

Cognitive Growth in Students with Uneven Cognitive Profiles Following Comprehensive Integrated Cognitive Training

Background

Students who struggle academically are often assumed to have generally low ability or weak overall learning skills. However, cognitive science suggests a different explanation: many struggling learners have uneven cognitive profiles, with areas of strength alongside areas of significant weakness. These imbalances can interfere with learning, even when students have strong underlying potential.

To better understand the cognitive characteristics of students who struggle with learning, BrainWare Learning Company analyzed data from 60 students (ages 8–16) who had recently completed one of its comprehensive, integrated cognitive training programs.¹ These students were not selected based on a specific diagnosis or profile; the only common factor was that they were experiencing learning challenges significant enough for their families to seek support.

All students completed a nationally normed cognitive assessment² measuring 10 cognitive skills critical for learning:

- Attention
- Working Memory
- Flexible Thinking
- Verbal Memory
- Visual Memory
- Abstract Reasoning
- Verbal Reasoning
- Spatial Perception
- Processing Speed
- Visual Motor Speed

Variability in Cognitive Profiles

For this report, the students' cognitive assessment results are reported as percentile rankings, which indicate how a student performs relative to peers. Scores between the 17th and 84th percentiles fall within the average range (that is, within one standard deviation of

¹ The data in this report were originally published in the book *Your Child Learns Differently, Now What?* by Roger Stark and Betsy Hill.

² MindPrint is an hour-long online, self-administered cognitive assessment developed at the University of Pennsylvania's Perelman School of Medicine. It is nationally normed so that student scores are compared to scores of the normative data for same-sex, same age students.

the mean), with the middle of that range (between the 31st and 69th percentiles) representing typical performance.

When the data for these 60 students were averaged, the results appeared relatively typical, as show in Figure 1. Average scores across most cognitive skills fell within the middle of the average range, with only processing speed somewhat lower, though low in the average range.

Average Pre-Test Cognitive Scores

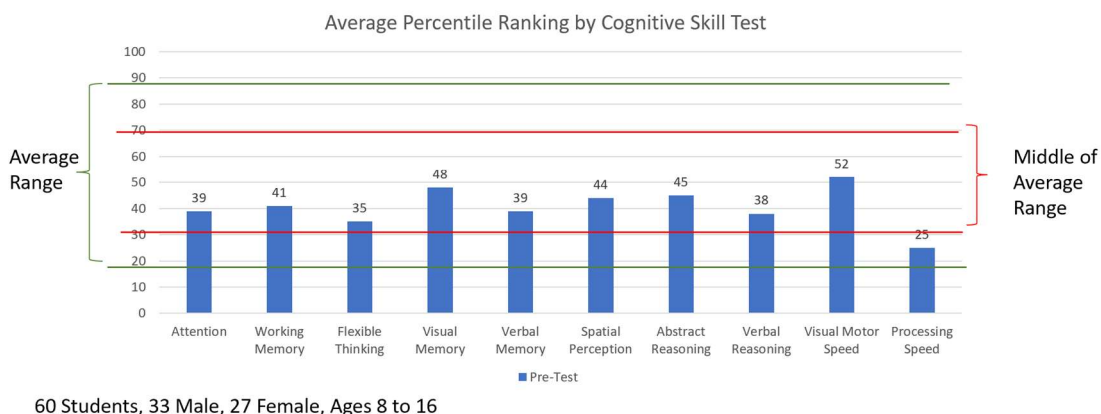


Figure 1. Average cognitive skills percentile rankings for 60 students

When individual student data were examined, however, a striking pattern emerged: cognitive scores varied widely across students and across skills within individual students.

Across the 60 students:

- Scores ranged from the 1st percentile to the 99th percentile on multiple cognitive skills, as shown in Figure 2 below.
- Nearly half of the students had at least one score in the bottom 5%, indicating an exceptional weakness in that skill.
- Approximately one-quarter had at least one score in the top 5%, indicating an exceptional strength.

