

INTERACTIVE METRONOME

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What is Interactive Metronome

The Interactive Metronome (IM) combines the concept of a musical metronome with a patented technology computerized program that accurately measures, assesses, and improves a person's rhythm and timing. It is the only program that uses a patented auditory guidance system plus interactive exercises to improve the foundational skills essential for learning and development.

Theory

Concerns about timing and human performance go back for centuries. Many scientists believe that a human being's capacity for timing and rhythmicity plays an important role in a variety of behaviors including motor planning, sequencing, and cognitive functions, such as attention and academic achievement. There has been evidence that timing and rhythmicity is an important central nervous system function that relates to a variety of cognitive and motor skills.

The core process is compromised in a variety of challenges involving attention, language, motor planning, motor coordination, social interactions, and learning disabilities, including nonverbal learning disabilities, as well as during the ageing process. In just about all advanced thinking and problem solving, the ability to plan and sequence thoughts with behaviors occurs at a basic, foundational level.

Today, there are interventions that exercise and improve the middle to higher levels of cognitive and social skills, but there have not been any that directly address and improve basic, foundational level of timing and rhythmicity.

History

The Interactive Metronome (IM) was first developed in 1992 by a man named James Cassily. His formal education is in child psychology. He has spent over twenty years in record production, engineering and recording studio equipment design, and manufacturing. His personal interest in audiology helped him pioneer psychoacoustic audio signal processing in the recording, sound reinforcement, and broadcast fields.

The Interactive Metronome was originally developed to help professional musicians numerically test and improve timing and rhythmicity. However, it turned out that Mr. Cassily's first prototype of the IM was not with musicians. He was urged by a personal friend (physician who suffered a traumatic brain injury which destroyed much of the motor control area of his brain) to use it on children with severe motor skill development problems. It was quickly discovered that training with this new tool also had unexpectedly broad positive effect on individuals with learning, attention, and motor challenges, as well as those with musical and athletic gifts.

It is of note that Dr. Stanley Greenspan (founder of the DIR Model – Developmental, Individual Differences, Relationship Model and the Floortime Approach) was instrumental in helping Mr. Cassily understand the role of emotions play, and how to refine the IM's intervention capabilities, especially with autistic children. Dr. Greenspan became the Director of Interactive

Metronome Research in 1997. It was his insights into emotional aspects of child development that confirmed Mr. Cassily's Theory of Sequentially Timed Learning.

After nearly a decade of research, the patented IM program was introduced for the first time in 1999 to qualified health professionals. In 2001, the "IM-Powered" training program was launched for mainstream applications including academic and sports performance.

How it Works

The IM program 'trains the brain' to plan, sequence and process information more effectively through repetition of interactive exercises. During the IM training a trainee wears stereo headphones and listens to special sounds that the IM computer software program generates to guide the training process. Motion sensing triggers, connected to the computer via cables, relay information about the trainees performance to the computer during training. One trigger is worn like glove on either hand. It senses exactly when the hand makes contact when tapped during training. The other trigger is placed on the floor, and senses exactly when the trainee taps either a toe or heel upon it.

Thirteen different hand and foot exercises are performed while auditory guide tones direct the individual to match the metronome beat. The IM program analyzes the accuracy of each tap as it happens and instantaneously creates a sound that the trainee hears in the headphones. They learn to focus all their attention on the steady metronome beat sound in their headphones, without being interrupted by thoughts around them. IM trainees experience maintaining precise focus for longer and longer periods of time. The ability to maintain focus becomes automated. The mental control learned through repetitively successful planning and sequencing experiences is rarely forgotten. Upon completion of IM training (following approximately a total of 35, 000 repetitions) most trainees find it significantly easier to learn new complex cognitive and physical tasks.

The difference between the individual's response and the computer generated beat is measured in milliseconds (ms.) and a score is provided. A low ms. score indicates improved timing and overall performance. The program consists of 12 or 15 one-hour sessions, which can be completed in 3 to 5 weeks. Additional sessions may be necessary and is decided on an individual basis.

