RESEARCH RESULTS AND CLIENT OUTCOMES

LearningRx

one-on-one brain training

Prepared by

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Educational Psychologist and Research Director at the Gibson Institute of Cognitive Research
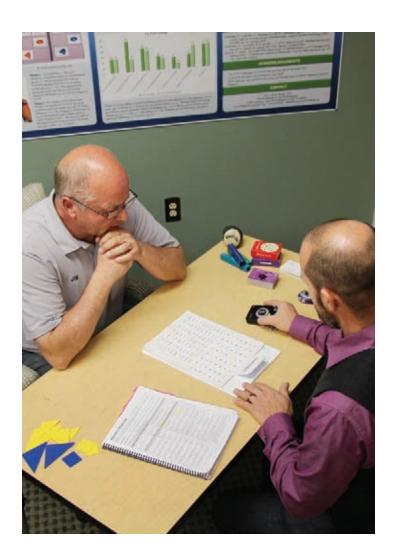
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FOREWORD

Executive processing is dependent upon the collective interplay of brain networks underlying fundamental cognitive skills. In ways, one's executive processing is only as strong as one's weakest cognitive skill. Cognitive training offers the most promising method for strengthening underlying cognitive networks, allowing one to increase overall executive processing ability!

However, not all cognitive training programs are alike! LearningRx is distinct in many ways from the variety of digital training programs available today. Foremost, LearningRx programs are delivered by a clinician who gives dynamic feedback throughout every training session. Further, LearningRx programs are based on the Cattell-Horn-Carroll theory of intelligence, a widely-accepted view of cognition and the theoretical foundation of modern day cognitive assessment. LearningRx is comprehensive; targeting and training seven key cognitive skills and multiple sub-skills. It is also highly intensive, including an average of 90 to 120 hours of training over several months.

We are now using MRIs to visualize the underlying changes in brain structure and function after LearningRx training. In one research study, we looked at underlying changes related to gains in auditory processing and found correlated changes in functional connectivity! In another study, we found normalization of key brain networks after training.

The dynamic feedback, thoroughness, and intensity of LearningRx cognitive training are keys to producing modifications of cognitive skill networks and the desired functional cognitive gains. It is certainly an exciting time to be in the field of cognitive training research.

Christina Ledbetter, PhD
Clinical Neuroscientist and Research Fellow LSU Health Sciences Center

INTRODUCTION

Since 1985, Dr. Ken Gibson and his colleagues have helped more than 100,000 clients with a unique cognitive training methodology designed to remediate deficits in multiple underlying learning skills. Dr. Gibson devoted his entire career to helping children and adults with learning struggles, beginning first with a visual information processing intervention and later restructuring the program to include auditory processing, memory, attention, processing speed, and reasoning training procedures. With input from a team of psychologists, educators, speech and language pathologists, and occupational therapists, Dr. Gibson continuously studied the results of learning and cognition research to develop an intensive reading intervention, a math intervention, and a reading comprehension intervention that have complemented the original training program.

In 2014, he also emphasized building an empirical research base that supports the cognitive training procedures and assessments used by LearningRx and BrainRx brain training centers, and to the continued development and testing of cognitive training program components. He established the Gibson Institute of Cognitive Research to accomplish those goals.

The mission of the Gibson Institute is to conduct research on LearningRx and BrainRx programs and assessments, to communicate the latest research findings to the education, psychology, neuroscience, and cognitive science communities, to provide opportunities for outside researchers to participate in research projects that utilize our cognitive training and assessment instruments, and to inform the practices of cognitive trainers by translating research findings into real-world applications. This report summarizes the major research on LearningRx programs and provides an overview of the LearningRx client outcomes from 2010 to 2018.

Amy Lawson Moore, PhD

Cognitive & Educational Psychologist

Research Director
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EXECUTIVE SUMMARY

Introduction

LearningRx cognitive training programs target attention, processing speed, working memory, long-term memory, auditory processing, visual processing, and logic & reasoning through repeated engagement in game-like mental tasks delivered one-on-one by a clinician or trainer. LearningRx intensive reading and math interventions are also delivered through a cognitive training approach based on The Learning Model developed by Dr. Ken Gibson.

Background

Since 1985, the LearningRx brain training methodology has been used with more than 100,000 clients at private clinical practices and in brain training centers in the United States and around the world. LearningRx works with clients of all ages regardless of prior diagnosis, including those with dyslexia, ADHD, traumatic brain injury, autism spectrum disorders, speech and language delays, learning disabilities, and age-related cognitive decline.

Report Objectives

- To summarize both the quantitative and qualitative results of formal research studies conducted on LearningRx methods
- To evaluate the training outcomes for all LearningRx clients between 2010 and 2018

Data Collection

The results from LearningRx training were obtained through the following:

- Pre and post standardized testing of 21,974 clients using the Woodcock-Johnson family of tests

- Neuroimaging with functional magnetic resonance imaging (fMRI) in 4 research studies

- Quantitative testing results in 13 research studies using gold-standard assessments including the Woodcock Johnson III Tests of Cognitive Abilities and Tests of Achievement, Woodcock Johnson IV Tests of Cognitive Abilities, Delis Kaplan Executive Function System (DKEFS), Test of Nonverbal Intelligence (TONI-4), Conners Continuous Performance Test (CPT-3), Dementia Rating Scale (DRS-2), Montreal Cognitive Assessment (MoCA), Learning Skills Rating Scale (LSRS), and Gibson Test of Cognitive Skills

- Survey data of behavioral outcomes in 2 research studies that included Behavior Rating Inventory of Executive Function (BRIEF-A) and Patient Competency Rating Scale (PCRS)

- Qualitative data from intake and exit interviews in 4 research studies

- Qualitative data from graduate exit surveys in 4 research studies

Quantitative Results from *Randomized Controlled Trials*

IQ Score. LearningRx training led to an average *IQ* score gain of 21 points for children and teens with learning struggles, and an average 26-point *IQ* score gain for children and teens with ADHD.

Logic & Reasoning. LearningRx training led to average *logic & reasoning* gains of 28 points for children and teens with learning struggles, and 27 points for children and teens with ADHD.

Working Memory. LearningRx training led to average *working memory gains* of 13 points for children and teens with learning struggles, and 20 points for children and teens with ADHD.

Long-Term Memory. LearningRx training led to average *long-term memory* gains of 28 points for children and teens with learning struggles, and 34 points for children and teens with ADHD.

Processing Speed. LearningRx training led to average *processing speed* gains of 13 points for children and teens with learning struggles, and 16 points for children and teens with ADHD.

Auditory Processing. LearningRx training led to average *auditory processing* gains of 13 points for children and teens with learning struggles, and 15 points for children and teens with ADHD.

Visual Processing. LearningRx training led to average *visual processing* gains of 11 points for children and teens with learning struggles, and 5 points for children and teens with ADHD.

Neuronal Connections. LearningRx training led to significant changes in neuronal connections and global network efficiency measured by fMRI.

Transfer Effects from *Randomized Controlled Trials*

Transfer Effects for Children with ADHD. Children and teens with ADHD reported transfer to improved confidence, cooperative behaviors, and self-discipline.

Transfer Effects for Children with Learning Struggles. Children and teens with learning struggles reported transfer to improved academic skills, self-esteem, relationships, and self-discipline.

Transfer Effects for At-Risk High Schoolers. Training gains transferred to improved attitudes about math for high schoolers who completed a Brainskills program.

Quantitative Results from *Controlled Studies, Quasi-Experimental Studies, and Pilot Trials*

Cognitive Skills. School-aged participants achieved significantly higher gains than the control group on working memory, associative memory, logic & reasoning, processing speed, auditory processing, and Word Attack scores.

Academic Difficulty. Parent ratings of 178 school-aged participants showed that those who completed LearningRx brain training experienced less academic difficulty afterwards, while academic difficulty in the same time period for children in a control group actually increased.

Oppositional Behavior. Parent ratings of 178 school-aged participants showed that those who completed LearningRx brain training experienced less oppositional behavior afterwards, while oppositional behavior in the same time period for children in a control group actually increased.

Traumatic Brain Injury. Soldiers with TBI achieved clinically significant changes in working memory, IQ score, auditory processing, long-term memory, auditory working memory, and logic & reasoning following LearningRx cognitive training; and 10 of the 11 soldiers who completed the study achieved overall recovery.

Transfer Effects from *Controlled Studies, Quasi-Experimental Studies, and Pilot Trials*

Transfer effects for Brain Injury. Adults with brain injury reported transfer to real-life improvements including increased confidence and perseverance, as well as improved attention, memory, affect, motivation, work performance, and outlook on life.