Every student showed a combination of strengths and weaknesses, often with large gaps between them.

Range of Pre-Test Cognitive Scores

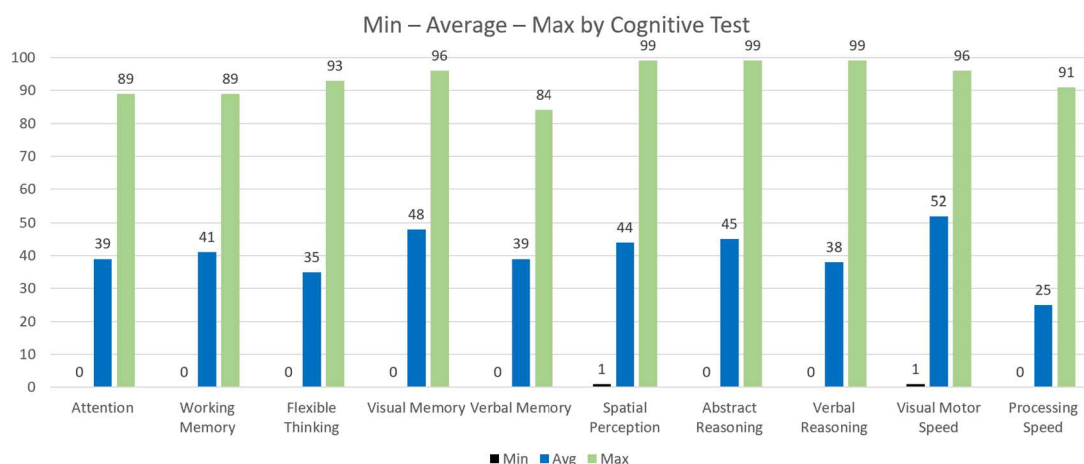


Figure 2. Minimum, maximum and average scores for 60 students

This pattern highlights an important characteristic of many students who struggle with learning. They may have average skills, on average, but they are not “average learners.” They are uneven learners.

These uneven cognitive profiles can make learning substantially more difficult. Weaknesses in areas such as working memory, attention, or processing speed can interfere with a student’s ability to fully use their strengths, leading to underperformance and frustration.

Strengthening of Skills with Comprehensive Integrated Cognitive Training (CICT®)

Each of the students participated in a comprehensive integrated cognitive training program³ designed to strengthen a broad range of cognitive and executive function skills through structured, adaptive activities, in an integrated manner.

Across the group:

- Students completed an average of 46–56 sessions
- Over 12 to 14 weeks
- In sessions lasting 30 to 45 minutes

³ BrainWare SAFARI develops 43 cognitive skills in an integrated manner, was derived from over 40 years of collaboration among multiple clinical disciplines and is delivered online in a video-game format.

- They progressed through an average of 136–144 of the 168 levels in BrainWare SAFARI

Cognitive Gains

Following cognitive training, students demonstrated marked improvement across all cognitive skill areas as shown below in Figure 3.

Average percentile rankings increased across all ten cognitive skills. For example:

- Attention improved from the 39th to the 51st percentile
- Working memory improved from the 41st to the 55th percentile
- Flexible thinking improved from the 35th to the 51st percentile
- Processing speed improved from the 25th to the 35th percentile

Across all measures, students showed an average gain of 10 percentile points, with average scores in all cognitive areas indicating overall stronger learning capacity. Because percentile rankings are norm-referenced, these gains reflect movement relative to age peers, not simply maturation over time.

