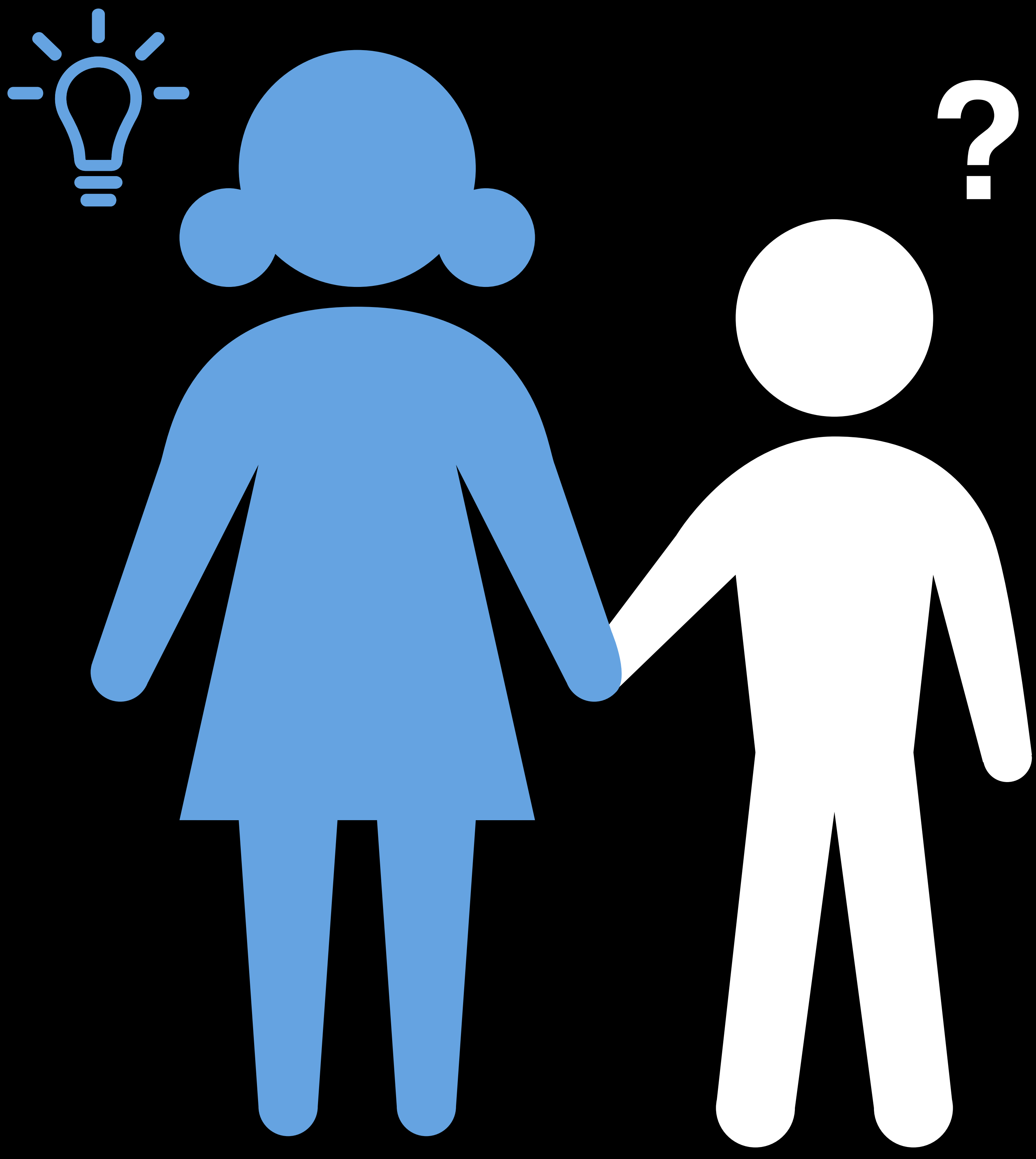
Automaticity:

Differences in Children



NeuroNet
LEARNING

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This E-Book is for:

- School Administrators
- Therapists and Psychologists
- Teachers
- Parents

Interests:

- Early Childhood Education
- Handwriting, Reading Decoding, Math
- Special Education
- Learning Opportunities and Motivation