Transfer effects for Seniors. Seniors reported improvements in: mood, work performance, driving, hobbies and sports, problem-solving, anxiety, confidence, hope, outlook, memory, and focus.

Transfer Effects for School-Agers. Parent ratings showed that school age children who completed LearningRx brain training experienced less oppositional behavior afterwards.

Transfer Effects for Mild Cognitive Impairment (MCI). Seniors with varying severity of cognitive impairment who completed LearningRx training reported improved social interactions, marital relationships, restoration of hope, confidence to return to school and work, and decreased depression.

Results from Analyses of Client Outcomes

Cognitive Results. Among all 21,974 LearningRx clients between 2010 and 2018, the average change in IQ score was 14 points for both children and adults across all programs, with individual program gains ranging from 11 to 17 IQ points following training. The mean cognitive skill gains overall ranged from 9 to 15 points for both children and adults. All changes were statistically significant. The results of each cognitive skill change by age group and program are in the following table:

Table of Cognitive Skill Standard Score Gains by Age Group for Graduates in Each Program

	ThinkRx		ReadRx		MathRx		ComprehendRx		
Skill	Children	Adults	Children	Adults	Children	Adults	Children	Adults	Skill Mean
Auditory Processing	14	13	14	14	14	14	13	11	13
Long-term Memory	15	17	15	15	15	15	15	15	15
Logic & Reasoning	11	10	11	10	13	11	11	9	11
Sustained Attention	12	12	12	14	12	12	11	13	12
Working Memory	10	10	10	11	11	10	10	9	10
Processing Speed	9	8	9	8	10	9	8	10	9
Visual Processing	8	10	11	10	9	8	8	9	9
IQ Score	17	16	14	11	12	14	15	12	14
Program Mean	12	12	12	12	12	12	13	11	

Reading Results. Among the 9,959 LearningRx reading program clients between 2010 and 2018, the average gain in reading skills was 3.5 years, with the largest gain of 6.3 years in Sound Awareness following training. All changes were statistically significant. In an analysis to control for placebo effects, ReadRx clients made nearly twice the gains on reading achievement tests than MathRx students made on reading achievement tests—illustrating the targeted effects of the reading program. Based on a separate analysis of state reading achievement test scores from 65 clients, 91% showed improvement on the state tests following training at LearningRx.

Math Results. Among the 3,521 LearningRx math program clients between 2010 and 2018, the average gain in math skills was 3.2 years, with the largest gain of 3.6 years in Quantitative Concepts following training. All changes were statistically significant. In an analysis to control for placebo effects, MathRx clients made nearly twice the gains on math achievement tests than ReadRx students made on math achievement tests—illustrating the targeted effects of the math program.

Cognitive Results by Diagnosis. The average standard score change overall for clients with a pre-existing diagnosis ranged from 10.8 to 11.2 points, with changes in individual skills ranging from 8.3 points to 14.7 points. All changes were statistically significant. The results of each cognitive skill change by diagnostic category are in the following table:

Table of Standard Score Gains by Diagnosis for All Ages

Skill	ADHD	Seniors	TBI	Dyslexia	Autism	LD	Speech	Skill Mean
Auditory Processing	14	13	13	15	14	15	15	14
Long-term Memory	15	16	17	14	13	15	13	15
Logic & Reasoning	11	10	10	12	11	11	11	11
Sustained Attention	12	7	10	11	10	10	10	10
Working Memory	10	9	11	9	11	10	10	10
Processing Speed	9	6	10	8	10	9	9	9
Visual Processing	8	9	9	8	8	8	8	8
IQ Score	14	16	11	13	10	11	10	12
Diagnosis Mean	12	11	11	11	11	11	11	

Retention. Follow-up testing of 516 clients one year after training showed that retention rates ranged from 96% to 99% in all cognitive areas, including IQ score, logic & reasoning, memory, and auditory processing.
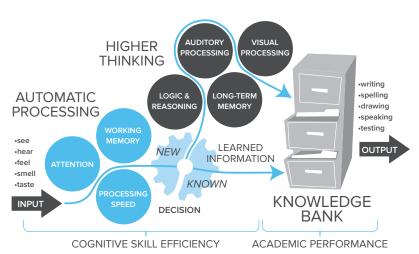
Conclusion

LearningRx training outcomes are consistent across research study designs and subgroups. Analyses of client outcomes reveal similar trends in statistically significant changes from pretest to post-tests across age groups and diagnostic categories. A convergence of evidence points to program efficacy, improved cognition, and transfer to real-life improvements.

THE SCIENCE BEHIND LEARNINGRX ONE-ON-ONE BRAIN TRAINING

The Learning Model is grounded in the Cattell-Horn-Carroll (CHC) theory of intelligence, which describes thinking as a set of seven broad abilities: comprehension knowledge, long-term retrieval, visual-spatial thinking, auditory processing, fluid reasoning, processing speed, and short-term memory.

According to the Learning Model, an individual takes information in through the senses (input) that must be recognized and analyzed by the active processing system (working memory, processing speed, attention). This executive control system determines which information is unimportant, easily handled, or requires thinking. Unimportant information is discarded from working memory. If the input contains important information about data that have already been stored in the knowledge bank, it is quickly retrieved and converted to output, such as speaking or writing.

If the information has not been previously stored, higher thinking processes must then occur. Reasoning, auditory processing, and visual processing must be used to solve the problem or complete the task. If the task is practiced often enough, however, the information is stored in the knowledge bank, which will decrease the time between input to output. This occurs because the higher thinking processes can then be bypassed.

SEVEN KEY COGNITIVE SKILLS

- **Attention:** Focus over time, despite distraction, or while multitasking

- **Processing Speed:** Think and perform tasks quickly and accurately

- **Working Memory:** Hold on to and use information during the learning process

- **Auditory Processing:** Distinguish, blend, and segment sounds accurately

- **Visual Processing:** Create and picture mental images while thinking or reading

- **Logic & Reasoning:** Reason, form ideas, and solve problems

- **Long-Term Memory:** Efficiently recall facts and stored information

LEARNINGRX COGNITIVE TRAINING

LearningRx cognitive training programs target and remediate seven primary cognitive skills and multiple sub-skills through repeated engagement in game-like mental tasks delivered one-on-one by a clinician or cognitive trainer. The tasks emphasize visual or auditory processes that require attention and reasoning throughout each 60- to 90-minute training period. Using a synergistic "drill for skill" and metacognitive approach to developing cognitive skills, the program incorporates varying levels of intensity, hierarchical sequencing of tasks, multiple-task loading, and instant feedback from the clinician or trainer. Training sessions are focused, demanding, intense, and tightly controlled by the clinician or trainer to push students to just above their current cognitive skill levels. Deliberate distractions are built in to the sessions to tax the brain's capacity for sorting and evaluating the importance of incoming information. This ability to correctly handle distracting information and interruptions is the foundation for focus and attention skills.

THE SEVEN KEY INGREDIENTS OF EFFECTIVE BRAIN TRAINING

Brain training must be practiced. Because brain training builds skills, it can't be taught in the classroom. It must be practiced, like learning to play tennis or the piano.

Brain training that gets the best results is done one-on-one with a personal trainer. Teaming with an experienced trainer provides accountability, motivation, and—ultimately—life changing results.

Brain training exercises need to be intense, requiring concentrated repetitions in order to train skills quickly.

Brain training exercises need to be targeted in order to address specific weak cognitive skills.

Brain training exercises need to be done in a particular sequence. Small challenging steps don't overwhelm the client, but allow the trainer to continually challenge the client incrementally and keep them engaged in the training.
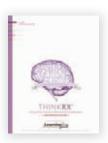
Brain training exercises must be progressively loaded. Loading incorporates multitasking and is a fast-track way to take a new skill and make it a more automatic skill.

Brain training, to be effective, requires immediate, accurate feedback. Instant, effective reinforcement and adjustments keep training focused and intense.

PROFILE OF LEARNINGRX PROGRAMS

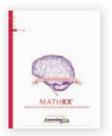| Years:	2010–2018
% of Clients:	39%
# Clients:	8,605
Age of Clients:	4–95
# Training hours:	90

ThinkRx is the foundational one-on-one cognitive training program for clients ages six to adult. ThinkRx includes 28 training procedures that target all major cognitive skills, including attention, memory, processing speed, auditory and visual processing, and logic & reasoning.

Years:	2010–2018
% of Clients:	45%
# Clients:	9,959
Age of Clients:	4–83
# Training hours:	120

ReadRx is an intensive sound-to-code reading and spelling intervention for clients ages six to adult. ReadRx includes all 28 ThinkRx training procedures and adds an additional 60 hours of training in auditory processing along with basic and complex code reading training to increase reading and spelling fluency.

