizes

<table>
<thead>
<tr>
<th></th>
<th>Overall</th>
<th>Attent.</th>
<th>Visuos</th>
<th>Lang</th>
<th>Memory</th>
<th>Comp</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Indep Group</strong></td>
<td>(n=115)</td>
<td>(n=14)</td>
<td>(n=29)</td>
<td>(n=34)</td>
<td>(n=14)</td>
<td>(n=24)</td>
</tr>
<tr>
<td>Pre-Post ES</td>
<td>.34 (.05)</td>
<td>.27 (.12)</td>
<td>.62 (.09)</td>
<td>.32 (.10)</td>
<td>.18 (.18)</td>
<td>-.01 (.12)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Single Group</strong></td>
<td>(n=115)</td>
<td>(n=14)</td>
<td>(n=29)</td>
<td>(n=34)</td>
<td>(n=14)</td>
<td>(n=24)</td>
</tr>
<tr>
<td>Pre-Post ES</td>
<td>.30 (.04)</td>
<td>.27 (.12)</td>
<td>.54 (.08)</td>
<td>.18 (.08)</td>
<td>.61 (.12)</td>
<td>.03 (.08)</td>
</tr>
</tbody>
</table>
## Level of Neurologic Recovery

<table>
<thead>
<tr>
<th></th>
<th>Overall (n = 31)</th>
<th>&lt; 1-year Post (n = 18)</th>
<th>&gt; 1-year Post (n = 13)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Independ Group</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-Post ES</td>
<td>.27 (.06)</td>
<td>.40 (.08)</td>
<td>.06 (.10)</td>
</tr>
<tr>
<td></td>
<td>(n = 80)</td>
<td>(n = 27)</td>
<td>(n = 53)</td>
</tr>
<tr>
<td><strong>Single Group</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-Post ES</td>
<td>.25 (.05)</td>
<td>.43 (.08)</td>
<td>.15 (.06)</td>
</tr>
</tbody>
</table>
What We Don’t Know Yet

Variables coded, but w/o sufficient data for analysis

- Lesion Severity (i.e., LOC, GCS, PTA)
- Lesion Location (left, right, fronto, temporal, blast, etc.)
- Cognitive Severity (loss of from premorbid ability)
- Premorbid Confounds (LD, Sub. Abuse, Psych)
- Concurrent Diagnoses (e.g., (Dep., PTSD, Seizure Dx)
**TBI Dose-Response Graphs**

(After excluding those who ailed SVTs)

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<table>
<thead>
<tr>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
<th>Group 4</th>
<th>Group 5</th>
<th>Group 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 1 hr</td>
<td>1-23 hrs</td>
<td>1-6 days</td>
<td>7-13 days</td>
<td>14-28 days</td>
<td>&gt; 28 days</td>
</tr>
</tbody>
</table>

Severity of TBI based on LOC

Max y = -2.1x + 56.2

90%ile y = -2.2x + 53.5

75%ile y = -2.3x + 50.4

50%ile y = -2.6x + 47.6

25%ile y = -3.1x + 44.6

10%ile y = -3.7x + 42.2

Min y = -3.9x + 36.4

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February 7, 2011

Rohling et al. - Cognitive Rehab - IOM

Washington, DC
Effort Has Bigger Impact on Test Scores than Neurological Status

Variance explained by effort (SVT) is 5X that explained by severity of traumatic brain injury.
What We Don’t Know Yet

Variables coded, but w/o sufficient data for analysis

- Influence of Meds (Stimulants, Antidep, Neuroleptics)
- Neuroimaging Measures (quantify lesion size)
- Treatment Variables
  - (Duration, Sessions/week, Session Length, # of Sessions)
- Age of Patient at time of injury
- Time post injury for which treatment is provided

- Effectiveness vs. Efficacy (Lab vs. Community)
Study Conclusions

- Modest Tx effect for all brain injury (TBI & Stroke)
  - Effect larger for stroke, but is quite small for TBI
- All domains modest Tx effect, except
  - Language Deficits following Stroke
  - Visuospatial deficits following Stroke
  - Attention Training following TBI
- Stroke pts. who are not yet stable have larger Tx effects other patients which is in addition to natural recovery or practice effects.