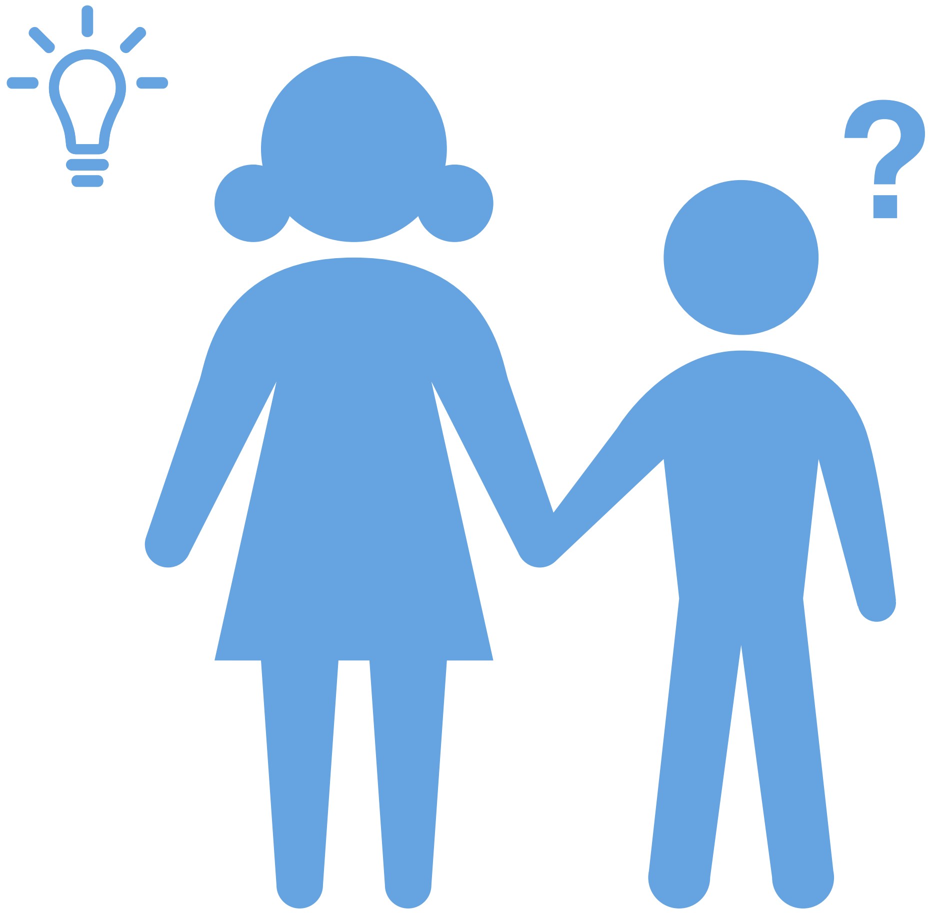
1

Introduction: Differences in Learning

How can we explain learning differences in children?

How is it that children who seem very similar in daily living can be very different in academic achievement? Some kids get it, and some kids don't. But why?

What's the difference between the independent learner and the struggling learner?



Often, the difference between the struggling learner and the independent learner isn't just the skill, it's also the speed or fluency with which the skill can be performed. Research tells us that automaticity is the *ability to perform skilled tasks without specific cognitive attention* to these tasks.[1] An example of automaticity is driving. As we learn to drive, we struggle to stay in the center of the road and be aware of the other cars, traffic signs, people, and bicycles. We struggle with just how far to turn the steering wheel, and with how hard to step on the gas and the brake.

Our dominant emotion is fear.

even though we are very focused on driving safely, our passengers are jolted as we shift our attention from the road to the gas to the brake to the steering wheel.

With some practice, however, we see a dramatic change.

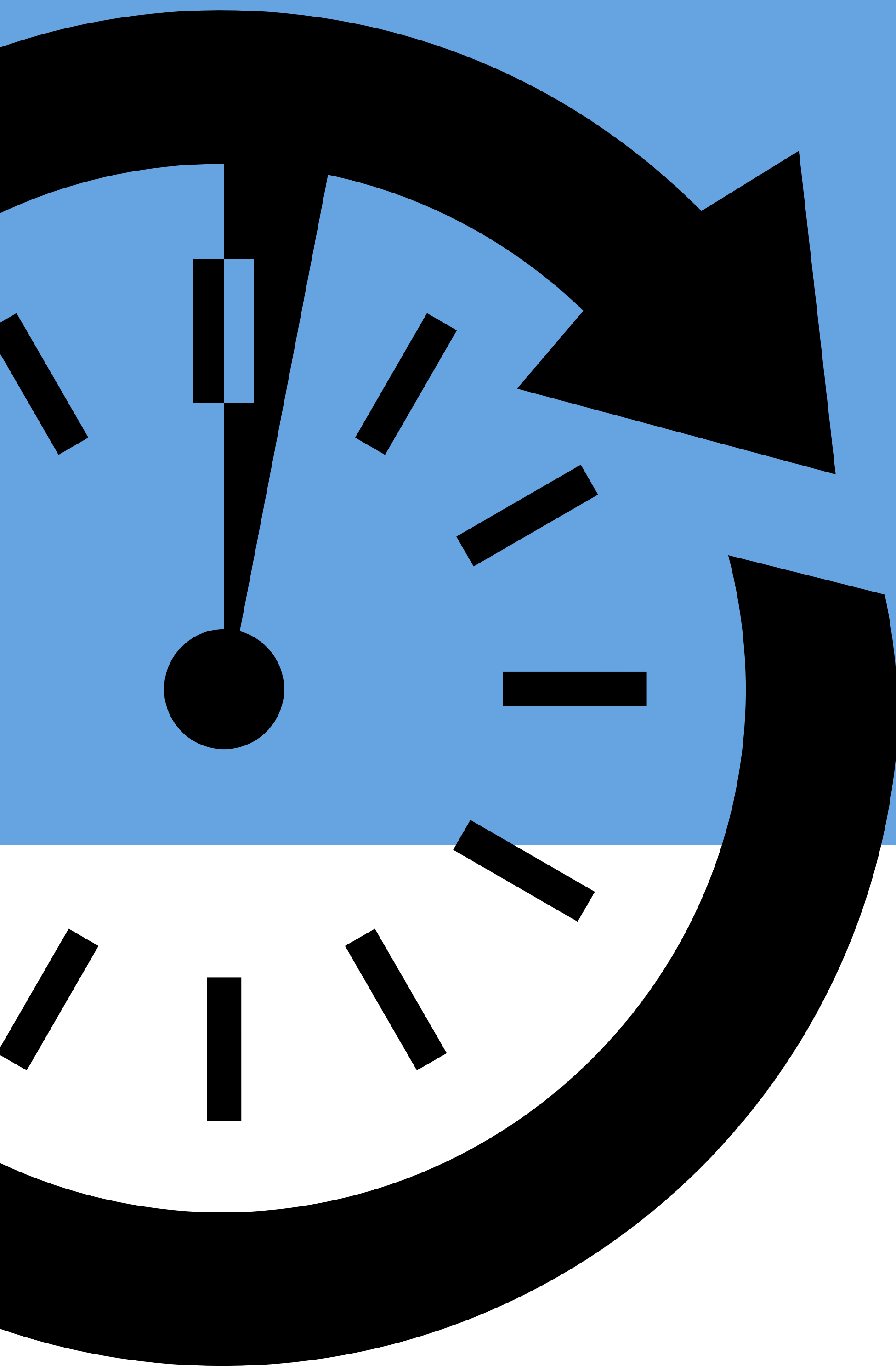
We automate the ability to manage the steering wheel, the gas and the brake, quickly and accurately. Our brains create the speed-and-accuracy network we need for safe driving.