Years:	2010–2018
% of Clients:	16%
# Clients:	3,521
Age of Clients:	5–71
# Training hours:	120

MathRx is an intensive math intervention for clients from fourth grade to adult. MathRx includes all 28 ThinkRx training procedures and adds an additional 60 hours of training in math concepts, problem solving, reasoning, and calculations designed to increase mathematical fluency.

Years:	2014–2018
% of Clients:	4%
# Clients:	853
Age of Clients:	6–78
# Training hours:	40

ComprehendRx is an add-on training for clients ages six to adult to improve reading comprehension and metacognition.

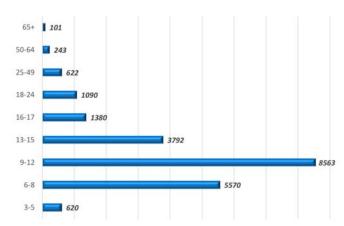| Years:	2010–2018
% of Clients:	7%
# Clients:	1,486
Age of Clients:	4–72
# Training hours:	60

LiftOff is a reading readiness and cognitive skills training intervention for four- to seven-year-olds.

*Note: The percentage of clients exceeds 100% and the total exceeds the total number of clients because some clients complete more than one program.

PROFILE OF LEARNINGRX CLIENTS

Age	Count
65+	101
50-64	243
25-49	622
18-24	1090
16-17	1380
13-15	3792
9-12	8563
6-8	5570
3-5	620

Clients with a Prior Diagnosis	
Attention Deficit Hyperactivity Disorder (ADHD)	29%
Dyslexia	11%
Learning Disability	11%
Speech/Language Delay	10%
Autism Spectrum Disorder	5%
Traumatic Brain Injury	2%
Age-Related Memory Loss	1%
Client Gender	
Male	59.8%
Female	40.2%

LearningRx Research

LearningRx Cognitive Training Effects in Children Ages 8–14: A Randomized Controlled Trial

- LearningRx improves cognitive skills and IQ score for children and adolescents with learning struggles.

- Randomized controlled trial led by Dick Carpenter, PhD of University of Colorado-Colorado Springs and Christina Ledbetter, PhD of LSU Health Science Center compared the effects of 60 hours of ThinkRx cognitive training to a waitlist control group using the Woodcock-Johnson III Tests of Cognitive Abilities and the NIH Toolbox Cognition Battery (attention only).

- IQ score of LearningRx group increased by 21 points.

- LearningRx group outperformed the control group on all measures. Differences were statistically significant except for the attention measure.
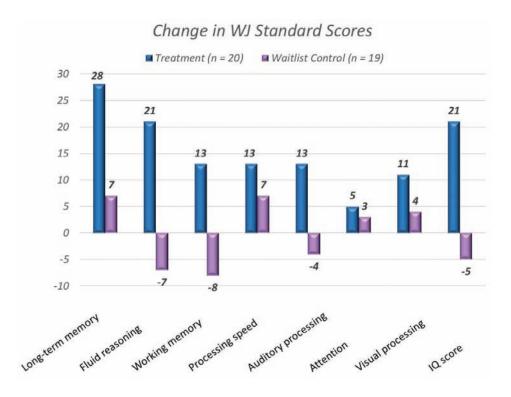

Change in WJ Standard Scores

Source: Carpenter, D., Ledbetter, C., & Moore, A.L. (2016). LearningRx cognitive training effects in children ages 8–14: A randomized controlled trial. *Applied Cognitive Psychology, 30*(5), 815–826. doi: 10.1002/acp.3257. Available at http://onlinelibrary.wiley.com/doi/10.1002/acp.3257/epdf

Clinician-Delivered Cognitive Training for Children with Attention Problems: Effects on Cognition and Behavior from the ThinkRx Randomized Controlled Trial

- LearningRx improves cognitive skills, IQ score, and cooperative behavior for children and adolescents with ADHD and attention problems

- Randomized controlled trial led by Dick Carpenter, PhD of University of Colorado-Colorado Springs and Christina Ledbetter, PhD of LSU Health Science Center compared the effects of 60 hours of ThinkRx cognitive training to a treatment-as-usual control group

- Results showed statistically significant differences between groups on 5 outcome measures

- IQ score of LearningRx group increased by 26 points

- All LearningRx group members obtained clinically significant change indicating overall recovery

- LearningRx group reported transfer to improved confidence, cooperative behaviors, and self-discipline

Change in WJ Standard Scores

■ Treatment (n = 20)   ■ Waitlist Control (n = 19)

Source: Moore, A.L., Carpenter, D.M., Ledbetter, C., & Miller, T.M. (2018). Clinician-delivered cognitive training for children with attention problems: Transfer effects on cognitive and behavior from the ThinkRx randomized controlled trial. *Neuropsychiatric Disease and Treatment, 14,* 1671–1683. doi: 10.2147/NDT.S165418 Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6027847/
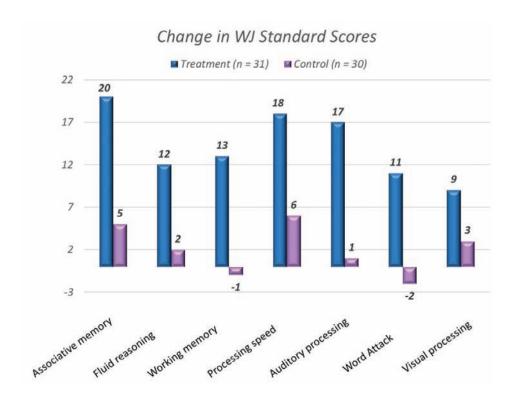
Training the Brain to Learn: Beyond Vision Therapy

- LearningRx improves cognitive skills and basic reading skills for children and adolescents with learning struggles.

- Controlled trial led by Dick Carpenter, PhD of University of Colorado-Colorado Springs

- Compared the effects of 24 weeks of ThinkRx/ReadRx cognitive training to a propensity-matched control group as measured by the Woodcock-Johnson lll.

- The LearningRx group outperformed the control group on all 7 measures. Differences were statistically significant except for visual processing.

Change in WJ Standard Scores

Treatment (n = 31)   Control (n = 30)

Measure	Treatment	Control
Associative memory	20	5
Fluid reasoning	12	2
Working memory	13	-1
Processing speed	18	6
Auditory processing	17	1
Word Attack	11	-2
Visual processing	9	3

Source: Gibson, K., Carpenter, D.M., Moore, A.L., & Mitchell, T. (2015). Training the brain to learn: Beyond vision therapy. *Vision Development and Rehabilitation, 1*(2), 120–129. Retrieved from https://www.covd.org/page/VDR_1_2

Comparing Two Methods of Delivering ThinkRx Cognitive Training to Children Ages 8–14: A Randomized Controlled Trial of Equivalency

- LearningRx improves cognitive skills and IQ score for children and adolescents with learning struggles

- Randomized controlled trial led by Dick Carpenter, PhD of University of Colorado-Colorado Springs and Christina Ledbetter, PhD of LSU Health Science Center compared delivery of 60 training hours solely by a clinician versus 50% delivered by a clinician and the other 50% through digital exercises in a supervised computer lab.

- Delivery method differences were not statistically significant except for long-term memory.

- Both groups reported transfer to improved academic skills, self-esteem, relationships, and self-discipline.

Change in WJ Standard Scores

Source: Moore, A.L., Carpenter, D.M., Miller, T.M., & Ledbetter, C. (2018). Comparing Two Methods of Delivering ThinkRx Cognitive Training to Children Ages 8–14: A Randomized Controlled Trial of Equivalency. *Journal of Cognitive Enhancement.* (Online first version). doi.org/10.1007/s41465-018-0094-z Retrieved from https://link.springer.com/article/10.1007/s41465-018-0094-z
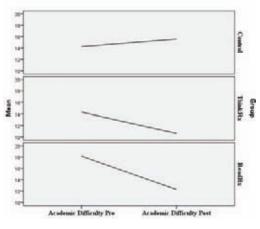
LearningRx Cognitive Training for Children & Adolescents Ages 5–18: Effects on Academic Skills, Behavior, & Cognition

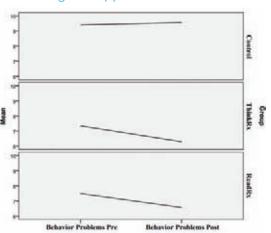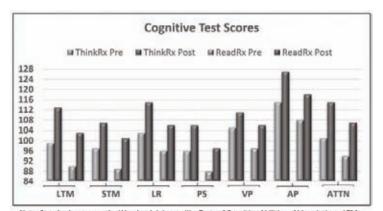- LearningRx improves parent-reported academic struggles and oppositional behavior for children and adolescents.

