Effectiveness of LearningRx Cognitive Skills Training Programs: An In-Depth Look at the Lowest Quartile

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Purpose of the Study

The purpose of this study was to document cognitive growth of students who completed LearningRx programs in 2006. Due to the nature of the program, which focuses on improving weaker areas, students whose scores fell in the lowest 25% of the sample were analyzed. This report includes preliminary statistical analyses documenting change in age equivalents and percentile ranks using pre-test and post-test scores obtained from the Woodcock Johnson Tests of Cognitive Abilities, Third Edition (WJ III-COG) and the Woodcock Johnson Tests of Achievement, Third Edition (WJ III-ACH).

Background

The LearningRx training system was developed to train and enhance cognitive learning skills. The LearningRx training procedures consist of tasks that emphasize auditory or visual processes and that require attention and reasoning throughout the training. The processing strategies are learned through inductive rather than deductive inference to ensure greater transfer. In other words, the subject is trained to develop the appropriate strategy to complete the task through the structured experience provided by the training procedures. The training consists of tasks that are organized in a progressively more challenging manner. Cognitive training uses a synergistic "drill for skill" and meta-cognitive approach to develop cognitive skills. The model is hierarchical and designed to specifically target one or more specific cognitive skills. The tasks repeatedly make demands on a person's processing abilities and progressively increase those demands. These tasks are the means of developing cognitive functions. This training approach is based, in part, on the scientific and biological basis that the retraining of cognitive functions can help reorganize and improve higher cognitive functions. To do this, however, the targeted functions must be worked on repeatedly. Therefore, as soon as a student has mastered a task or group of tasks, higher-level tasks that target the same cognitive function must be available.

An important component of the training is the interactive nature of the sessions and feedback provided by the trainer to facilitate the learning of the student. The immediate reinforcement and feedback of both correct and incorrect responses is designed to enhance the student's learning. This reinforcement is also important for the sequential nature of the cognitive procedures. As the procedures move from simple to more complex, the consistent feedback and reinforcement becomes increasingly important to allow the student to achieve mastery of the tasks and move forward to the more challenging levels of tasks. These intense, sequenced tasks and the accompanying feedback are the hallmarks of the LearningRx approach to processing skills training.

* For additional information about the history and development of the LearningRx cognitive training procedures, visit http://www.learningrx.com.

LearningRx Training Programs

Each of the students assessed within this study were enrolled in one of ten different training programs including various combinations of the ReadRx, ThinkRx, MathRx, and LiftOff programs. For each program, sessions consist of one-on-one training for an hour at a time. Partner and Directed programs include home training in which parents observed professionally led sessions and were trained by LearningRx trainers in procedures assigned for home. They were then expected to implement these training procedures at home three to six times a week (dependent on the program) for each week enrolled in the program. Each of these programs is described in more detail in Appendix A. The ThinkRx, ReadRx, and MathRx programs are described in more detail below.

ThinkRx Training

ThinkRx training consists of 24 procedures and over 1000 levels are graded according to difficulty, and tasks become progressively more complex. The pace is regulated by mastery, so the numbers of tasks completed during training sessions differ from student to student. However, the administration of the procedures is standardized across trainers. While all cognitive skills are addressed, programs are individualized to primarily address and strengthen deficient areas and enhance strengths. Certain modifications may initially be allowed to assist a student with a procedure; however, mastery is quickly established through repetition and drill. Mental activities and distractions are implemented frequently in order to develop complex problem solving and concentration abilities.

An example of a ThinkRx procedure is described as follows:

Attention Arrows: Develops divided, sustained and selective attention, processing speed, visual sequencing, saccadic fixation, and self-regulation.

Using a metronome and a board with several rows of different colored arrows randomly pointing in the four primary directions, the subject would proceed through the following levels:

Level 1: Student calls out the color of the arrows without error in 3 rows within a set time (for between 10 and 30 seconds).

Level 2: Student calls out the direction of the arrows without error for three rows within a set time.

Level 3: Student calls out the color of the arrows in four rows on every other beat, in sync with the metronome set to between 85 beats per minute (bpm) and 160 bpm.

Level 4: Student calls out the direction of the arrows as if they were turned a quarter-turn clockwise on every other beat (in sync with the metronome set to between 85 bpm and 160 bpm).

Level 5: Student calls out the color of the "up" and "down" arrows and calls out the direction of the "right" and "left" arrows in 4 rows on every other beat (in sync with the metronome set to between 85 bpm and 160 bpm).