Read

Write

Count

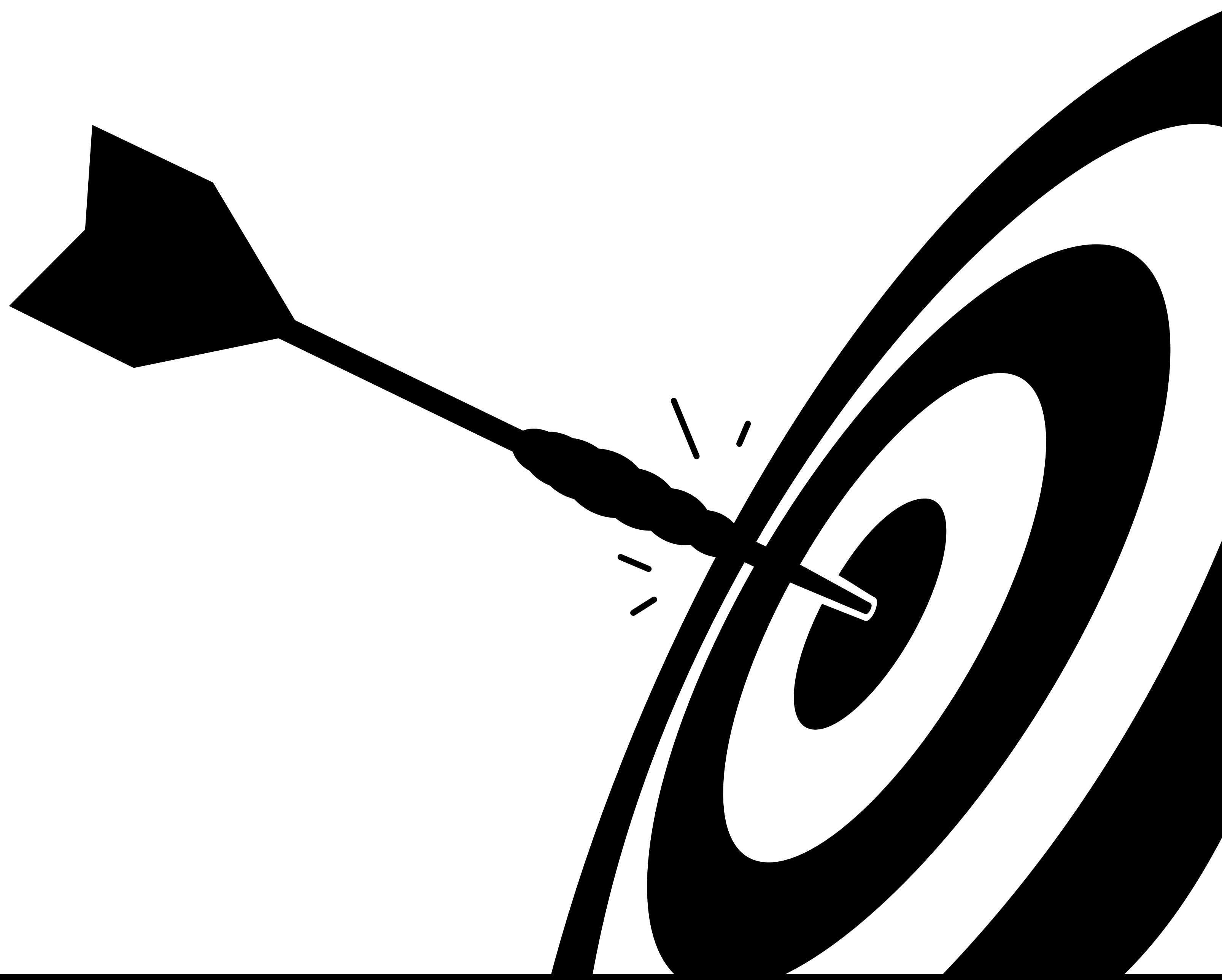
Automaticity is not only relevant to learning to drive, it's also relevant to learning to read, write and count. When basic skills are automated, this allows our mental energy to be focused on problem-solving instead of the details of perception and movement.[2]



Automaticity is essential to turn basic skills into tools for future learning.

- A child who needs extra time to see number sets will have trouble automating math-fact retrieval.[3]
- A child who needs extra time to hear differences between letter sounds will have a hard time automating reading decoding.[4]
- And a child who has difficulty with balance and movement will have difficulty automating handwriting.[5]

Academic skills that can be automated include reading decoding, handwriting, and math-fact retrieval. Once these skills become automated, they no longer require a lot of mental energy to be performed. In other words, automaticity is a process of brain development which enables students to *quickly* and *accurately* use already learned skills. [6]