- Controlled trial led by Edward Jedlicka, PhD of Lakeland University compared changes in parent-reported academic difficulty and oppositional behavior between a ThinkRx group (n = 67), a ReadRx group (n = 53), and a no-contact control group (n = 58) using the Learning Skills Rating Scale.

- Both LearningRx groups outperformed the control group on reduction in parent-reported academic difficulty and oppositional behavior ratings; and had significantly improved cognitive skills as well.

Change in Academic Difficulty

Change in Oppositional Behavior

Note. Standard scores on the Woodcock Johnson III – Tests of Cognitive Abilities. Abbreviations: LTM = long-term memory, STM = short-term memory, LR = logic and reasoning, PS = processing speed, VP = visual processing, AP = auditory processing, ATTN = attention

Source: Jedlicka, E. (2017). LearningRx cognitive training for children and adolescents ages 5–18: Effects on academic skills, behavior, and cognition. *Frontiers in Education, 2*(62). doi: 10.3389/feduc.2017.00062 https://www.frontiersin.org/articles/10.3389/feduc.2017.00062/full
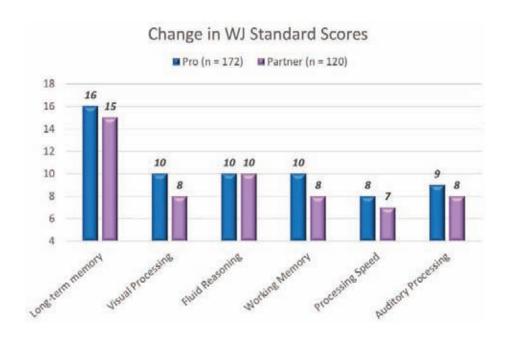
ThinkRx Cognitive Training for Adults over Age 50: Clinician Caregiver Partners in Delivery as Effective as Clinician-Only Delivery

- LearningRx improved cognition and life skills for adults over age 50 with memory and attention complaints

- Two-group study led by Dick Carpenter, PhD of UCCS and Amy Lawson Moore, PhD of Gibson Institute of Cognitive Research to compare the cognitive and transfer effects from two methods of delivering 78 hours of ThinkRx to adults ages 50–95 with subjective memory and attention problems (n = 292): clinician-only delivery versus a combination of clinician/home partner delivery.

- Participants in both LearningRx groups improved significantly on all six measures and reported transfer to real-life improvements. Differences between methods of delivery were small, but clinician-only delivery overall led to greater cognitive gains.

Improvements Reported on Exit Surveys

- Mood
- Memory
- Focus and attention
- Work performance
- Hobbies and sports
- Driving
- Problem-solving
- Multi-tasking
- Processing speed
- Less anxiety
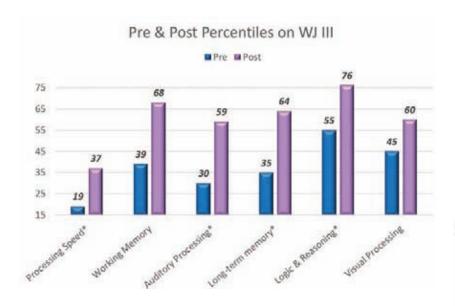- Confidence and hope
- Outlook

Change in WJ Standard Scores

■ Pro (n = 172)   ■ Partner (n = 120)

	Long-term memory	Visual Processing	Fluid Reasoning	Working Memory	Processing Speed	Auditory Processing
Pro	16	10	10	10	8	9
Partner	15	8	10	8	7	8

Source: Moore, A.L., Carpenter, D.M., Miller, T.M., & Ledbetter, C., (2019). ThinkRx Cognitive Training for Adults over Age 50: Clinician-Caregiver Partners in Delivery as Effective as Clinician-Only Delivery. *Psychology and Neuroscience.* doi: 10.1037/pne0000162

Cognitive Effects of ThinkRx Cognitive Rehabilitation Training for Eleven Soldiers with Brain Injury: A Retrospective Chart Review

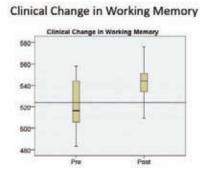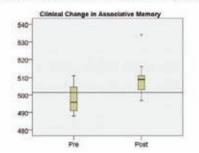- LearningRx improved cognition and life skills for soldiers recovering from brain injury

- Pilot study led by Christina Ledbetter, PhD of LSU examining outcomes from 80 hours of ThinkRx supplemented with Brainskills for eleven soldiers in a warrior transition unit

- 10 of 11 soldiers achieved overall recovery based on clinically-significant changes in general intellectual ability which increased an average of 13 points

- Soldiers reported transfer to real-life improvements including increased confidence and perseverance, improved attention, and improved memory.

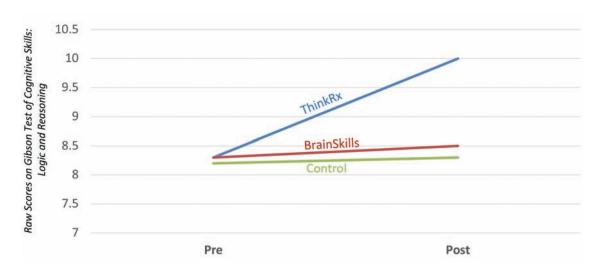- Soldiers also reported returning to school and work and a higher tolerance for frustration

Pre & Post Percentiles on WJ III

* Significant at p < .007

Clinical Change in Working Memory

Clinical Change in Associative Memory

Source: Ledbetter, C., Moore, A.L., Mitchell, T. (2017). Cognitive effects of ThinkRx cognitive rehabilitation training for eleven soldiers with brain injury: A retrospective chart review. *Frontiers in Psychology, 8*(825). doi: 10.3389/fpsyg.2017.00825 http://journal.frontiersin.org/article/10.3389/fpsyg.2017.00825/full

The Efficacy of the LearningRx Cognitive Training Program: Modality and Transfer Effects

- LearningRx improves memory and reasoning skills in at-risk high school students

- Three million dollar NSF-funded randomized controlled trial led by Oliver Hill, PhD of Virginia State University compared outcomes on tests of memory, reasoning, and math attitudes between ThinkRx one-on-one training, Brainskills (digital ThinkRx program), and homework assistance for 225 at-risk high school students

- Significant differences between groups were found on measures of fluid reasoning and long-term memory

- Training gains transferred to improved attitudes about math for the Brainskills group

Change in Fluid Reasoning Scores

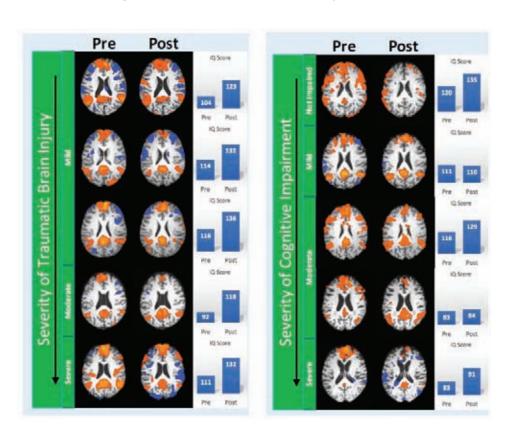# Neuroimaging Outcomes of a Cognitive Rehabilitation Training Program

- Changes in the Default Mode Network of the brain can be seen on functional Magnetic Resonance Imaging for clients with Traumatic Brain Injury following training with LearningRx.

- In a multiple case study design led by neuroscientist Christina Ledbetter, PhD of LSU, 10 participants with varying levels of injury and impairment were imaged before and after 90 hours of ThinkRx cognitive training.

- Normalization of the Default Mode Network was most evident in severe TBI. Significant training induced changes were noted in the mild TBI group as well.

Training-Induced Functional Connectivity for TBI & MCI

Source: Ledbetter, C., & Moore, A. (2018). Neuroimaging outcomes of a cognitive rehabilitation training program. J*ournal of Neuroimaging, 28*(2), 225–233. doi: 10.1111/jon.12507 https://www.gibsonresearchinstitute.org/wp-content/uploads/2018/03/Neuroimaging-Outcomes-of-a-Cognitive-Rehabilitation-Training-Program_-J-of-Neuroimaging-excerpt.pdf

Reliability and Validity of the Revised Gibson Test of Cognitive Skills, A Computer-Based Test Battery for Assessing Cognition across the Lifespan

- The Gibson Test of Cognitive Skills (Version 2) is correlated with the Woodcock Johnson III as a valid and reliable method for assessing cognitive skills in children and adults

- Using a nationwide sample of 2,737 people ages 5 to 85, Amy Lawson Moore, PhD and Terissa Miller, MS Psy of Gibson Institute examined evidence of validity and reliability of the Gibson Test in measuring short-term memory, long-term memory, processing speed, logic and reasoning, visual processing, auditory processing, and Word Attack skills.