Level 6+: The levels continue to increase in difficulty. Throughout the procedures, the trainer includes a variety of distractions ranging from low level (walking around the student, coughing, etc.) to high-level

The procedures require focused attention and progression through the levels, which requires the attainment of increased speed and complexity of processing. Also, as the levels of the task are achieved, the sequenced demands are increased, which makes the task increasingly intense and challenging.

ReadRx Training

The ReadRx program includes the 24 procedures of the ThinkRx program plus an additional 24 lessons of approximately 8 procedures each which focus on areas referred to as auditory processing, basic code, and complex code skills involved in reading rate, accuracy, fluency, comprehension, spelling, and writing. The training method is similar to ThinkRx. An example of parts of a ReadRx procedure is described as follows:

Using a metronome, the trainer says a word consisting of three to five sounds and the student recites the word, but without one of the sounds, as directed.

Level 4: Drop either the first or the last sound

Level 8: Drop out a sound as directed, varying which consonant sound to drop (Trainer: “cat,” beat, “last,” beat, Student: “ca,” beat, beat, Trainer: “lut,” beat, first, beat, Student: “ut,”…)

MathRx Training

MathRx takes an innovative approach to improving both math and higher level thinking skills. Instead of limiting training to only a narrow area within mathematics, MathRx training develops the broad set of underlying cognitive skills (such as high-level thinking, problem solving skills, and reasoning skills) that are required to efficiently and effectively learn mathematical concepts, solve problems, and perform mathematical calculations faster. Like the other LearningRx programs, the program is designed around non-academic training. Skills are improved through a variety of increasingly challenging drills that improve core cognitive skills as well as the higher level thinking skills MathRx targets. The overall goal is to create strong computation skills, numerical fluency, number sense, and as a result, overall math success. An example of a MathRx procedure is described as follows:

Using a metronome, the trainer reads a description of a mathematical operation and then the student gives 10 answers in a row on every other beat.

Level 2 (Gold): Starting with 98, subtract 9 from the previous number. The student responds with (91, 82, 73, 64…).

Assessment of Cognitive Skills

Before and after cognitive skills training, each student was assessed on up to 16 different sub-tests which measure 14 different areas of cognitive processing depending on the program the student is enrolled in. The measures used to assess these different abilities included the Woodcock Johnson Tests of Cognitive Abilities, Third Edition (WJ III-COG) and the Woodcock Johnson Tests of Achievement, Third Edition (WJ III-ACH). These tests are nationally standardized norm-referenced tests which are often used by educators and psychologists to measure cognitive skills and academic abilities. Sub-tests given to each student were partly dependent upon the specific program the student was enrolled in. The following table illustrates the sub-tests used for analyses in this study as well as the skill that is tested by each sub-test.

Table 1

Name of Sub-Test	Measure	Skills Tested
Test 2: Visual-Auditory Learning	WJ III-COG	Long-Term Memory
Test 12: Retrieval Fluency	WJ III-COG	Long-Term Memory
Test 7: Numbers Reversed	WJ III-COG	Short-Term Working Memory
Test 9: Auditory Working Memory	WJ III-COG	Working Memory/Divided Attention
Test 3: Spatial Relations	WJ III-COG	Visual Processing
Test 5: Concept Formation	WJ III-COG	Logic and Reasoning
Test 15: Analysis-Synthesis	WJ III-COG	Deductive Reasoning
Test 6: Visual Matching	WJ III-COG	Processing Speed
Test 16: Decision Speed	WJ III-COG	Decision Processing Speed
Test 20: Pair Cancellation	WJ III-COG	Executive Processing Speed
Test 6: Math Fluency	WJ III-ACH	Processing Speed
Test 10: Applied Problems	WJ III-ACH	Math Problem Solving
Test 18: Quantitative Concepts	WJ III-ACH	Mathematical Concepts
Test 13: Word Attack	WJ III-ACH	Word Attack (Decoding)
Test 20: Spelling of Sounds	WJ III-ACH	Spelling
Test 21: Sound Awareness	WJ III-ACH	Auditory Processing

See the *Glossary of Terms* for a description of each skill measured.

Demographics of Sample

The original sample included 2,080 students who completed a LearningRx program in 2006. Student data was compiled from 36 different LearningRx centers throughout the United States. Students were enrolled in one of ten programs and ranged in age from 4 years to 19 years, 3 months, with a mean of 11 years, and a standard deviation of 3 years. Participants who were 20 years of age and over (N=5) were dropped from the sample for more clear interpretation of data. Ninety percent of the sample fell between 6 years, 11 months, and 17 years, 2 months of age at initial assessment. The average time between pre and post assessment was 6 months. Overall, 63% of the sample was male.