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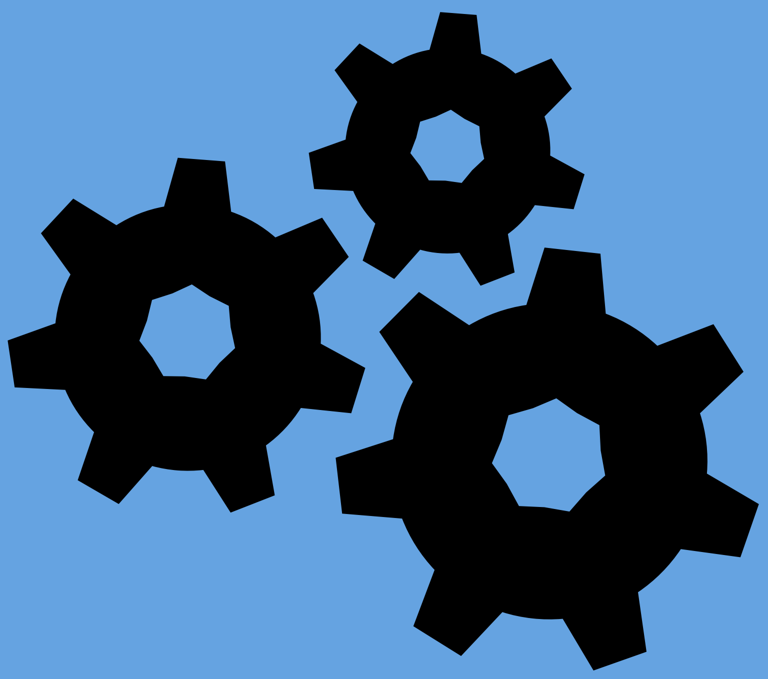
Basic Academic Skills: Reading Decoding, Handwriting, Math-Fact Retrieval

How do we prepare students to be independent learners in school?

- Automaticity
- Learning opportunities
- Children's ability to predict success in learning



Basic perceptual-motor skills can be automated with adequate fine-motor practice (e.g., handwriting, drawing) and gross-motor practice (e.g., jumping, running, balancing and stepping). Repetitive movement and practice with these perceptual-motor skills help children develop automaticity, which is essential to becoming an independent learner.[7]

Examples of perceptual-motor skills that can be automated:

BIKE RIDING

MATH-FACT RETRIEVAL

RUNNING

TALKING

BRUSHING TEETH

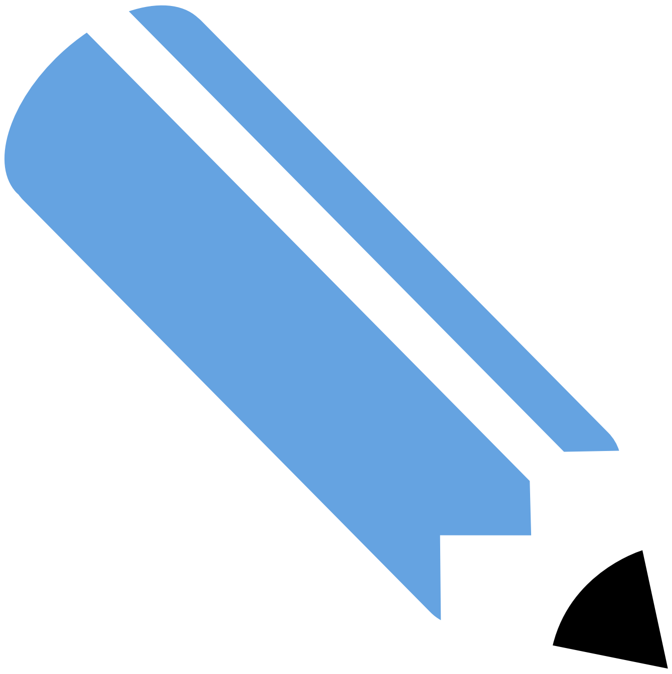
BATHING

TYING SHOES

SWIMMING

READING

HANDWRITING



Handwriting

Independent learners are able to write letters and numbers with speed and accuracy.

Handwriting is not only a perceptual-motor skill, but also a tool for learning and remembering letter names and sounds. If handwriting isn't automated, the child will struggle with recalling number-names, letter names, and grammatical rules. [8]

Reading Decoding

Independent learners have well-developed reading decoding skills. Children are able to translate a printed word into a sound. Reading decoding includes the knowledge of letter sounds and patterns, as well as being able to correctly turn written words into spoken words. Children who are unable to successfully decode words and sounds will struggle with reading fluency and reading comprehension.[9]

Math-Fact Retrieval

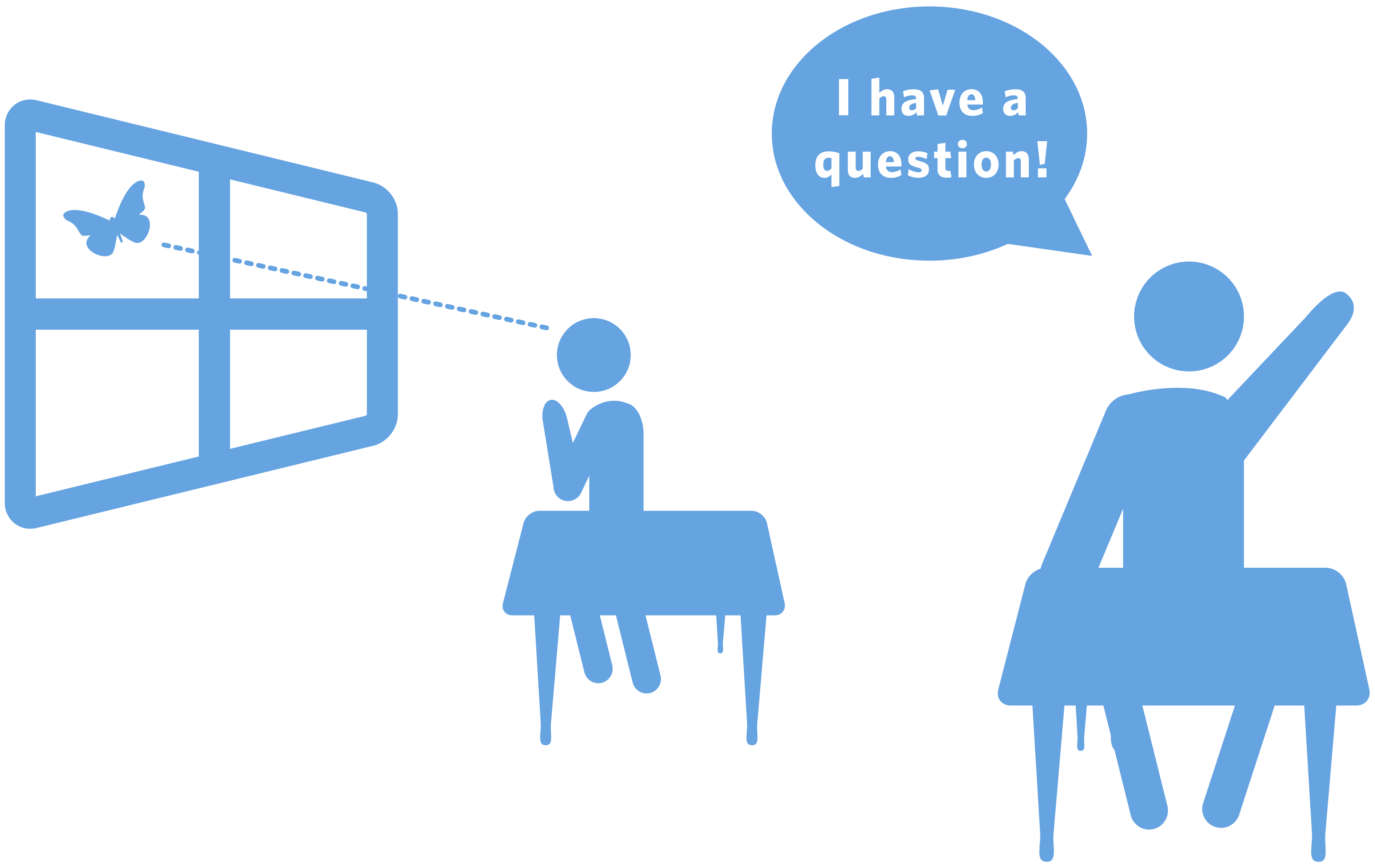
Independent learners are able to recall the basic facts in mathematical operations with speed and accuracy. Children who automate math facts are able to devote their working memory to solve more advanced math problems, such as word problems. [10]

