

Title: There is moderate evidence to support that Interactive Metronome™ therapy in conjunction with standard rehabilitation therapy is a more effective treatment for improving attention in adults with mTBI compared to standard rehabilitation therapy alone.

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CLINICAL SCENARIO:

Client Population:

- Adults, 21-49 years old, with a diagnosis of a mild traumatic brain injury.
- Children, 6-13 years old, with a diagnosis of attention deficit disorder.

Treatment Context:

- Interactive Metronome™ (IM) therapy was delivered on a one-on-one basis in an outpatient setting.

Problem/Condition this Intervention Addresses:

- Interactive Metronome™ therapy has been used to address inattention, cognitive deficits, and poor motor coordination (Shaffer et al., 2001). This CAT, however, is limited to the effect of IM therapy on attention in people with brain injury.

Intervention:

- The Interactive Metronome™ is a computer based training program that provides participants auditory and visual feedback to synchronize timing and rhythmicity of various hand and feet movements using contact-sensing buttons. Sensor buttons are attached to the participant's hands or feet depending on the exercise. The participant taps the sensor button with the beat as they receive visual and auditory feedback. Headphones provide auditory feedback while the computer screen simultaneously provides visual feedback, allowing the user to continuously correct their rhythm to synchronize with the beat (Schaffer et al., 2001).

Science behind the Intervention:

- The proposed science behind Interactive Metronome™ includes that neuroplasticity, or changeability, of the brain allows for new neural connections to be made which allows us to learn new information every day. Neuroplasticity is also a beneficial characteristic of the post-brain damage, such as after a TBI, which allows the individual to re-learn neural processes including sensory modulation, attention, and problem solving. (Nelson et al., 2013; Shaffer et al., 2001).
- IM Therapy is the repetitive practice of continued and accurate attention. This, in conjunction with the repetitive experience, predictable timing, and pattern relationships between sensory inputs and motor outputs, helps to promote the production of neurotransmitters in the synapse. (Nelson et al., 2013).
- This is helpful as human learning and memory processes rely on neurotransmitters such as dopamine, NE, and ACH. When repetitive and recurring firing of neurons from

a specific task occurs (attention-related tasks), neuroplastic responses like dendritic sprouting and receptor upregulation occurs in neurons and the pathway for that skill becomes laid down, allowing for that skill to be repeated in the future. The more repetition and practice, the better the neural pathway gets laid down, allowing for better quality of the skill in the future (Nelson et al., 2013).

Why is the intervention appropriate for occupational therapy:

- Interactive Metronome™ is a preparatory method and task that addresses client factors and performance skills in the occupational therapy framework. Specific client factors include mental functions of attention and thought. The performance skill of temporal organization is also addressed. Improving client factors and performance skills prior to occupational engagement is expected to improve participation and overall occupational performance during desired activities (American Occupational Therapy Association, 2008).

What ICF Level is the intervention:

- Interactive Metronome™ therapy aims to improve attention, which falls under the ICF category of Body Functions and Structures

FOCUSED CLINICAL QUESTION:

- Patient/Client Group: Adults with mTBI experiencing decreased attention
- Intervention: Interactive Metronome™ therapy in addition to standard rehabilitation therapy
- Comparison Intervention: Standard rehabilitation therapy
- Outcome(s): Improved attention

SUMMARY:

- This CAT investigates Interactive Metronome™ (IM) in adults with mTBIs and its effect on attention
- Search
 - We searched 9 total databases
 - We located three articles relative to our topic
 - We critiqued three articles. We found the one article including adults to be of high rigor (PEDRO >8) and the two articles including children to be of limited rigor (PEDRO 5-7) (CASP <6).
 - The three articles selected were included because they most closely correlated to our PICO question and represented highest rigor.
 - Research looking at the effectiveness of IM therapy in adults to improve attention is relatively new, thus we also looked at its effectiveness of IM on

attention in children, which has more research, to see if there were any correlations that we could make.

- Overall, there is moderate evidence to support that Interactive Metronome™ therapy is effective in improving attention in adults with mTBIs and there is no evidence to support its effectiveness in improving attention in children with ADHD.

CLINICAL BOTTOM LINE: There is moderate evidence to support that Interactive Metronome™ therapy in conjunction with standard rehabilitation therapy is a more effective treatment for improving attention in adults with mTBI compared to standard rehabilitation therapy alone.

Limitation of this CAT: This critically appraised paper (or topic) has been reviewed by occupational therapy graduate students and the course instructor.

SEARCH STRATEGY:

Table 1: Search Strategy

Databases Searched	Search Terms	Limits Used	Inclusion and Exclusion Criteria
<p>Cochrane Central Register of Controlled Trials</p> <p>OVID</p> <p>OT Seeker</p> <p>EBSCOhost</p> <p>PsychInfo</p> <p>Alt Health Watch</p>	<p>“Interactive Metronome”</p> <p>“Interactive Metronome and Traumatic Brain Injuries”</p> <p>“Interactive Metronome and TBI”</p> <p>“Interactive Metronome and Attention Deficit Hyperactivity Disorder”</p> <p>“Interactive Metronome and ADHD”</p> <p>“Interactive Metronome and Attention”</p> <p>“IM Technology”</p> <p>“IM Programming”</p> <p>“Rhythmic Sound”</p> <p>“Rhythmic Auditory Cues”</p> <p>“Interactive Computer”</p>	<p>And</p>	<p>None Used</p>

RESULTS OF SEARCH

All of the relevant studies that were located should be categorized by level of evidence and listed in Table2.