The sample size used for analyses for each sub-test ranged from 25 to 764 and was dependent upon the number of students who fell in the lowest quartile on that particular sub-test. The average age of this sample was 13 years, 1 month at the time of initial assessment, with a standard deviation of 2 years, 6 months.

The following table illustrates the demographics of students by program:

Table 2

LearningRx Program	Number of Participants	Percent Male	Percent Female	Average Age	Time Between Assessments
LiftOff	103	65%	35%	6 years, 4 months	5 months
MathRx Partner	26	73%	27%	13 years, 7 months	7 months
MathRx Pro	3	67%	33%	13 years, 6 months	5 months
ReadRx Directed	31	61%	39%	11 years, 7 months	7 months
ReadRx Partner	685	59%	41%	11 years, 3 months	7 months
ReadRx Partner/Directed	107	58%	42%	11 years, 3 months	7 months
ReadRx Pro	139	66%	34%	10 years, 10 months	7 months
ThinkRx Directed	54	63%	37%	11 years, 3 months	5 months
ThinkRx Partner	775	64%	36%	11 years, 1 month	5 months
ThinkRx Pro	152	66%	34%	11 years, 10 months	5 months

Analyses that were conducted on the full sample include all 2,080 students across all programs. The racial backgrounds of all participants in these separate programs were similar. Table 3 illustrates the racial/ethnic breakdown of the entire sample.

Table 3

Race	Percent
Caucasian	85.7%
Black	5.5%
Asian	2.1%
Hispanic	2.2%
Other	1.6%
Unknown	2.9%

Pre/Post Differences for all Students in Lowest Quartile

The following table illustrates the average growth measured as age equivalents achieved across all students in the lowest 25% of the sample for each skill. Average pre test age equivalents (AE)[1], average post-test AE[2], the average true gain score[3], as well as F statistic[4] and p-values[5] obtained from the repeated measures analyses of variances (ANOVA's) that were conducted on each skill are reported in this table.

* All F values were significant at the $p < .001$ level of significance.
1 Average pre-test age equivalents (AE) is the mean AE achieved at the initial testing session across all students for each skill.
2 The average post-test AE was calculated by taking the post-test AE for each student and subtracting out the length of time the student was enrolled in the program.
3 The true growth column represents the average actual growth achieved in each skill. This number takes into account the amount of time elapsed between pre test and post test.
4 If the F value is sufficiently greater than 1 then this indicates that the effects of the program are significantly greater than the differences that may be present due to statistical error.
5 The p-value tells us how likely a statistically significant result would be due to error. For example, $p < .001$, indicates that there is a .1% chance that the significant result obtained was due to error.

Table 4

Skill Sub-Test	Number	Pre-Test AE	Post-Test AE	True Growth	F*
Auditory Processing					
Segmenting Nonwords	210	7 years, 4 months	13 years, 9 months	5 years, 11 months	1665.44
Sound Awareness	485	8 years, 10 months	14 years, 11 months	5 years, 7 months	578.02
Blending Nonwords	215	7 years, 9 months	12 years, 3 months	5 years	793.80
Spelling Spelling of Sounds	206	8 years, 8 months	11 years, 10 months	2 years, 7 months	162.90
Decoding Word Attack	515	9 years	11 years, 10 months	2 years, 4 months	391.15
Processing Speed					
Visual Matching	510	9 years, 9 months	12 years, 1 month	1 year, 10 months	229.66
Decision Speed	42	9 years, 5 months	12 years, 9 months	2 years, 11 months	48.51
Math Fluency	221	9 years, 8 months	11 years, 1 month	1 year	48.07
Executive Processing Speed Pair Cancellation	225	9 years, 9 months	13 years, 7 months	3 years, 4 months	344.97
Memory					
Long-Term Memory					
Visual-Auditory Learning	501	7 years, 9 months	13 years, 3 months	4 years, 11 months	767.50
Retrieval Fluency	764	10 years, 10 months	13 years, 9 months	2 years, 6 months	210.17
Short-Term Working Memory Numbers Reversed	491	8 years, 3 months	12 years, 6 months	3 years, 9 months	469.16
Working Memory/Divided					
Attention Auditory Working Memory	312	8 years, 10 months	12 years, 4 months	3 years, 6 months	314.45
Visual Processing					
Spatial Relations	524	8 years, 7 months	15 years	5 years, 11 months	563.63
Logic and Reasoning					
Concept Formation	496	8 years	12 years, 11 months	4 years, 5 months	723.11
Applied Problem	25	10 years, 9 months	12 years, 4 months	1 year, 2 months	30.64

Sixteen repeated measures ANOVA's were conducted to test the difference between the pre- and post-test age equivalents. The repeated measures ANOVA statistic was chosen because this statistic takes into account the error factor associated with using the same measure twice on the same set of participants.