What are the Benefits?

The IM program has been shown to produce significant results in children and adults with a wide range of physical and cognitive difficulties including ADHD. The March/April 2001 issue of the American Journal of Occupational Therapy identified five core areas of statistically significant improvements gained through the IM training program:

Attention and Focus

Motor Control and Coordination

Language Processing

Reading and Math Fluency
Ability to Regulate Aggression/Impulsivity

The goal of IM training is to bring lasting improvements in an individuals overall planning and sequencing and attentional capacities. The IM millisecond scores are the benchmarks of the level of mastery achieved, not how many sessions or repetitions have been completed. Every individual is different, and each has a unique set of pre-existing capabilities and timing related “habits”. Therefore, no single IM training program or schedule can meet the specific needs of all individuals.

Ongoing studies continue to validate correlations between Interactive Metronome and academic achievement in mathematics, language, reading, and attention to task. The IM program has also proven to be a powerful tool for improving both the physical and mental aspects of athletic performance.

Who Can Benefit from Going Through the IM Program?

IM's adaptive design can be used with a broad spectrum population 'developmentally' 6 years of age and older. This may include but not limited to:

Learning Disabilities

ADD/ADHD

PDD

Traumatic Brain Injury

Aspergers Syndrome

Language Deficits (poor listening comprehension, poor verbal expression, poor reading comprehension, motor and sequencing aspects of language, etc.)

Attention and Motor Coordination Difficulties

Poor organizational skills, poor memory, poor fine motor skills, etc.

Motor Planning and Sequencing Difficulties

Parkinson's Disease

As with any intervention, the varying degrees of severity will indicate appropriateness.

Is Maintenance Necessary After Completing The IM Program?

Case studies monitored over the past five to 6 years indicate that lasting residual effects may be obtained after an individual completes the IM program. Patients tested 6 and 12 months post-training, exhibit nearly identical performance on the IM as achieved during the training process. Further long-term effect studies are underway.

A SUMMARY OF INTERACTIVE METRONOME RESEARCH (2003)

The Interactive Metronome (IM) has been subjected to a number of scientific trials beginning in 1995. Below is a summary of those studies to date. References to sources from which these summaries were abstracted are provided.

Special Education Students

A comparison of IM trained special education students to a control group found the IM trained group to improve significantly in both motor control and motor coordination as measured by independent assessments (Bruininks-Oseretsky and SIPT Motor Accuracy Test) compared to the control group. Parents of the IM trained group also reported marked improvement in their children's ability to attend to tasks, read, write and improve general-behavior. (Stemmer, PAL (1996). *Improving Student Motor Integration by Use of an Interactive Metronome*. Study paper presented at the 1996 Annual Meeting of the American Educational Association, Chicago, IL.)

Kindergarten and Elementary School Children

A correlation study of 585 children in a mid-western school district found significant correlations between IM timing and academic performance in reading, mathematics, language, science, social studies, and study skills, suggesting timing and rhythmicity may play a foundational role in the cognitive processes underlying performance in these academic areas. Timing and rhythmicity measurement was also found significant in differentiating children in special education classes, participation in dance and musical instrument training. A strong relationship between attentiveness in class and better timing and rhythmicity was also found. Finally, Interactive Metronome timing and rhythmicity measures show impressive evidence of being a reliable and valid means of assessing children's motor timing and planning capacity. Children's motor planning and timing is important because it is a key factor in sports, music, dance, speech and general life functioning. (Kuhlman, IC & Schweinhart U. (1999). *Timing in child development*. Ypsilanti, MI: High/Scope Educational Research Foundation)