- Strong evidence of reliability included test-retest reliability coefficients ranging from .69–.91 and split-half reliability coefficients ranging from .87 to .91. Strong evidence of validity included concurrent validity with the Woodcock Johnson III with coefficients ranging from .53 to .93.

- Compared to 7 major digital cognitive tests, the GT is the only one that measures auditory processing (including blending, segmenting, and dropping) and Word Attack skills. It has the second largest normative database among the available digital cognitive tests, and the largest one that includes children.

Comparison to Seven Major Digital Cognitive Tests

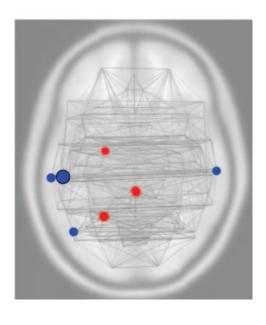| Digital Cognitive Test	STM	LTM	VP	PS	LR	AP	WA	Normal Sample	Norm Group Ages
Gibson Test of Cognitive Skills -V2	X	X	X	X	X	X	X	2,737	5–85
NeuroTrax	X	X	X	X	X			1,569	8–120
MicroCog	X		X	X	X			810	18–89
ImPACT	X			X				931	13–college
CNS Vital Signs	X	X	X	X				1,069	7–90
Computer-Administered Neuropsychological Screen (CANS-MCI)	X			X				310	51–93
Automated Neuropsychological Assessment Metrics (ANAM)	X	X	X	X	X			107,801	17–65
Cambridge Neuropsychological Test Automated Battery (CANTAB)	X		X	X	X			2,000	4–90

MRI Study: Correlation of Cognitive Training Gains and Resting State Functional Connectivity

- LearningRx training changed *overall global efficiency* of the brain and *increased functional connectivity* between regions of the brain

- As part of a larger randomized controlled trial by Hill, Serpell, and Faison (2016), neuroscientist Christina Ledbetter, PhD of LSU conducted pre and post-training resting state fMRI studies on 30 of the 225 participating high school students.

- LearningRx training changed *overall global efficiency,* a measure of information exchange, for areas associated with visual processing, auditory processing, contextual associations, the default mode network, and the cerebellum

- LearningRx training induced changes in functional connectivity, a measure of the relationship between anatomically distinct regions, for areas associated with *auditory processing, contextual associations, and memory*

- For all 7 cognitive skills measured, changes in resting state functional connections correlated with changes in performance on the tests for the treatment group
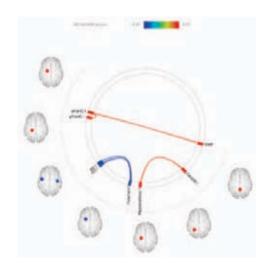
Training-Induced Global Efficiency Treatment vs Control

Training-Induced Functional Connectivity Treatment vs Control

Source: Ledbetter, C., Faison, M., Hill, O., & Patterson, J. (2016). C*orrelation of Cognitive Training Gains and Resting State Functional Connectivity.* Presented at Society for Neuroscience, San Diego, CA, November 12, 2016. https://www.gibsonresearchinstitute.org/wp-content/uploads/2016/11/SFNposters_CLedbetter.pdf

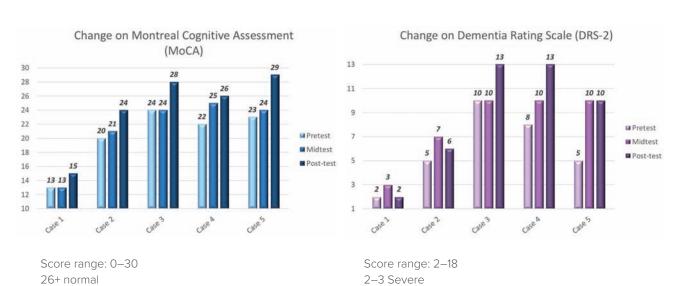| Presented at *American Psychological Association*

MRI and Neuropsychological Outcomes following a Functional Medicine Intervention with Cognitive Training in Mild Cognitive Impairment (MCI): A Multiple Case Study

- A multidisciplinary intervention with cognitive training increased cognitive test scores and improved quality of life for participants in this research study

- In a multiple case study design led by Randolph James, MD of True Life Medicine and neuroscientist Christina Ledbetter, PhD of LSU, five senior clients with various levels of cognitive decline completed 90 hours of cognitive training coupled with a functional medicine protocol including a Paleo diet, aerobic exercise, sleep optimization, stress management, and nutritional supplementation.

- In all five cases, improvement in both cognitive and life skills was achieved. Four of the five cases were no longer classified as MCI by the Montreal Cognitive Assessment (MoCA) at post-testing.. The cutoff for MCI is 23.

- Functional MRI showed participants exhibited modest training-induced changes in neural connectivity. Normalization of the Default Mode Network (DMN) was evident along with the appearance of anti-correlations and decreased hyperconnectivity.

Change on Montreal Cognitive Assessment (MoCA)

Change on Dementia Rating Scale (DRS-2)

Score range: 0–30
26+ normal
18–25 mild
10–17 moderate
<10 severe

Score range: 2–18
2–3 Severe
4–5 Moderate
6–8 Mild
9–18 Non-clinical

Source: Moore, A.L., James, R., Carpenter, D., Miller, T., & Ledbetter, C. (2018). *MRI and Neuropsychological Outcomes following a Functional Medicine Intervention with Cognitive Training in Mild Cognitive Impairment (MCI): A Multiple Case Study.* Presented at American Psychological Association Annual Convention, August 2018, San Francisco, CA. Link to poster

MRI, qEEG, & Neuropsychological Outcomes following Cognitive Rehabilitation Training for Severe Traumatic Brain Injury: A Clinical Case Study.

- Changes in the Default Mode Network after LearningRx cognitive training can be seen on functional MRI.

- In a clinical case study of a participant who suffered a severe TBI 8 years prior, Christina Ledbetter, PhD of LSU and Amy Lawson Moore, PhD of Gibson Institute examined changes in neural connectivity using fMRI and qEEG as well as changes on standard neuropsychological tests following 60 hours of ThinkRx brain training.

- The largest cognitive gains were noted on processing speed and working memory, along with a 21-point increase in IQ score from 111 to 132. Participant returned to his former high level STEM career field, was able to stop taking Aricept for memory, and reported improved motivation and outlook on life.

- Post-training MRI showed normalization of connectivity in the Default Mode Network with restoration of anticorrelations in attention and visual areas. Post-training qEEG showed normalization of left frontal activity consistent with improvements in mood, depression, and memory.

MRI Results

Source: Moore, A.L., & Ledbetter, C. (2018). *MRI, qEEG, & neuropsychological outcomes following cognitive rehabilitation training for severe traumatic brain injury: A clinical case study.* Presented at Brain Injury Summit, Jan 2018, Vail, CO.
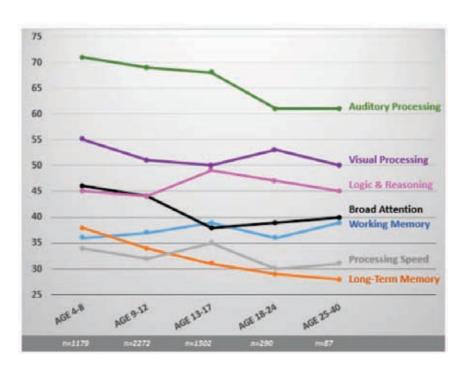
Beyond Attention: Memory and Processing Speed Deficits Dominate Cognitive Profiles in ADHD Across the Lifespan.

- Attention was not the weakest cognitive skill among more than 5,000 children and adults with ADHD.

- In a cross-sectional study and chart review of clients from 79 learning centers between 2010 and 2015, Christina Ledbetter, PhD of LSU and Amy Lawson Moore, PhD of Gibson Institute collected scores on the Woodcock Johnson III - Tests of Cognitive Abilities (WJ III) administered to children and adults previously diagnosed with ADHD (n = 5,416).

- Across the lifespan, the greatest cognitive deficits in clients with ADHD were working memory, long-term memory, and processing speed.

- Sustained attention was the fourth weakest out of seven skills measured. The strongest skills were auditory and visual processing.