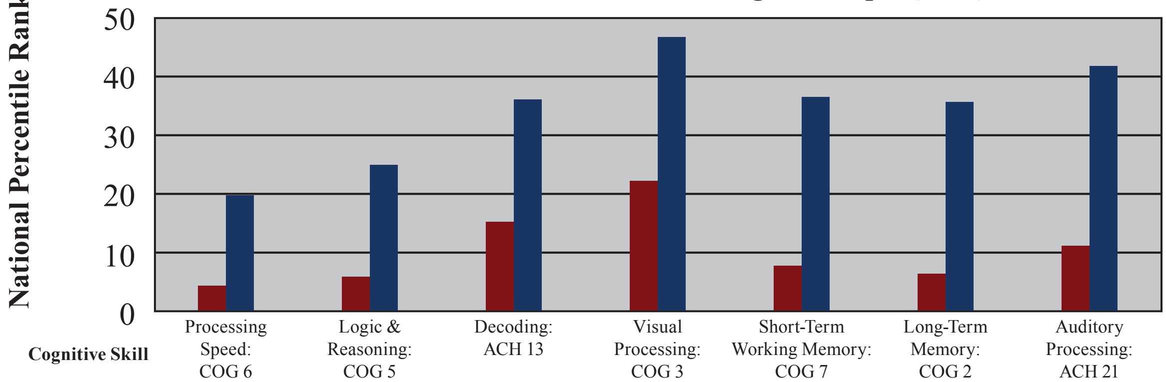
Growth of 5 years or more was present in all areas of Auditory Processing as well as in Visual Processing, with sub-tests of Visual Auditory Learning and Concept Formation showing growth above 4 years. Three tests had growth over 3 years, four showed growth over 2 years, and the remaining sub-tests showed growth of 1 year or more. Every sub-test analyzed was significant at the $p < .001$ level of significance, indicating that the change between pre-test and post-test (accounting for time elapsed between testing sessions) was due to actual cognitive growth beyond any chance factor. Therefore, it can be concluded that students in the lowest quartile of the LearningRx cognitive skills training programs in 2006 experienced cognitive growth in areas tested which was the direct result of participation in LearningRx programs.

Percentile Rank Analyses by Program

Additional analyses were conducted using percentile ranks for students who scored in the lowest 25% of the total LearningRx sample on individual sub-tests. Further, separate analyses were conducted to examine the results from the students in the lowest 25% of the ReadRx, ThinkRx, and MathRx programs. Differences between pre-percentile ranks and post-percentile ranks were analyzed using Repeated Measures ANOVA's to determine the significance of the differences in scores. The specific sub-tests were chosen for analyses due to the number of respondents and relevance to that particular program. The following graphs indicate mean percentile ranks[6] at both pre- and post-testing sessions for students in the lowest quartile of the respective sample.

Lowest Quartile: Total LearningRx Sample

Pre-Test Percentile Rank versus Post-Test Percentile Rank for Students in the Lowest Quartile of LearningRx Sample (2006)