Average Cognitive Scores Pre- and Post-

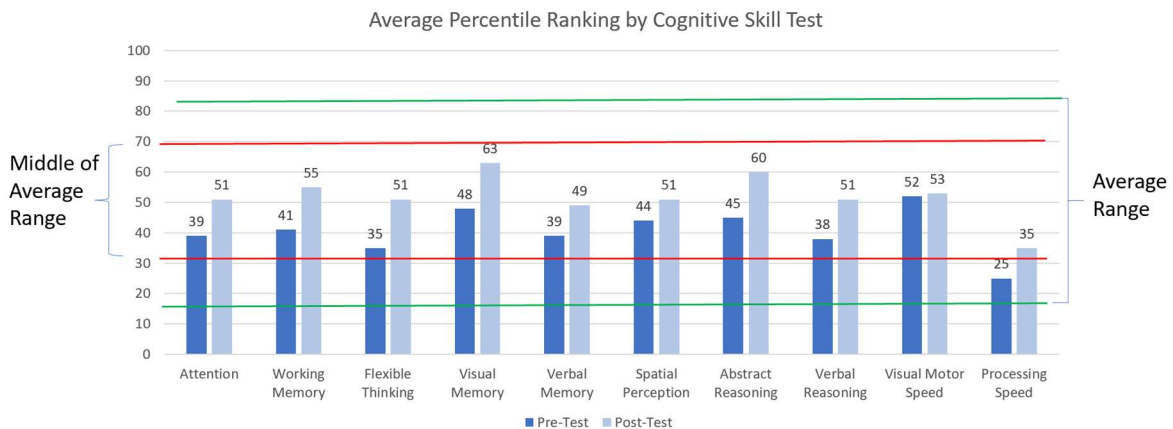


Figure 3. Average pre- and post-test cognitive skill rankings for 60 students

Impact on Weaker Cognitive Skills

Because these students began with uneven cognitive profiles, it is particularly important to examine what happened to the skills that were weaker prior to their training. Because many of these students already demonstrated relative strengths in some areas, the most meaningful changes would be expected in initially weaker skills. We also note that students' parents were generally seeking remediation of their children's weakest skills to reduce the impact of those weaker areas on schoolwork and everyday functioning.

Students who perform in the bottom 30% of the population in a skill often require more individualized support than is typically feasible in a general classroom setting, so we analyzed scores for the students in each skill area who scored below the 30th percentile.

The results showed substantial gains in the skills that were initially below the average range:

- Scores that were in the bottom third of the distribution moved into the average range across all ten cognitive skills
- In 8 of the 10 skill areas, average scores moved into the *middle of the average range*

These improvements, displayed in Figure 4, represent meaningful changes in students' ability to process, retain, and use information.

Impact on Scores Below Middle of Average Range (0-31st Percentile)

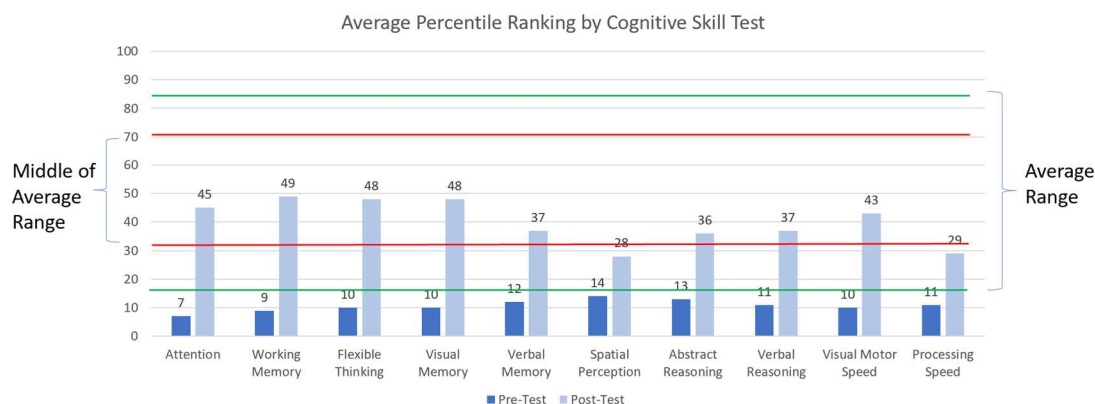


Figure 4. Average percentile ranking pre- and post-test scores, impact on scores below middle of expected range

Changes in Cognitive Profiles

Cognitive training not only improved individual skills—it changed the overall structure of students' cognitive profiles, as shown in Figure 5.