Many educational programs teach skills and hope for automaticity.

Children who fail to automate reading decoding, math-fact retrieval, and handwriting will be struggling learners until they graduate or drop out of school. The only way to change the trajectory for these children is to help them develop automaticity. Practicing automaticity is the only way to improve automaticity.

If academic skills are not automated, children will be self-distracted during learning.

It's important to understand that basic reading, handwriting, and math skills have underlying components that must be automatic in order for children to use these skills as tools for higher-order learning.



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Characteristics of the Struggling Learner and the Independent Learner

A struggling learner is a child who experiences limited success in quickly mastering new skills.

The struggling learner will be distracted by the significant effort he must make to stay focused on learning while trying to read and decode words, and write letters or numbers.[11]

As a result of struggling without success, the struggling learner lacks the vision of success. This creates a lack of sustained, self-directed attention and effort. The struggling learner doesn't predict that his hard work will be rewarded and loses motivation.

Struggling Learners Lack Automaticity

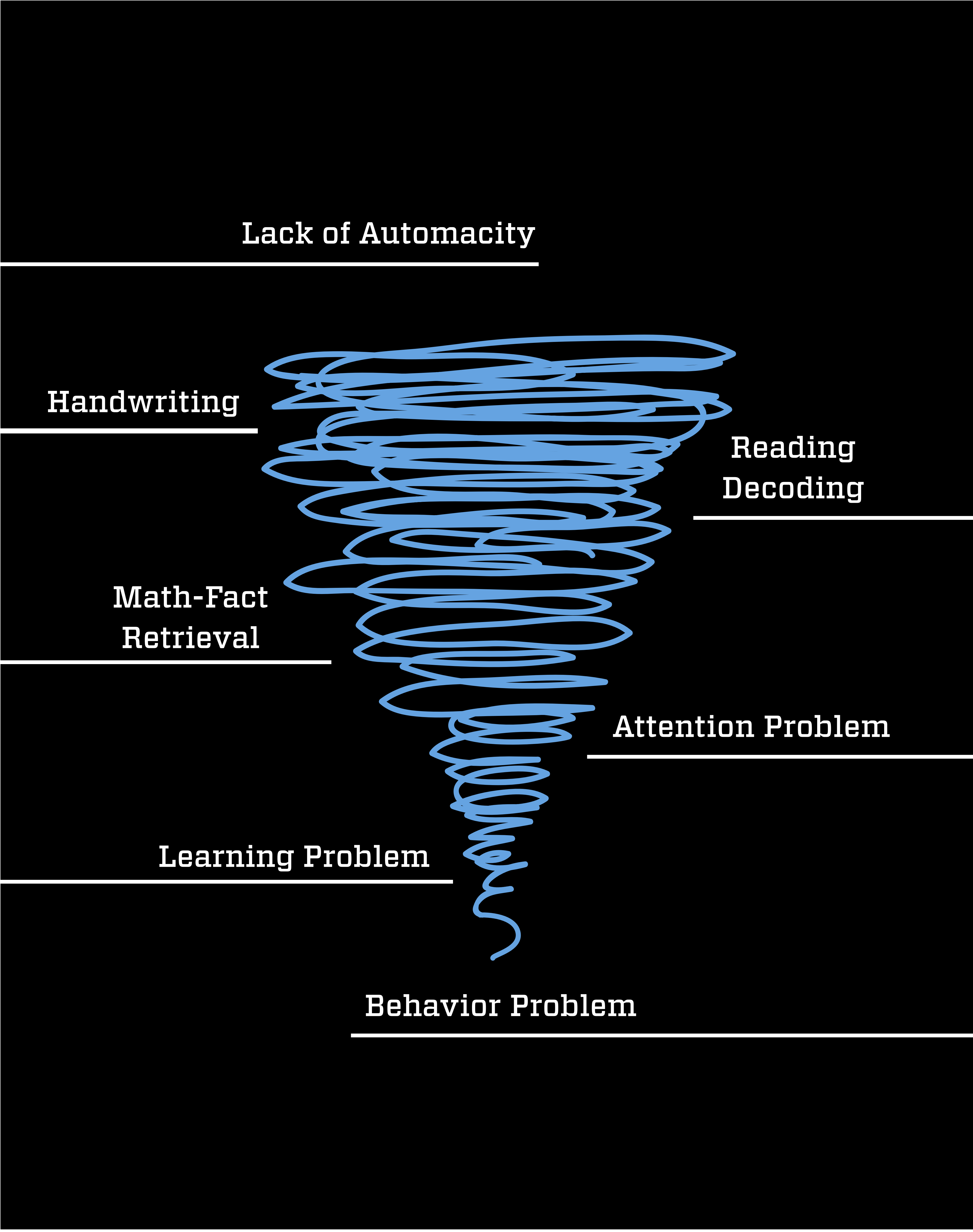
If basic academic skills of handwriting, reading decoding, and math-fact retrieval are difficult or not automated they will create cognitive conflicts in learning; e.g., more work to think of multiple things at once. [12]