ADHD Boys

An experimental study of 56 boys, nine to 12 years old diagnosed with ADHD, found those undergoing IM treatment (19 subjects) to show significant improvements compared to a Control group (18 subjects) and a Video-placebo group (19 subjects). The IM group improved in 53 of 58 test scores compared to 28 of 58 and 40 of 58 for the Control and Video groups. The IM group showed statistically significant and consistent patterns of improvement in measures of attentional processes (as measured by the Test of Variables of Attention) compared to the other two groups. The differences were associated with improvements in attention, processing times of stimuli, inconsistency in response to stimuli, decreased variability in these responses and an improved TOVA ADHD score falling in the range of that expected for a normal rather than to an ADHD population. Parents of IM trained ADHD boys reported a significantly different and stronger pre-post pattern of decline in aggression compared to the other two groups. IM trained subjects showed significant patterns of improvements in cognitive processing for measures of language processing (similarities and differences) and academic skills in reading than did the other two groups. (Schafer, R. J., Jacokes, L.E., Cassily, J.F., Greenspan, S.I., Tuchman, R.F., & Stemmer,

Jr., P.J. (2001). Effect of Interactive Metronome Training on Children with ADHD. The American Journal of Occupational Therapy, 2: 155-162)

Theoretical and Clinical Perspectives on the Interactive Metronome

A review of the experiences of occupational therapists with the Interactive Metronome is presented. The journal article review relevant literature, looks at the clinical challenges of children with sensory integration difficulties and the central role of timing and rhythmicity in motor planning processes of organizing and sequencing. Case studies of IM trained subjects are reviewed and attest to the positive impact IM has had as an adjunct to occupational therapy practice. *(Koomar, J., Burbee, J. D., DeJean, S. F., Kawar, M J. Fischer, D. M. (2001). Theoretical and clinical perspectives on the interactive metronome: a view from occupational therapy practice. The American Journal of Occupational Therapy, March/April 2001, Vol. 55, Number 2)*

Adult Golfers

Adult golfers trained with the IM compared to a control group who read golf magazine articles to improve their golf swing produced significant improvements in golfing accuracy after twelve IM training sessions. The IM trained group performed significantly better on three of four clubs (7 iron, 5 iron and driver) and the total average for all clubs. These results indicate that the IM motor performance training in timing improved accuracy relative to the control group, which did not show any improvements. Specifically, training in motor timing leads to changes in tempo and suggests such improved tempo translates into a smoother golf swing with a resulting increase in accuracy. Additionally, the training increases a golfers focus, concentration and the ability to coordinate intention with the execution of a complex motor activity. *(Libkuman, T. M & Otani, Hajime, O. (2002). Training in Timing Improves Accuracy in Golf. Journal of General Psychology, 2002, 129(1), 77-96; Libkuman, T. M. & Otani, Hajime, O. (2000). IM Training In Timing And Accuracy In Golf. Golf Research News - St. Andrews Scotland).*

Timing and Rhythmicity and Cognitive-Academic Performance

A correlation analysis of five data sets including kindergarten, elementary students, ADHD boys, special education students and teenage high school dropouts found significant relationships between IM performance and the following abilities:

Reading abilities including vocabulary, reading comprehension, language mechanics, letter sounds and total reading performance.

Mathematic abilities including computation, mathematics applications, number knowledge, writing dictated numbers, recognizing number names, relating number sets and total mathematics performance.

Oral/written language abilities including language expression, writing dictated numbers and overall language abilities. Writing including spelling, writing and, for Kindergarteners, printing capitals and lower case letters. Attention including response time, omission and commission errors, attention variability, and short time attention and attention over time.

Motor coordination and performance including motor proficiency, bilateral and upper and lower limb coordination, visual motor control, motor accuracy, instrumental and dance training, physical coordination/motor skills, and timing.

(Greenspan, S. Jacokes, L & Cassily, J. (2002). Timing and Rhythmicity and Cognitive-Academic Performance. Submitted for publication)

High School Students

Eighty-seven high school students in the 9th through 12 grades were trained with the IM over 12 one-hour sessions. After IM training, statistically significant increases in grade equivalent performances on the following tests of the Woodcock Johnson III were found: reading fluency increased by 1.92 grade equivalents (GE), math fluency by 1.11 GE, processing speed by 2.61 GE, visual matching by 2.19 GE, decision speed by 5.68 GE. A follow up study after one year with 12 of these IM trained students revealed measures of reading and mathematical fluency to have remained at the same performance levels obtained at the end of the previous years training. This suggests the impact of the original IM training was sustained over the one-year period.