On average:

- The number of cognitive strengths doubled
- The number of significant weaknesses was cut in half

As a result, students became more balanced learners, with fewer bottlenecks interfering with learning and more areas of strength to support performance.

These changes reflect a shift from uneven and inefficient cognitive functioning to more integrated and effective learning capacity. It is also the case that having fewer cognitive skills in the weakness range means that support can be far more targeted.

Average Number of Scores in Each Range

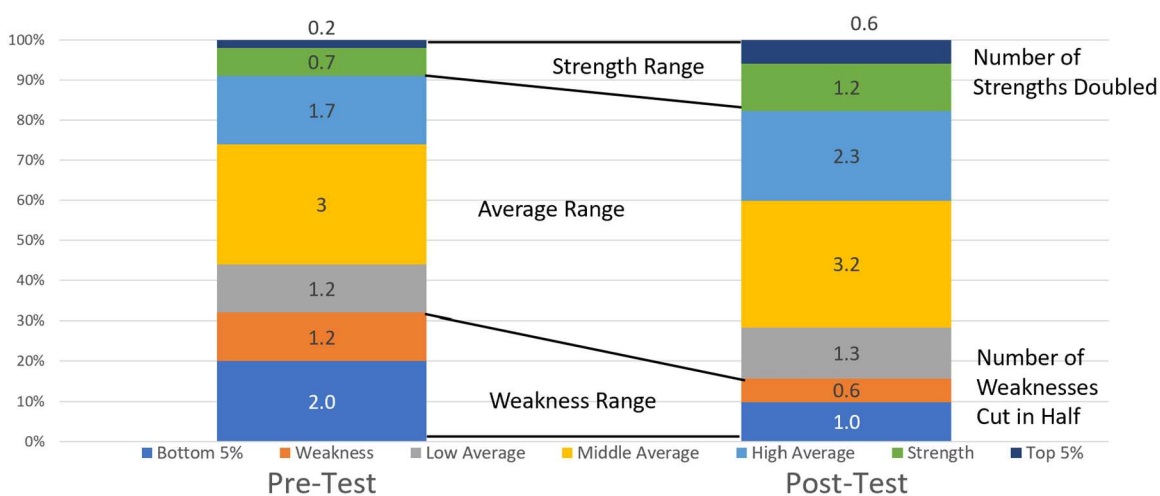


Figure 5. Increase in Strength and Decrease in Weak Skills for 60 students

Implications

These findings highlight an important distinction in how we understand students who struggle with learning.

When students have uneven cognitive profiles, averages can be misleading. A student may have cognitive skills in the average range overall, yet still experience significant difficulty in learning due to specific areas of weakness that constrain performance. These weaker skills can limit the student's ability to fully utilize their strengths, leading to underperformance that is often misunderstood.

In this study, students experienced meaningful gains in those weaker areas. Skills that initially fell below the average range improved to levels that are typical of their peers, with most moving into the middle of the middle range. This represents a critical shift—from areas of constraint to areas of functional capacity.

These findings support a capacity-centered view of learning:

- Academic struggles are often the result of constrained cognitive capacity, not lack of ability
- Cognitive strengths alone are not sufficient for success if key supporting skills are underdeveloped
- Improving weaker skills can enable students to demonstrate their true capabilities

These findings suggest that understanding the pattern of strengths and constraints within a student's cognitive profile may be more informative than relying on overall averages alone. When critical bottleneck skills improve, students may be better able to access and demonstrate abilities that were previously masked by cognitive inefficiencies.