The struggling learner becomes distracted

by having to stop and think about how to decode words or form a written letter which derails his train of thought. The cognitive conflicts resulting from a lack of automaticity often cause the struggling learner to become fatigued because he has to think consciously about basic skills, such as how to form letters or to decode words. [13]

Stopping to think is disruptive to the learning process.[14] It's hard to read and comprehend when decoding is happening at the conscious level. It's hard to write a sentence or a story when forming letters is happening at the conscious level. Thus, a lack of automaticity in these areas makes learning slower and more effortful.

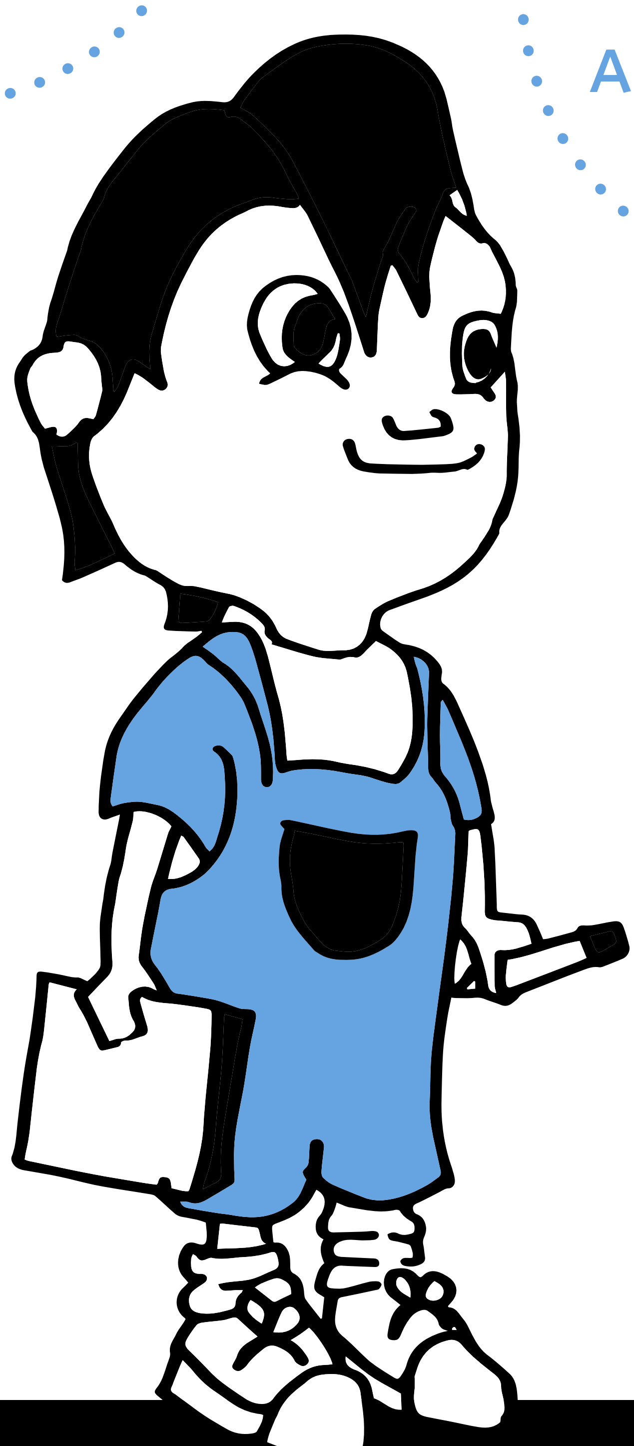
When struggling learners lack automaticity, a negative downward spiral can occur. A learning problem may become an attention problem and the attention problem may become a behavior problem.


Lack of Automacity
Handwriting
Reading Decoding
Math-Fact Retrieval
Attention Problem
Learning Problem
Behavior Problem

PREDICTING SUCCESS AND MOTIVATION

PERCEPTUAL-MOTOR AUTOMATICITY

LEARNING OPPORTUNITIES TO AUTOMATE BASIC ACADEMIC SKILLS



The Independent Learner

Only an independent learner becomes an independent adult.

An independent learner is able to master basic academic skills and predict success in learning. He is able to use learned skills in handwriting, reading decoding, and math-fact retrieval as tools for higher-order thinking. The independent learner brings sustained and self-directed attention to problem-solving because he predicts that his efforts will be successful.

A child's ability to predict and obtain success affects self-confidence.[15]

An independent learner who has confidence in their handwriting and problem-solving is willing to participate in activities that require higher-order thinking, such as reading comprehension or math story problems.

Independent learners have the universal ticket to success.

- Independent learners know how to look for solutions to the unfamiliar problems they encounter in an unpredictable and novel world.
- They not only have a current base of knowledge and skills, they also know how to seek out new information and develop new skills.