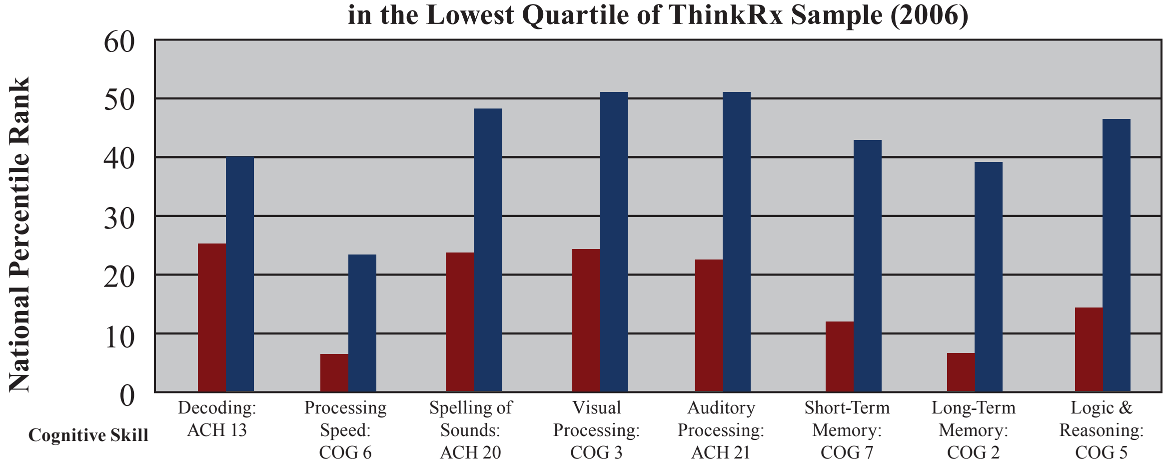


	Processing Speed: COG 6	Logic & Reasoning: COG 5	Decoding: ACH 13	Visual Processing: COG 3	Short-Term Working Memory: COG 7	Long-Term Memory: COG 2	Auditory Processing: ACH 21
Pre-Percentile	3.5	6.6	14.8	21.9	8.2	6.1	10.7
Post-Percentile	19.9	24.4	36.5	47.8	36.6	35.9	41.4

Changes in percentile ranks ranged from 16.4 (Processing Speed) to 30.7 (Auditory Processing). All skills (with the exception of Processing Speed) were improved from the below average range[7] to the average range[8]. All comparisons between pre- and post-test percentile ranks were significant at the $p < .001$ level, thereby indicating that growth in these skills was most likely (with 99.9% accuracy) due to actual gains achieved rather than a result of statistical error.

Lowest Quartile: ThinkRx Sample

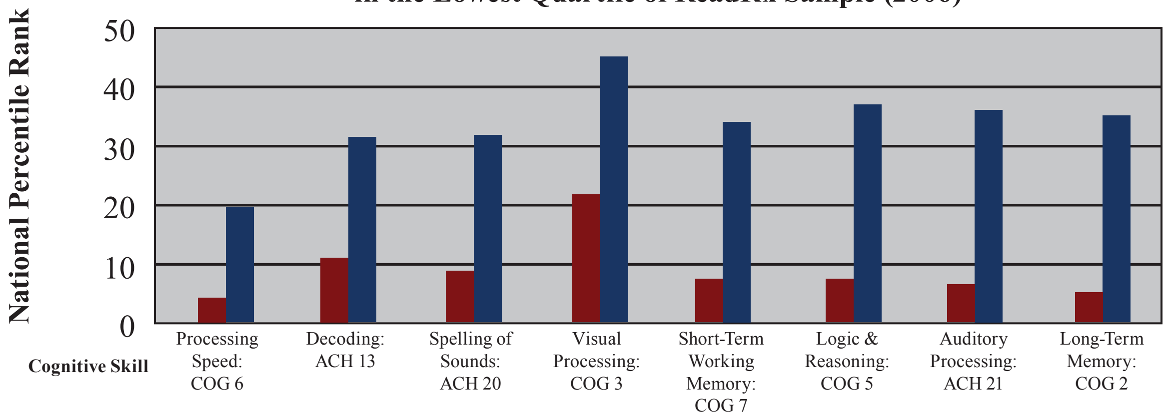
Pre-Test Percentile Rank versus Post-Test Percentile Rank for Students in the Lowest Quartile of ThinkRx Sample (2006)



	Decoding: ACH 13	Processing Speed: COG 6	Spelling of Sounds: ACH 20	Visual Processing: COG 3	Auditory Processing: ACH 21	Short-Term Memory: COG 7	Long-Term Memory: COG 2	Logic & Reasoning: COG 5
Pre-Percentile	25.2	5.8	23.2	24.2	21.8	12.1	8.3	13.8
Post-Percentile	39.8	22.6	48.8	50.4	50.1	42.2	39.7	46.7

Lowest Quartile: ReadRx Sample

Pre-Test Percentile Rank versus Post-Test Percentile Rank for Students in the Lowest Quartile of ReadRx Sample (2006)