(Interactive Metronome, Inc., Internal research, 2002).

High School Dropouts

A small pilot study comparing three groups of participants in the Challenge program at the Aberdeen Proving Grounds was conducted. Four encouraging results suggest that IM training may contribute to improved participant performance.

- IM timing and rhythm city measures are significantly correlated with the General Education Development (GED) Tests of writing, social studies and mathematics subtests and with the reading, mathematics and language subtests of the Test of Adult Basic Education. This suggests timing and rhythm city plays a significant role in underlying cognitive processes associated with these academic capacities.
- The IM trained group increased its passing percentage on the final GED test by 33% compared to a practice GED test taken earlier in training while the comparison and general groups showed no increases in passing percentages.
- The IM group produced significantly higher scores on the Woodcock-Johnson III subtests of reading and mathematic fluency in contrast to the comparison group.
- The IM trained group improved its timing and rhythm city performances by 67.7% over their pre-test millisecond performances. This establishes the ability of intensive IM training to significantly improve the initial timing and rhythm city patterns of participants. *(Interactive Metronome, Inc. Internal research, 20002)*

Academic Correlation Study

A correlation analysis of five data sets including kindergarten, elementary students, ADHD boys, special education students and high school dropouts found significant relationships between IM performance and the following abilities:

Reading abilities including vocabulary, reading comprehension, language mechanics, letter sounds and total reading performance.

Mathematic abilities including computation, mathematics applications, number knowledge, writing dictated numbers, recognizing number names, relating number sets and total mathematics performance.

Oral/written language abilities including language expression, writing dictated numbers and overall language abilities.

Writing including spelling, writing and, for Kindergarteners, printing capitals and lower case letters.

Attention including response time, omission and commission errors, attention variability, and short time attention and attention over time.

Motor coordination and performance including motor proficiency, bilateral and upper and lower limb coordination, visual motor control, motor accuracy, instrumental and dance training, physical coordination/motor skills, and timing. *(Greenspan, S., Jacks, L. & Classily, J. (2002). Timing and Rhythm city and Cognitive-Academic Performance. Submitted for publication)*

Academic Fluency Study

Over 700 middle and high school students were trained with the IM over 12 one-hour sessions and given select pre and post subtests of the Woodcock-Johnson III standardized test. The aggregated results from the IM group showed statistically significant increases in grade equivalent (GE) performances in the following areas:

- Over 1 .5 Year Gain in Math Fluency
- Over 2 Year Gain in Reading Fluency
- Over 2.5 Year Gain in Mental Processing Speed

Title I Study

A controlled study of 80 fourth and fifth grade students from *Title I schools found those who completed IM training showed significant improvements in reading and math fluency as compared to a control group that showed no improvements. The results from the IM group showed:

- Avg. Gain of 1.3 Grade in Math Fluency
- Avg. Gain of 1.7 Grade in Reading Fluency

*Title I is the largest federal aid program for elementary and secondary schools.

Parkinson Patients

A pilot study of eight Parkinson's disease patients classified as stages 1 through 3 on the Hahn and Yarn Disease Scale revealed IM training to positive impact on Parkinson symptoms. Symptom improvements were observed for tremors, freezing, speech clarity, walking, movement and coordination, balance and spatial stability, memory and attention and focus, and fatigue and

stamina. Six of eight subjects experienced observable improvements. Subjects did not experience these changes equally; individual patterns of improvement were the rule.

Objective measures of timing and rhythm city revealed an average pre-post Long Form improvement of 68% overall, 72% for hands and 59% for feet. The Get-Up-And-Go test showed an average pre-post improvement of 2.09 seconds. These results suggest the IM can produce positive changes in subject internal timing and external capacity for movement. Improvement in attention occurred with a slight improvement in longer-term attention and a statistically significant improvement in shorter-term attention. (*Interactive Metronome, Inc., Internal research, 2002*).