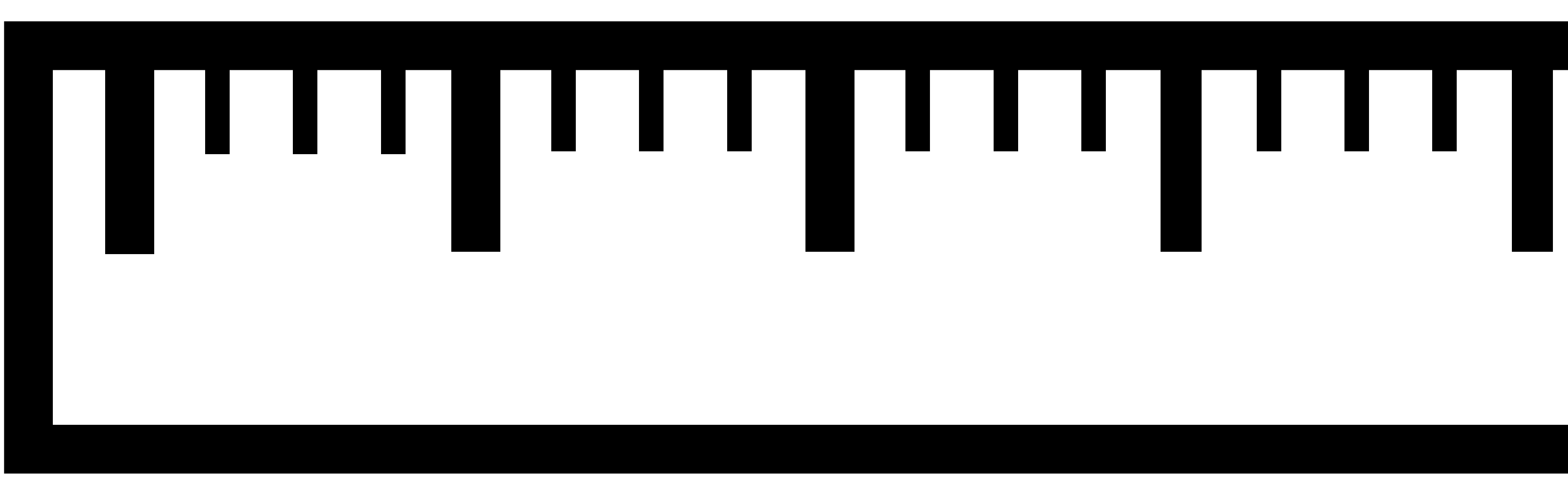
4

Summary

Once skills are automated, they are present in the brain and are now retrieved from memory rather than requiring the child to rethink or relearn the skill.[18]

Remember that *automaticity is the ability to perform skilled tasks without cognitive attention.*[19] It's hearing phoneme differences, or seeing number sets, or being able to write letters and numbers, without stopping to think.

Automaticity frees our brain to engage in bike riding, or any other kind of learning without being self-distracted by the details of perception and movement.
The good news is we can teach it, we can learn it, and we can measure it.



Skills must be practiced at one to two second intervals:

it is not sufficient to practice skills at one minute intervals or at five minute intervals.

How do we practice automaticity?

- We measure automaticity by measuring how quickly and accurately we can do skilled tasks.

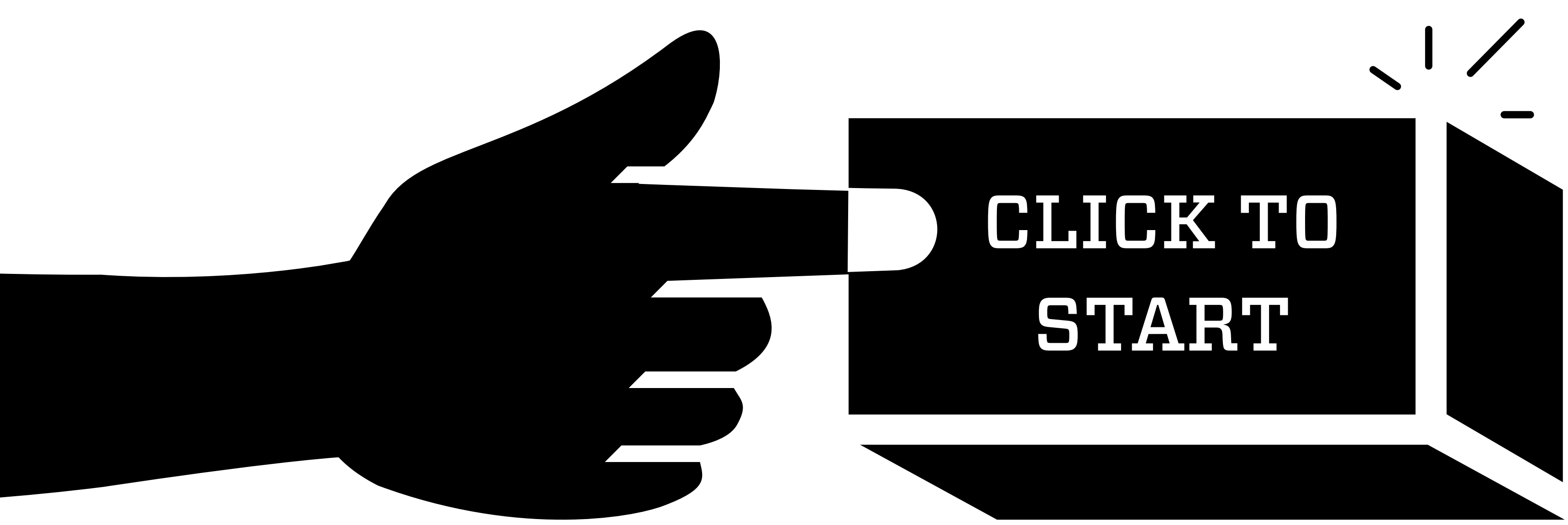
- By measuring basic skills (reading decoding, math-fact retrieval and handwriting) at the speed of 1 or 2 seconds per answer, we can determine which skills are automated.