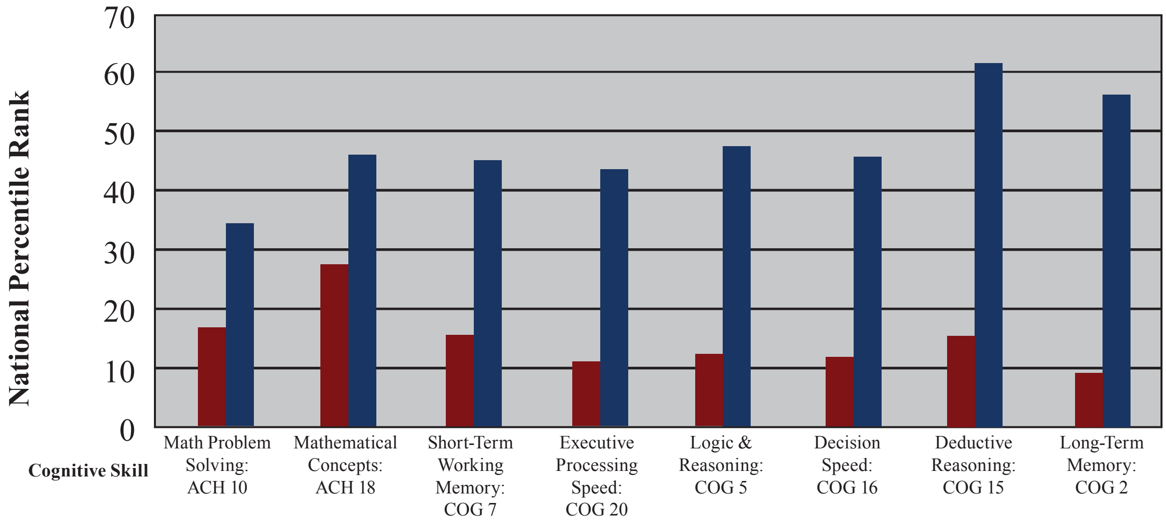


Pre-Percentile	3.3	10.7	9.3	20.4	7.0	8.5	6.7	4.5
Post-Percentile	19.3	31.3	31.6	45.1	33.4	37.2	36.3	35.5

Changes in percentile ranks ranged from 16 (Processing Speed) to 31 (Long-Term Memory). All skills (with the exception of Processing Speed) were improved from the below average range to the average range. All comparisons were significant at the $p < .001$ level.

Lowest Quartile: MathRx Sample

Pre-Test Percentile Rank versus Post-Test Percentile Rank for Students in the Lowest Quartile of MathRx Sample (2006 and 2007)



Pre-Percentile	17.4	27.9	16.1	10.8	11.7	11.4	16.0	9.6
Post-Percentile	34.4	46.8	44.6	43.8	48.1	46.5	61.4	55.7

See page 7 for these references:

6 A percentile rank describes an individual's standing from 1 to 99 in comparison with same-age peers. The individual's percentile rank indicates the percentage of people in the same age group whose scores were the same as or lower than that individual's score. For example, a percentile rank of 50 means that the individual student scored as well or better than 50% of his or her peers. A percentile rank between 25 and 75 is considered average, as 50% of students fall within this range.

7 National percentile ranks below the 25th percentile are considered to be in the below average range.

8 National percentile ranks between the 25th and 75th percentile are considered to be in the average range.

9 A p-value of $p < .05$ indicates that there is less than a 5% chance that the significant results are due to error.

Due to the small sample size of students enrolled in the MathRx sample for 2006, data from 2006 and 2007 were combined for these analyses. This new sample consisted of 49 students, 42 of which demographic data was available. Students ranged in age from 10 years, 10 months to 17 years, 11 months, with a mean of 14 years, 7 months and a standard deviation of 1 year, 10 months. The sample included 95% Caucasian and 5% Hispanic students. Sixty-two percent of the sample was male. The average time between pre- and post-testing was 6 months. Changes in percentile ranks ranged from 17 (Math Problem Solving) to 46.1 (Long-Term Memory). All skills were improved from the below average range to the average range (with the exception of mathematical concepts which had pre-test data in the average range). All comparisons between pre and post-test percentile ranks were significant at the $p<.05$[9] level, thereby indicating that growth in these skills was most likely due to actual gains achieved rather than a result of statistical error.

Study Summary

When looking at age equivalents in the lowest 25% of the LearningRx student sample, the biggest gains were evident in the sub-tests related to auditory processing. All three of these sub-tests; Segmenting Nonwords, Sound Awareness, and Blending Nonwords; as well as Spatial Relations (Visual Processing) showed growth of 5 years or more. Areas such as Visual-Auditory Learning (Long-Term Memory) and Concept Formation (Logic and Reasoning) all showed over 4 years growth. There were three sub-tests in which the average growth was over 3 years and four sub-tests showing over 2 years growth. The remaining sub-tests showed growth of one year or more.

It should be noted that there is an expectation for these students in the lowest quartile to perform closer to the 50th percentile rank at post-test due to a phenomenon known as regression to the mean. However, students in the lowest quartile of the entire LearningRx sample made significant percentile rank gains in all skill areas and those gains appear to accurately reflect true cognitive growth. Gains ranged from a 16.4 percentile gain in Processing Speed to a 30.7 percentile gain in Auditory Processing (Sound Awareness). When looking at national percentile ranks of the WJ III-COG and WJ III-ACH norming samples, the lowest quartile of LearningRx students went from being in the below average range at pre-test (below the 25th percentile) to the average range (between the 25th and 75th percentile) at post-test, in all areas except for Processing Speed.