Table 2: Summary of Study Designs of Articles Retrieved

Level	Study Design	Total Number Located	Database Source	Citation
Level 1a	Systematic Reviews or Meta Analysis of Randomized Control Trials	0		
Level 1b	Individual Randomized Control Trials	1	PsychARTICLES	Nelson, L. A., MacDonald, M., Stall, C., & Pazdan, R. (2013)
Level 2a	Systematic reviews of cohort studies	0		
Level 2b	Individual cohort studies and low quality RCT's (PEDRO < 6)	2	PsychInfo	Shaffer, R.J., Jacokes, L. E., Cassily, J. F., Greenspan, S. I., Tuchman, R. F., & Stemmer, P. J. (2001)
			PsychInfo	Leisman, G. & Melillo, R. (2010)
Level 3a	Systematic review of case- control studies	0		
Level 3b	Case-control studies and non- randomized controlled trials	1	EBSCOhost	Bartscherer, M., & Dole, R. (2005)
Level 4	Case-series and poor quality cohort and case-control studies	2	OVID	Cosper, S.M., Lee, G.P., Peters, S.B., & Bishop, E. (2009)
			Alt Health Watch	Leisman, G., Melillo, R., Thum, S., Ransom, M., Orlando, M.,

				Tice, C., & Carrick, F. (2010)
Level 5	Expert Opinion	3	OVID PsychInfo EBSCOhost	Koomar, J., Burpee, J. D., DeJean, V., Frick, S., Kawar, M. J., Fischer, D. M. (2001) Roberds, J.A. (2005) Ghajar, J., Ivry, R. (2008)

STUDIES INCLUDED

	Study 1: Nelson et al. (2013)	Study 2: Schafer et al. (2001)	Study 3: (2009)
Research Design and Strength	Individual Randomized Control Trial Level 1b: RCT	Individual Randomized Control Trial Level 2b: Low quality RCT (PEDRO < 6)	Pre-Post test Design Level 4: Case Series
Rigor	8/10 PEDRO Rating	5/10 PEDRO Rating	6/9 CASP case control form
Purpose of Research	Look at effectiveness of IM therapy and standard rehabilitation treatment on attention and memory	To determine the effects of IM therapy on select motor and cognitive skills in children with ADHD	To determine if children with neurodevelopmental disorders who complete treatment with the Interactive Metronome™ will display pre-treatment to post-treatment improvement in motor

			coordination and sustained attention.
Population	Active duty soldiers with persistent cognitive complaints following a documented history of blast-related mild-moderate TBI	56 children (55 of whom have outcome measures due to one dropout), ages 6-12.5, diagnosed with ADHD (all males)	12 children all with ADHD. 10 of which also had a developmental coordination disorder and 2 who had pervasive developmental disorder.
Intervention Investigated	Interactive Metronome™ (IM)	15 hours of Interactive Metronome™ training exercises (n=19)	15, 1 hour sessions of Interactive Metronome™ over 15 weeks
Comparison Intervention	Control: Standard rehabilitation care (SRC)	Training on selected computer video games (n=19) Control: No Intervention (n=18)	Pre-post test design, children were their own controls
Dependent Variables	Attention & Memory	A) Attention & concentration B) Clinical functioning C) Academic & cognitive skills	Motor coordination and sustained attention.
Outcome Measures	RBANS Index Attention Index IVA-CPT Full Scale Attention Quotient (FSAQ), Auditory Attention Quotient (AAQ), Visual Attention Quotient (VAQ), and 8 others (11 total)	A) Tests of Variables of Attention (TOVA), Conners' Rating Scales–Revised (CRSR), Wechsler Intelligence Test for Children–Third Edition, and Achenbach Child Behavior Checklist B) CRS-R, Achenbach Child	BOT2 and Gordon's diagnostic test (GDS)