Trajectory of Cognitive Skills Percentiles from Age 4 to 40 in ADHD

Source: Moore, A.L., & Ledbetter, C. (2017). *Beyond Attention: Memory and Processing Speed Deficits Dominate Cognitive Profiles in ADHD Across the Lifespan.* Presented at American Psychological Association Annual Convention, August 2017, Washington, D.C. https://www.gibsonresearchinstitute.org/wp-content/uploads/2017/08/2017APA_Ledbetter-Moore-poster.pdf
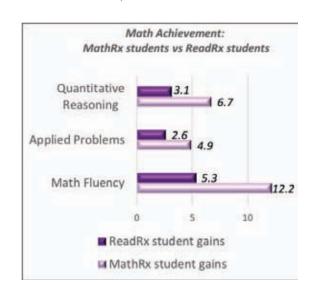
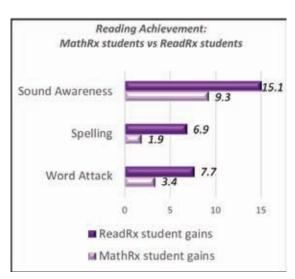# Achievement Outcomes for LearningRx Students: Math and Reading Achievement Before and After Cognitive Training

- Reading and math interventions at LearningRx remediated their intended target skills in a large sample of clients.

- In a controlled differential effects analysis of the results of MathRx and ReadRx outcomes, Amy Lawson Moore, PhD of Gibson Institute of Cognitive Research compared the results in a sample of 2,096 clients who had completed either MathRx or ReadRx between 2010 and 2015 at a LearningRx center.

- MathRx students made nearly twice the gains on math achievement tests than ReadRx students. ReadRx students made nearly twice the gains on reading achievement tests than MathRx students. This study controlled for placebo effects in assessing reading and math outcomes at LearningRx.

- State reading achievement tests were also collected for 65 ReadRx graduates. Prior to training, the mean percentile for this group was 33. After training, the group had jumped to the 47th percentile in reading – nearly average for their age. Further, 91% of students who completed the ReadRx program (59 of 65) showed improvement on state reading achievement tests after the intervention.

Comparison of MathRx and ReadRx Client Results on Opposite Tests
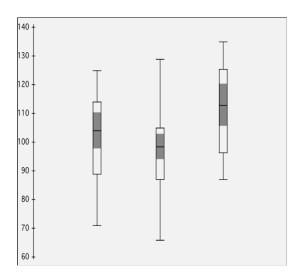

Source: Moore, A. (2015). *Achievement Outcomes for LearningRx Students: Math and Reading Achievement Before and After Cognitive Training.* (Technical report.) http://downloads.learningrx.com/Achievement-Results-LearningRx.pdf

LearningRx Training and IQ Gains: A Double Baseline Study

- LearningRx clients who declined cognitively after their initial diagnosis while waiting to begin training improved after completing LearningRx training.

- In a double baseline study with participants serving as their own controls, Amy Lawson Moore, PhD of Gibson Institute of Cognitive Research and distinguished research scientist Howard Wainer, PhD collected diagnostic baseline IQ test results, pretraining IQ test results, and post-training IQ test results from 40 LearningRx graduates to identify trends within participants.

- After diagnosis, while waiting to begin training, there was a slight decline in average IQ score from 102 to 96. After training at LearningRx, the lost points were regained and additional significant gains were noted, averaging 112 at post-testing.

IQ Change from Diagnosis to LearningRx Pretesting to LearningRx Post-Testing

Source: Moore, A.L. (2015). *LearningRx Training and IQ Gains.* Colorado Springs, CO: Gibson Institute of Cognitive Research.
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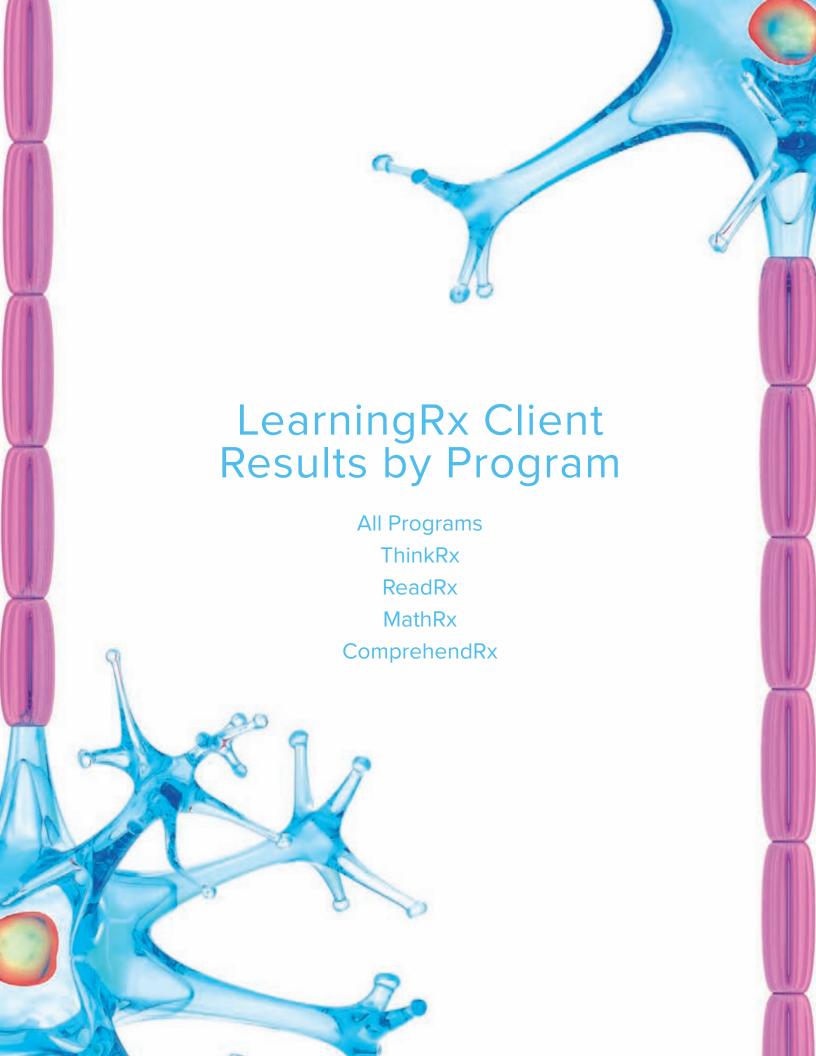
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LearningRx Research in Progress

Cognitive Training and Traumatic Brain Injury *(ClinicalTrials.gov NCT#02918994)*

Multidisciplinary Approach to Treating Mild Cognitive Impairment/Early Alzheimer's *(ClinicalTrials.gov NCT#02943187)*

LearningRx Client Results by Program

All Programs

ThinkRx

ReadRx

MathRx

ComprehendRx

ALL PROGRAMS I COGNITIVE RESULTS
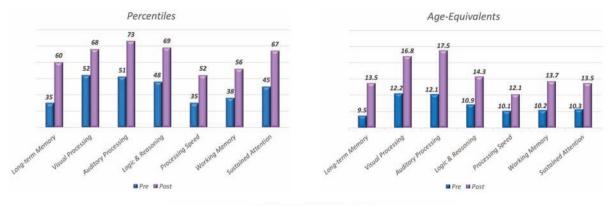
Number of Clients: 21,974

Avg. Training Hours: 90

Average Gain: 3.7 years

Largest Gain: 5.4 years in Auditory Processing

CHILDREN

Ages: 4–17 (Mean = 10.4)   **# of clients:** 19,918

ADULTS

Ages: 18–95 (Mean = 31.6)   **# of clients:** 2,056

Changes in standard scores were statistically significant at p < .006 on all measures for both children and adults.

ALL PROGRAMS I IQ SCORE RESULTS BY AGE

Number of Clients: 21,974

Ages: 4–95

Pre and Post IQ Score by Age

THINKRX | COGNITIVE RESULTS

Number of Clients: 8,605

Avg. Training Hours: 82

Average Gain: 3.5 years

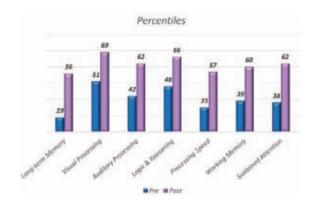Largest Gain: 5.0 years in Auditory Processing

CHILDREN
Ages: 4–17 (Mean = 10.6)   **# of clients:** 7,426

ADULTS
Ages: 18–95 (Mean = 34.8)   **# of clients:** 1,179

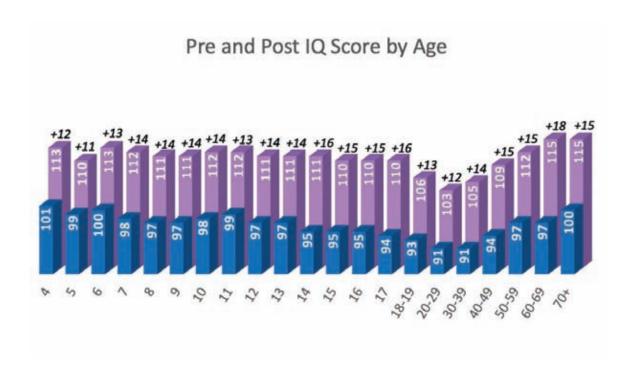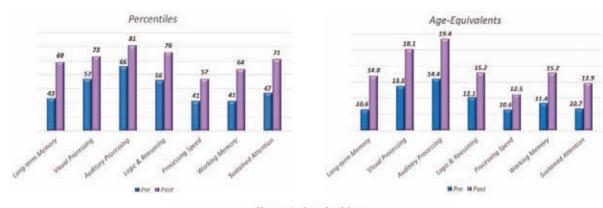*Changes in standard scores were statistically significant at p < .006 on all measures for both children and adults.*

READRX I READING SKILLS RESULTS

Number of Clients: 9,959

Avg. Training Hours: 103

Average Gain: 3.5 years

Largest Gain: 6.3 years in Sound Awareness

CHILDREN

Ages: 4–17 (Mean = 10.6)   **# of clients:** 9,250

ADULTS

Ages: 18–83 (Mean = 27.7)   **# of clients:** 709

Changes in standard scores were statistically significant at p < .006 on all measures for both children and adults.