During examination of ThinkRx, ReadRx, and MathRx students separately, some patterns emerged. Processing Speed had the smallest gains for most students across all programs. The only exception to this was the gain of 14.6 percentile points in Decoding for students in the ThinkRx program only. One of the biggest areas of growth that appeared to be consistent for all students in the lowest quartile was Long-Term Memory.

Students in the lowest quartile of the ThinkRx sample had bigger gains than those in the ReadRx sample in the following areas; Visual Processing, Processing Speed, Short Term Working Memory, Logic and Reasoning and Long Term Memory. Counter intuitively, students in the ThinkRx sample also had bigger gains in Spelling. However, students in the ReadRx program had an average pre-percentile of 9.3 and a post-percentile of 31.6 (a gain of 22.3 percentile points) and students in the ThinkRx program had an average pre-percentile of 23.2 and post-percentile of 48.8 (a gain of 25.6 percentile points). It can be accurately assumed that a change from below the 10th percentile to the Average range would be more difficult to achieve than a change from just below the Average range to the Average range.

As anticipated, Auditory Processing and Decoding had larger gains among students in the lowest quartile of the ReadRx sample when compared to those students in the lowest quartile of the ThinkRx sample.

In all, each and every sub-test showed significant true growth of at least 1 year (when looking at Age Equivalents) as well as illustrated significant changes in percentile ranks. From the analyses conducted in this study, it can be concluded that LearningRx Programs were responsible for promoting significant cognitive change amongst students in the lowest quartile of the LearningRx sample.

Strengths of the Study

This study has several strengths. First, this study is one of a kind primarily due to the revolutionary approach to cognitive skills training that LearningRx employs. Additionally, to this author's knowledge, there are not any other cognitive skills training programs that have been statistically analyzed to determine if true cognitive growth measured by a norm-referenced test exists as a result of direct training.

Additionally, by using normative measures that have been nationally standardized (like the Woodcock Johnson III) to gather pre and post-test data, the results of this study can be interpreted without concern of testing instrument bias. By using a true growth score which accounts for the time elapsed between testing sessions, developmental growth that would be expected to occur over time is accounted for allowing for a clear interpretation of actual growth achieved through LearningRx procedures and programs.

Finally, the large sample size and the fact that the data consisted of students from 36 different centers nationwide add to the reliability, generalizability and validity of the results.

Study Limitations

No study is without its limitations. In this study, because conclusions were made from age equivalent scores and percentile ranks (both forms of rank order data), results are considered preliminary. Future analyses of this data should include standard scores to compare pre and post-test scores. The equal interval nature of standard scores would allow for more complex data analyses as well as more confidence in data interpretation.

Because the study focused solely on the lowest 25% of the sample, conclusions cannot be generalized to those students already performing in the average range or above. Sample demographics included mostly Caucasian participants, which may constrict the generalizability of results to children with other ethnic/racial backgrounds.

Lastly, pre- and post-tests were conducted using the same form of the test. Although Repeated Measure ANOVA's were conducted to control for this, using two different forms of the same test would help to make stronger conclusions, it would also control for practice effects which are usually associated with using the same test at two different time points less than 1 year apart.

Future Directions

Due to the underlying reason for improving cognitive skills training being that of helping students succeed in school, teacher and academic data reflecting actual school performance before and after participation in LearningRx programs would add depth to this study.

Further analyses could take into account the age of the student and disability (if any) to determine if these factors contribute to growth of skills achieved through LearningRx programs. Additionally, students performing in the average and above average ranges could be analyzed for comparison with students in the lowest quartile.

Due to the innovative nature of LearningRx Programs, the significance of results obtained from this study, and the current lack of literature that exists in the educational and psychological fields, publishing reports such as these would be beneficial in adding to the knowledge of professionals in related fields.

Glossary of Terms

Auditory Processing: The ability to analyze, blend, segment, and synthesize sounds. Auditory processing is a crucial underlying skill for reading and spelling

Deductive Reasoning: The ability to reason and draw conclusions from given conditions. For example, one is given a set of instructions on how to perform an increasingly difficult task.

Decision Processing Speed: The ability to make decisions quickly.

Decoding: The ability to accurately read written words.

Executive Processing Speed: The ability to perform a simple cognitive task quickly. This skill also measures the ability to work quickly and accurately while ignoring distracting stimuli.