Greenspan and Jacks Article

This publication presented a brief literature review of timing and rhythm city as related to time perception, cognitive processes, motor coordination and neurological basis of timing and rhythm city. A theoretical framework for understanding the developmental processes related to timing and rhythmicity and their impact on higher mental processes was presented.

External Agency Research

A number of independent organizations are presently engage in research with the Interactive Metronome. These research projects are described below.

Parkinson Disease Study

The Parkinson Institute of Sunnyvale California is conducting an experimental vs. control group study to assess the impact, which Interactive Metronome training may have upon improving Parkinson disease symptoms. The study includes 20 IM trained and 20 control group subjects. The hypothesis of the study is that IM training will produce significant improvements in Parkinson symptoms such as gait, balance, movement, freezing and other related Parkinson symptoms.

ADHD, Stimulant Medication and Interactive Metronome Training

The objective of this study is to determine whether IM training when implemented with children already taking stimulant medication, provides beneficial effects beyond those realized by children taking ‘mediation alone. The experimental study will use a -randomized parallel groups design with eight to fourteen-year-old formally diagnosed ADHD children (112 children in each group). This is a cooperative study between Health South of Birmingham Alabama and Dr. Scott Kollins and Dr. C. Keith Connors, independent consultants to the study.

The Cognitive Impact of Interactive Metronome Training on High School Students

The objective of this experimental study is to assess the impact of IM training vs. no IM training upon ninth and tenth grade high school students. The hypotheses being tested seek to establish whether IM training significantly improves such executive functions as focus, attention, concentration and cognitive capacities of reading and mathematical fluency and scholastic aptitudes. Three hundred twenty students will be randomly assigned to the two experimental groups (160 in each group). The principal investigators for the study are Drs. Gordon Taub (University of Central Florida) and Phillip Lazarus (Florida International University). The study is being conducted at Flanagan High School of the Broward County School District in Ft. Lauderdale Florida.

Motor Skills Study

The underlying hypothesis is that differences between retention of motor tasks learned under blocked vs., random motor task learning may be significantly related to poor timing and rhythmicity prior to learning motor tasks. The objective of this research is to study the effects of Interactive Metronome pre-training in timing and rhythmicity upon the long-term retention differential effects experienced between blocked and random training. The study is being performed by Patricia A. Shewokis, Ph.D, Professor of Rehabilitative Sciences of Drexel University, Philadelphia PA.

At Risk Student Study of Reading and Mathematics Fluency

This study experimentally compare two groups of ‘at risk’ early elementary Title I students matched on grade/age, gender, race and SAI scores (40 IM trained and 40 control subjects). Both groups were pre-post tested on the reading and math fluency tests of the Woodcock Johnson III. The IM group received 12 IM training sessions over a four-week period. The results of the study revealed the IM trained group produced statistically significant increases in both reading fluency (an increase of 1.69 grade equivalence, $p < .000$) and mathematic fluency (an increase of 1.29 grade equivalence, $p < .000$). Over the same twelve-week period, the control group showed a significant decline in reading fluency and no change in math fluency. The results strongly suggest IM training in timing, rhythmicity and attention facilitates improvements in cognitive planning and sequencing processes related to reading and math fluency in Title I elementary students. The principal investigator is Cindy Cason, Ph.D. former Director of Student Services for the Homewood Board of Education, Homewood, Alabama.

Neural Imaging Study

This study will use Functional MRI to assess the differences in brain functioning of previously train IM subjects compared to untrained subjects. Additionally, pre-post brain scans of traumatic brain injury patients undergoing IM training will be compared to assess changes in brain functioning. The principal investigator for these studies is Neal Alpiner, M.D. of the Hurley Family Rehabilitation Center, Flint Michigan.

Interactive Metronome Internal Research

Long Term Retention of Interactive Metronome Performance

This research is retesting 500+ former IM trainees and assessing how well their final IM training performances have held up since ending training. In addition, where trainees were given other pre-post tests as part of their training regimen, re-testing on these tests will be attempted. Results of this study will allow determination of the longevity effects of IM training analyzed by a number of demographic, diagnostic and activity variables not available until this time.