		<p>Behavior Checklist, The Sensory Profile, and Bruininks-Oseretsky Test for Motor Efficiency</p> <p>C) Wide Range Achievement Test (WRAT 3), and Language Processing Test assesses basic language</p>	
Results	<p>Significant benefits measured by performance on well-defined cognitive tests, relative to standard rehab care without IM.</p>	<p>Upon being compared to video game training and no intervention, IM training was found to facilitate significant improvements in attention, motor control, and selected academic skills.</p>	<p>Significant improvement in visuomotor control and complex visual choice reaction time, no improved sustained attention or motor inhibition.</p>
Effect Size	<p>RBANS Index Attention Index: = .379</p> <p>IVA-CPT Full Scale Attention Quotient (FSAQ): 2.354</p> <p>Auditory Attention Quotient (AAQ): 2.645</p> <p>Visual Attention Quotient (VAQ): 1.440</p>	N/A	<p>GDS Reaction time= -6.15</p> <p>BOT2 Visual motor = 1.01</p>
Conclusion	<p>The Interactive Metronome™ training program is effective in improving attention and delayed memory</p>	<p>Although it was stated that the Interactive Metronome™ training program was effective in improving attention,</p>	<p>The study found significant improvements in complex visual choice reaction time (P <.05) and significant improvements in</p>

		motor control, and selected academic skills for children with ADHD, the article did not provide any data or evidence to support this claim.	visuomotor control (P =0.02)
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IMPLICATIONS FOR PRACTICE, EDUCATION, AND FUTURE RESEARCH

Overall Conclusions:

There is moderate evidence to support that Interactive Metronome™ therapy in conjunction with standard rehabilitation therapy is a more effective treatment for improving attention in adults with mTBI compared to standard rehabilitation therapy alone (Nelson et al., 2013). All three of the studies measured attention. Two of the three studies measured attention in children with ADHD (Casper et al. 2009; Shaffer et al., 2001). The third study measured attention in adults with mTBI (Nelson et al., 2013).

Participants in all three studies received a standardized schedule of IM Therapy, which included 15, 1-hour sessions. Shaffer et al. (2001), who studied children, and Nelson et al. (2013), who studied adults, both reported a statistically significant increase in attention in the experimental group compared to the control group, however, no numerical data was reported to support the significance in Shaffer et al. and therefore this claim of significance can not be considered valid. Nelson et al. (2013) reported a significant increase of $p= 0.04$ in the RBANS Attention Index.

Outcome measures used to measure attention varied between all three studies and included the Tests of Variables of Attention (TOVA), Conners Rating Scale - Revised (CRSR), Weschlers Intelligence Test for Children, Achenbach Child Behavior Checklist, Gordon Diagnostic Systems (GDS), Full Scale Attention Quotient (FSAQ), Visual Attention Quotient (VAQ), and Auditory Attention Quotient (AAQ) (Nelson et al., 2013; Shaffer et al., 2001; Casper et al., 2009). Between the two studies that focused on children, Shaffer, et al. (2001) found a statistically significant improvement in attention (though no numerical data was provided to support this significance), while Casper et al. (2009) did not find a statistically significant improvement in attention. Participants received the same total hours of IM therapy however they varied in number of weeks taken to complete the IM Therapy session from 3 to 17 weeks.

Despite the belief that IM therapy increases attention in children with ADHD, our studies did not show significant results to support this claim (Casper et al., 2009; Shaffer et al., 2001). IM therapy attempts to incorporate practice and repetition into a single set of tasks that are designed to encourage neuroplastic activity (Nelson et al., 2013). This concept should hold true in children and adults, however, there is a lack of evidence to support the use of IM therapy to increase attention in children. Therefore, though we had hoped to find evidence that IM was effective in improving attention in children to provide more support for its use with adults, we were unable to establish a connection and the rest of this CAT will refer only to the one strong, well designed study with adult males.

Boundaries:

There were a total of 46 adult males ages 21-49 years old participating in our study for adults (Nelson et al., 2013). The adults in this study were all diagnosed with mTBI due to a blast-related injury and, as a result, displayed signs of decreased attention. Exclusion criteria for this study were: (a) having had a current or prior (6 months) unstable medical condition that could affect current brain function; (b) being status post craniotomy prior to cranioplasty; (c) having a prior history of moderate to severe TBI, not including present injury; (d) having current (last 3 months) active suicidal or homicidal ideation or intent; (e) having current (last month) drug and/or alcohol abuse or dependence; (f) using benzodiazepine or narcotic medications; (g) participation in a concurrent drug or treatment trial; (h) being physically unable to complete the treatment tasks (including sensory functions) (Nelson et al., 2013).

Implication for practice:

The program in the study used a standardized schedule of Interactive Metronome™ (IM) therapy within their treatment intervention (Nelson et al., 2013). Interactive Metronome™ is a commercially available product and was used in this study. Adults in the study included 21-49 years old with diagnoses of mTBI (Nelson et al., 2013). Intervention consisted of 15, 1-hour sessions of IM therapy over a course of 3-17 weeks, and was administered by staff certified and trained to administer IM therapy. The length of time between the final IM therapy session and completing the posttest measures varied between participants (Nelson et al., 2013). Participants in the treatment group received standard rehab therapy in addition to IM therapy (Nelson et al., 2013). All sessions were delivered in outpatient treatment sessions (Nelson et al., 2013). Overall, IM therapy was found to improve attention in adults with mTBI (Nelson et al., 2013). No negative effects of IM training were reported in the literature (Nelson et al., 2013).

In summary, the key components of this study include a standardized schedule (15, 1-hour sessions) of IM Therapy, given over a time period of 3-17 weeks, and administered by trained staff who are certified to administer IM Therapy (Nelson et al., 2013).

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