Logic and Reasoning: The ability to reason, form concepts, and solve problems using unfamiliar information or novel procedures.

Long-Term Memory: The ability to recall information that was stored in the past. Long-Term memory is important for spelling, recalling facts on tests, and comprehension.

Math Problem Solving: The ability to analyze and solve math word problems.

Mathematical Concepts: The ability to count and identify numbers, shapes, and number sequences as well as understand and having knowledge of mathematical terms and formulas.

Processing Speed: The ability to perform cognitive tasks quickly. This is an important skill for completing complex tasks or tasks that have many steps. For example, if we are dividing two numbers in our head but our processing is slow, we might forget an earlier calculation before we are done and have to start over again. We took longer to do the problem than our ability to remember.

Short-Term Working Memory: The ability to apprehend and hold information in immediate awareness while simultaneously performing a mental operation. Students with short-term memory problems may need to look several times at something before copying, have problems following multi-step instructions, or need to have information repeated often.

Spelling: The ability to spell unknown words while using accurate combinations of letters based on rules of the English language.

Visual Processing: The ability to perceive, analyze, and think in visual images. This includes visualization, which is the ability to create a picture in your mind. Students who have problems with visual processing may reverse letters or have difficulty following instructions, reading maps, doing word math problems, and comprehending.

Working Memory/Divided Attention: The ability to remember information while performing a mental operation and attending to two things at once (multi-tasking).

Spelling: The ability to spell unknown words while using accurate combinations of letters based on rules of the English language.

Visual Processing: The ability to perceive, analyze, and think in visual images. This includes visualization, which is the ability to create a picture in your mind. Students who have problems with visual processing may reverse letters or have difficulty following instructions, reading maps, doing word math problems, and comprehending.

Working Memory/Divided Attention: The ability to remember information while performing a mental operation and attending to two things at once (multi-tasking).

Appendix A

ThinkRx Partner is a cognitive skills training program that lasts for 12 weeks and includes 72 total hours of training. Students receive training 3 times per week from a professional trainer (for a total of 36 hours) and an additional 36 hours of home training is required.

ThinkRx Pro is a cognitive skills training program that lasts for 12 weeks and includes 60 hours of training. Students receive training 5 times a week from a professional trainer.

ThinkRx Directed is a cognitive skills training program that lasts for 12 weeks and includes 84 hours of training. Students receive training once per week from a professional trainer (for a total of 12 hours) and an additional 72 hours of home training is required.

ReadRx Partner is a sound-to-code based reading program that teams with the cognitive skills developed by LearningRx's ThinkRx program. This program lasts for 24 weeks, and includes 144 hours of training. Students receive training 3 times per week from a professional trainer (for a total of 72 hours) and an additional 72 hours of home training is required.

ReadRx Pro is a sound-to-code based reading program that teams with the cognitive skills developed by LearningRx's ThinkRx program. This program lasts for 24 weeks, and includes 120 hours of training. Students receive training 5 times per week from a professional trainer.

ReadRx Directed is a sound-to-code based reading program that teams with the cognitive skills developed by LearningRx's ThinkRx program. This program lasts for 24 weeks and includes 168 hours of training. Students receive training once per week from a professional trainer (for a total of 24 hours) and an additional 144 hours of home training is required.

ReadRx Partner/Directed is a sound-to-code based reading program that teams with the cognitive skills developed by LearningRx's ThinkRx program. This program lasts for 24 weeks and includes 156 hours of training. During the first 12 weeks students receive training 3 times per week from a professional trainer (for a total of 36 hours) and an additional 36 hours of home training is required. For the last 12 weeks, students receive training once per week from a professional trainer (12 hours) and an additional 72 hours of home training is required.

LiftOff is a program that develops a strong foundation of underlying cognitive and reading skills in students from age 4-6. This program lasts for 12 weeks and includes 72 hours of training. Students receive training 3 times per week from a professional trainer (for a total of 36 hours) and an additional 36 hours of home training is required.

MathRx Partner is a program that develops core cognitive skills developed through LearningRx's ThinkRx program. This program also works on developing executive functioning, higher level reasoning, problem solving and numerical fluency skills. This program lasts for 20 weeks and includes 120 hours of training. Students receive training 3 times per week from a professional trainer (for a total of 60 hours) and an additional 60 hours of home training is required

MathRx Pro is a program that develops core cognitive skills developed through LearningRx's ThinkRx program. This program also works on developing executive functioning, higher level reasoning, problem solving and numerical fluency skills. This program lasts for 20 weeks and includes 100 hours of training. Students receive training 5 times per week from a professional trainer.