Interactive Metronome Assessment (IMA) National Norming Project

An improved version of the IM Long Form (IMA) test will be administered to a national sample of 700 to 800 normal children and adults. The objective is to produce norms for the IMA that reflect normal population performance and can be used by individual providers to assess client capacities for timing, rhythmicity and attention. The study will result in a stand-alone evaluation instrument for professionals.

SUMMARY OF THE MAJOR RESULTS OF THE INTERACTIVE METRONOME STUDIES

The above studies support the following conclusions about the Interactive Metronome. The Interactive Metronome:

1. Improves visual motor control and aspects of motor planning and coordination in both special education students and ADHD boys.
2. Improves adult focus, concentration and the ability to coordinate intention with the execution of some complex motor activities such as golf.
3. Significantly correlates with measures of motor coordination and attention to task.
4. Significantly correlates with children who have been involved in rhythmic activities such as music and dancing.
5. Significantly correlates with measures of elementary school children's academic performance such as mathematics, language, reading and achievement.
6. Differentiates between students in compensatory education programs and those not in such programs.
7. Shows statistically significant patterns of improvements in boys with ADHD in their attention, language processing, reading, and the regulation of aggression.

8. Demonstrates that high school students who received IM training also significantly increased their post-training grade equivalent performance in reading and math fluency, visual matching and processing and decision speed compared to their pre-training performance.
9. Correlates significantly with the reading, mathematics and language performance of students who dropped out of high school and increased the proportion of IM trained subjects able to pass high school equivalency tests.
10. Supports the capacity of IM training to significantly improve reading and math fluency in Title I elementary students compared to no changes in a control group.
11. Shows evidence of reliability and validity as a measure of motor planning, motor planning capacity and cognitive processes underlying academic performance.
12. Demonstrates the capacity of the Interactive Metronome to significantly improve timing and rhythmic accuracy in both children and adults.
13. Supports IM training as positively impacting on various Parkinson disease symptoms.

What Thought Leaders Say About IM

“Attention, learning and problem solving depend in part on the ability to p/an and sequence actions and ideas. The Interactive Metronome helps individuals systematically exercise and often improve basic motor planning and sequencing capacities”

Stanley Greenspan MD, a noted child psychiatrist and ex-head of the NIMH is Chairman of IM’s Scientific Advisory Board.

“The Interactive Metronome is spectacularly helpful. It is one of the most promising developments with non-medication of ADHD that’s come along in a long while.... This is really solid, extremely helpful non-medication (intervention) not only for ADHD but for mental functioning in general.”

Edward Hallowell MD, author of [Driven to Distraction](#), and leading clinician and speaker on ADHD

The Interactive Metronome “has shown great promise in kids with Attention Deficit Disorder.”
Emily Senay MD, Medical Editor, CBS Early Show, April 20, 2001

“As for the clinical usefulness of the IM, as my intuition originally suggested, I have found the IM to be an extremely helpful intervention for motor planning and sequencing problems. It is helpful in the motor and sequencing aspects of language as well as attention and motor coordination.”

LorRainne Jones, MA, CCC, SLP, Ph.D., heads Kid Pro Therapy, a speech, occupational and physical therapy center in Tampa, FL and author of the book For Parents and Professionals: Expressive Language Delay.

“In our clinical experience, IM training appears to address spatial problems at the neural level -preparing the brain to be receptive to learn - and because of the repetitions it becomes automatic.”

Barbara Fisher, Ph.D., a Neuropsychologist and head of Cognitive Precision Therapy

“As occupational therapists, we have found the Interactive Metronome to be very valuable tool for improving rhythmicity, timing and sequencing in children and adults with sensory integration problems. Upon completing the IM program, our clients have noticed significant improvements in their coordination, focus, and ability to process information”

Jane Koomar, Ph.D., OTR/L, FAOTA Executive Director, Occupational Therapy Associates in Watertown, MA

The above information was obtained from the Interactive Metronome Website at www.interactivemetronome.com