MATHRX | MATH SKILLS RESULTS

Number of Clients: 3,521

Avg. Training Hours: 114

Average Gain: 3.2 years

Largest Gain: 3.6 years in Quantitative Concepts

CHILDREN

Ages: 5–17 (Mean = 12.0)   **# of child clients:** 3,162

ADULTS

Ages: 18–71 (Mean = 24.6)   **# of adult clients:** 359

Changes in standard scores were statistically significant at p < .006 on all measures for both children and adults.

COMPREHENDRX | READING COMPREHENSION RESULTS

Number of Clients: 853

Avg. Training Hours: 110

Average Gain: 3.2 years

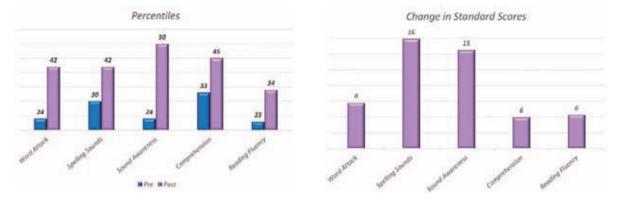Largest Gain: 6.4 years in Sound Awareness

CHILDREN

Ages: 6–17 (Mean = 11.7)   **# of child clients:** 766

ADULTS

Ages: 18–78 (Mean = 22.9) **# of adult clients:** 87

Changes in standard scores were statistically significant at p < .006 on all measures for both children and adults.

LearningRx Client Results by Diagnosis

ADHD

Dyslexia

Brain Injury

Learning Disability

Autism Spectrum

Speech & Language Disorder

Seniors

ADHD | COGNITIVE RESULTS

Number of Clients: 6,466

Avg. Training Hours: 81

Average Gain: 3.8 years

Largest Gain: 5.6 years in Auditory Processing

CHILDREN

Ages: 4–17 (Mean = 10.9)   **# of clients:** 5,902

ADULTS

Ages: 18–73 (Mean = 27.9)   **# of clients:** 564

Changes in standard scores were statistically significant at p < .006 on all measures for both children and adults.

DYSLEXIA | COGNITIVE RESULTS

Number of Clients: 2,494

Avg. Training Hours: 94

Average Gain: 3.7 years

Largest Gain: 5.6 years in Auditory Processing

CHILDREN

Ages: 5–17 (Mean = 10.6)   **# of clients:** 2,264

Percentiles

	Pre	Post
Long-term Memory	29	55
Visual Processing	49	65
Auditory Processing	38	65
Logic & Reasoning	45	68
Processing Speed	31	42
Working Memory	36	47
Sustained Attention	42	65

Age-Equivalents

	Pre	Post
Long-term Memory	9	13
Visual Processing	11.8	16.5
Auditory Processing	10.4	16
Logic & Reasoning	10.7	14.4
Processing Speed	9.5	11.2
Working Memory	9.1	12.3
Sustained Attention	10.3	13.4

Change in Standard Scores

IQ	13
Sustained Attention	11
Working Memory	9
Processing Speed	8
Logic & Reasoning	12
Auditory Processing	15
Visual Processing	8
Long-term Memory	14

ADULTS

Ages: Ages: 18–71 (Mean = 27.9)   **# of clients:** 230

Percentiles

	Pre	Post
Long-term Memory	24	51
Visual Processing	42	65
Auditory Processing	28	53
Logic & Reasoning	42	61
Processing Speed	25	45
Working Memory	37	47
Sustained Attention	32	59

Change in Standard Scores

Long-term Memory	16
Visual Processing	11
Auditory Processing	14
Logic & Reasoning	10
Processing Speed	8
Working Memory	11
Sustained Attention	14
IQ	12

Changes in standard scores were statistically significant at p < .006 on all measures for both children and adults.

DYSLEXIA | READING RESULTS

Number of Clients: 2,494

Avg. Training Hours: 94

Average Gain: 2.9 years

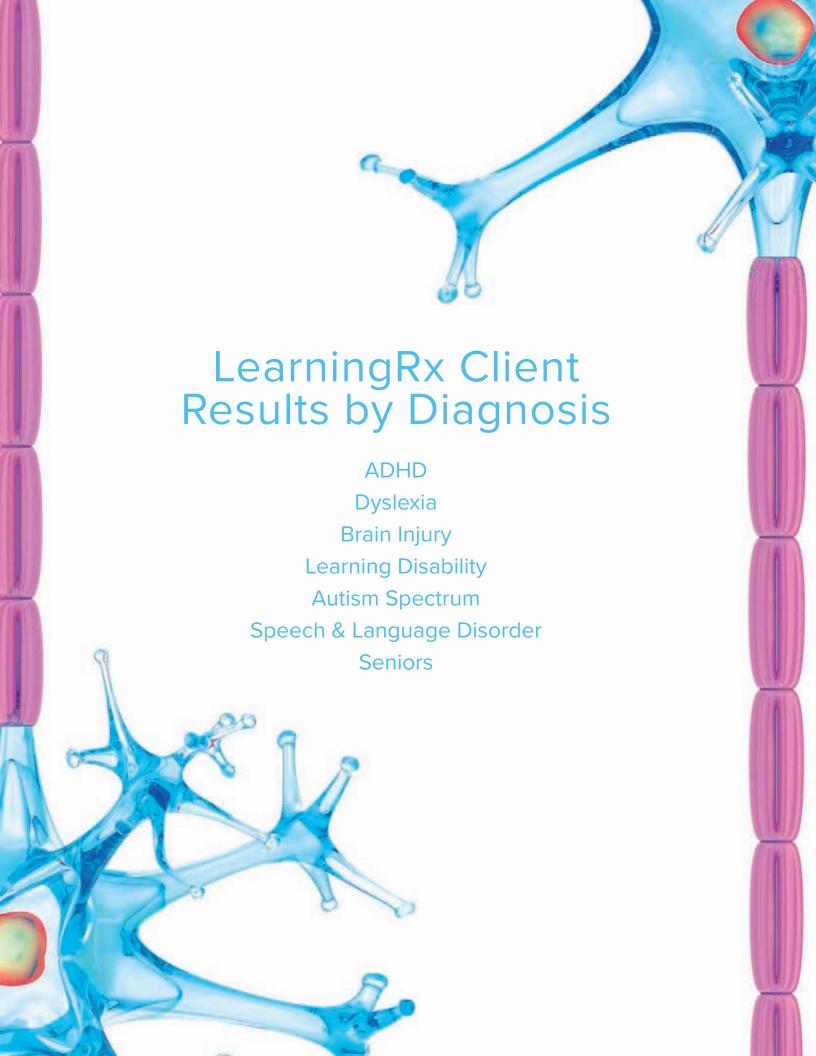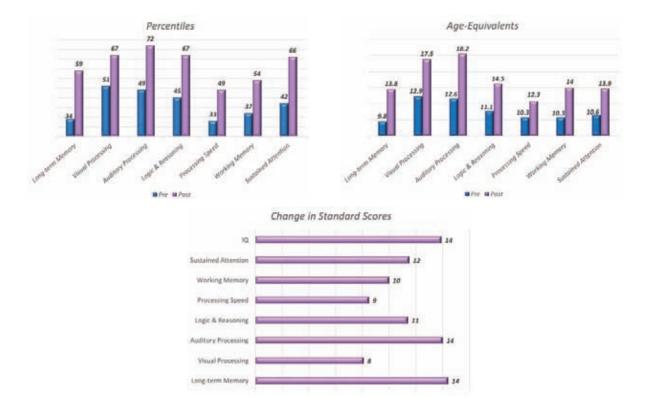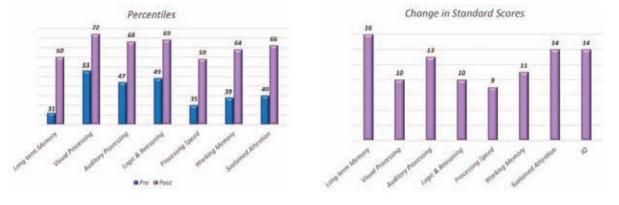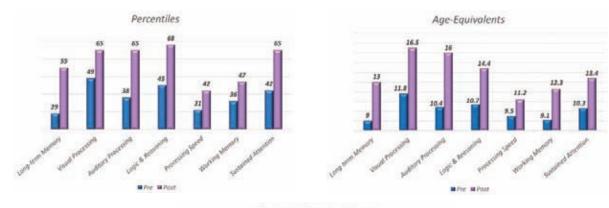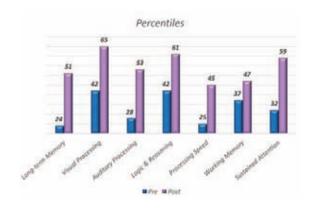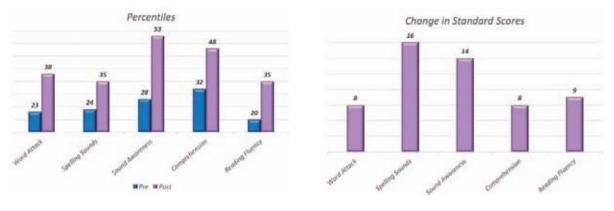Largest Gain: 5.6 years in Sound Awareness

CHILDREN

Ages: 5–17 (Mean = 10.6)   **# of clients:** 2,264

ADULTS

Ages: 18–71 (Mean = 27.9)   **# of clients:** 230

Changes in standard scores were statistically significant at p < .006 on all measures for both children and adults.

BRAIN INJURY I COGNITIVE RESULTS

Number of Clients: 386

Avg. Training Hours: 95

Average Gain: 3.7 years

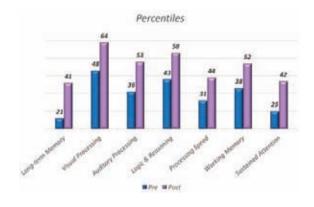Largest Gain: 5.2 years in Auditory Processing

CHILDREN
Ages: 5–17 (Mean = 12.2)   **# of clients:** 163

ADULTS
Ages: 18–87 (Mean = 36.4) **# of clients:** 223

Changes in standard scores were statistically significant at p < .006 on all measures for both children and adults.

LEARNING DISABILITY I COGNITIVE RESULTS

Number of Clients: 2,449
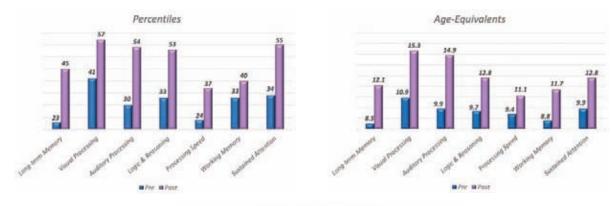
Avg. Training Hours: 93

Average Gain: 3.3 years

Largest Gain: 4.9 years in Auditory Processing
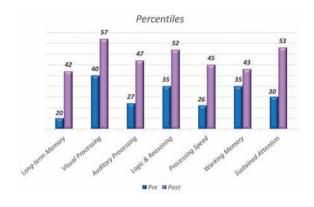
CHILDREN

Ages: 4–17 (Mean = 11.0)   **# of clients:** 2,105

ADULTS

Ages: 18–67 (Mean = 26.2) **# of clients:** 344

Changes in standard scores were statistically significant at p < .006 on all measures for both children and adults.

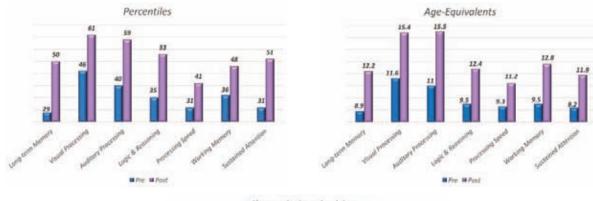# AUTISM SPECTRUM I COGNITIVE RESULTS

Number of Clients: 1,049

Avg. Training Hours: 94

Average Gain: 3.2 years

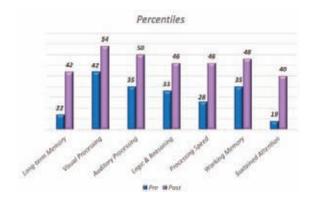Largest Gain: 4.5 years in Auditory Processing

CHILDREN
Ages: 4–17 (Mean = 10.7)# of clients: 935

ADULTS
Ages: 18–63 (Mean = 22.6) **# of clients:** 114

Changes in standard scores were statistically significant at p < .006 on all measures for both children and adults.

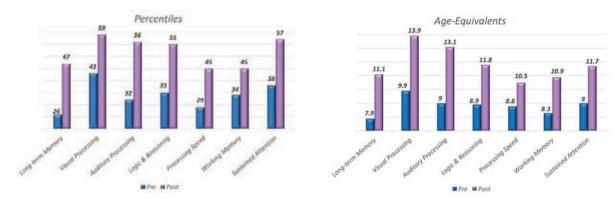# SPEECH & LANGUAGE DISORDER I COGNITIVE RESULTS

Number of Clients: 2,217

Avg. Training Hours: 90

Average Gain: 3.0 years

Largest Gain: 4.1 years in Auditory Processing
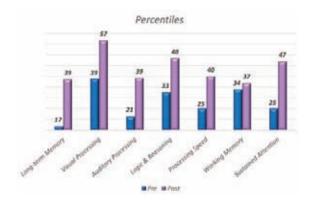
CHILDREN

Ages: 4–17 (Mean = 10.7)   **# of clients:** 2,074

ADULTS

Ages: 18–76 (Mean = 27.6)   **# of clients:** 143

Changes in standard scores were statistically significant at p < .006 on all measures for both children and adults.

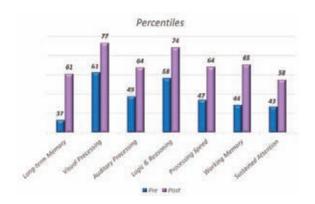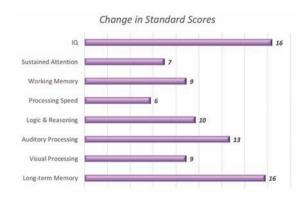# SENIORS | COGNITIVE RESULTS

Number of Clients: 321

Avg. Training Hours: 68

Average Gain: 10.6 standard points

Largest Gain: 16.4 points in IQ score

Ages: 51–95 (Mean = 61.3)   **# of clients:** 321

Changes in standard scores were statistically significant at p < .006 on all measures for both children and adults.

ONE-YEAR RETENTION RESULTS FOR LEARNINGRX CLIENTS

Abstract: To assess retention of training gains for LearningRx clients, we analyzed the results for 516 clients who opted to return for a one-year follow-up assessment on the Woodcock-Johnson III – Tests of Cognitive Abilities. The average age of clients who completed the follow-up testing was 10.8. Retention rates ranged from 96% to 99%, with the greatest retention of skills in visual processing, auditory processing, and logic & reasoning.

PRE, POST, AND FOLLOW-UP STANDARD SCORES				
Skill	Pre	Post	One Year Later	Retention
IQ	95	111	107	97%
Long-Term Memory	94	107	106	98%
Visual Processing	102	109	108	99%
Auditory Processing	111	122	121	99%
Logic & Reasoning	100	111	111	99%
Processing Speed	91	99	94	96%
Working Memory	94	104	101	98%

All scores are rounded to the nearest whole number

CLIENT SATISFACTION RATINGS

Abstract: To assess client satisfaction with LearningRx training programs, parents and adult clients complete an exit survey at the end of training. From 2005–2015, over 19,000 of our 21,836 clients rated the training a 9 or a 10. 71% rated LearningRx a 10, and another 24% rated LearningRx an 8 or a 9. And in 2015, the average score across all LearningRx Centers was a 9.6 out of 10!

EXIT INTERVIEW RATINGS				
Question	10	9 or 8	7 or below	Average Rating
On a scale of 1 to 10, how likely would you be to refer a friend or family member to LearningRx?	71%	24%	5%	9.6

Source: Moore, A.L., and Wainer, H. (2016). *LearningRx Client Outcomes and Research Results. (2016 Edition.).* Available at LearningRx.com

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