- By practicing these skills at this speed, we can automate the basic skills which we need to use as tools for independent learning.

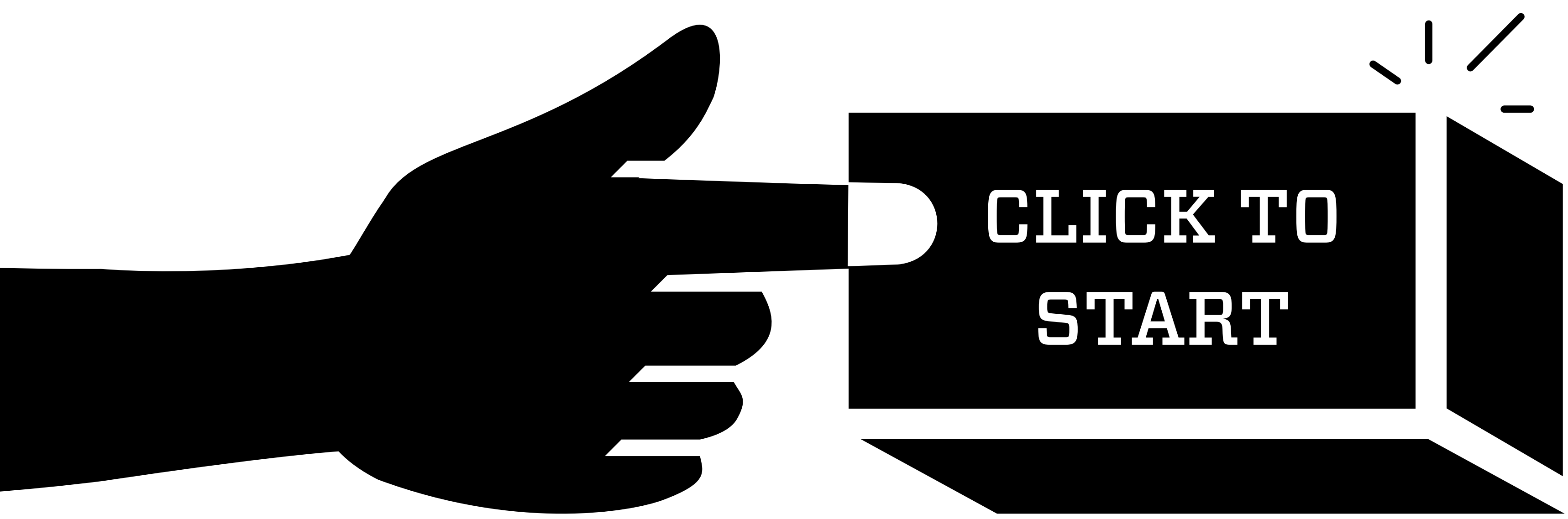
The goal of NeuroNet is to help students become independent learners. NeuroNet enables children to learn how to automate basic academic skills, which are tools for higher learning. Children who complete NeuroNet programs demonstrate improvements in reading decoding, language skills, and handwriting.

Sign-up for a free program trial:

- Classroom Enrichment Program Trial
- Therapy Program Trial



If you'd like to measure automaticity for your student, your child, or your class, please sign up for our free trial.



“Get your brain to practice what you want your brain to learn.”

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References

1. Poldrack, Russell A., Fred W. Sabb, Karin Foerde, Sabrina M. Tom, Robert F. Asarnow, Susan Y. Bookheimer, and Barbara J. Knowlton. 2005. "The Neural Correlates of Motor Skill Automaticity." *The Journal of Neuroscience* 25(22):5356-5364.

2. Dudukovic, Nicole M. Sarah DuBrow, and Anthony D. Wagner.2009. "Attention During Memory Retrieval Enhances Future Remembering." *Memory & Cognition* 37(7):953-961.

3. Rivera, S. M., A. L. Reiss, M. A. Eckert, and V. Menon. 2005. "Developmental Changes in Mental Arithmetic: Evidence for Increased Functional Specialization in the Left Inferior Parietal Cortex." *Cerebral Cortex* 15(11):1779–90.

4. Klauda, Susan Lutz, and John T. Guthrie. 2008. "Relationships of Three Components of Reading Fluency to Reading Comprehension." *Journal of Educational Psychology* 100(2): 310–321.

5. Bara, Florence, and Edouard Gentaz. 2011. "Haptics in Teaching Handwriting: The Role of Perceptual and Visuo-motor Skills." *Human Movement Science* 30(4): 745–759.

6. See Poldrack et al. 2005

7. Westendorp, Marieke, Esther Hartman, Suzanne Houwen, Joanne Smith, and Chris Visscher. 2011. “The relationship between gross motor skills and academic achievement in children with learning disabilities.” *Research in Developmental Disabilities* 32(6):2773–79.

8. Olive, Thierry, Monik Favart, Caroline Beauvais, and Lucie Beauvais. 2009. “Children’s cognitive effort and fluency in writing: Effects of genre and of handwriting automatisation.” *Learning and Instruction* 19:299–308.

9. See Westendorp et al. 2011.

10. See Rivera t et al. 2005.

11. Meyniel, Florent, Claire Sergent, Lionel Rigoux, Jean Daunizeau, and Mathias Pessiglione. 2013. “Neurocomputational account of how the human brain decides when to have a break.” *Proceedings of the National Academy of Sciences* 110(7):2641–46.

12. Salvucci, D. D. & Taatgen, N.A. (2011). *The Multitasking Mind.* New York, NY: Oxford University Press, Inc.

13-14. Lally, Phillippa, Cornelia H. M. van Jaarsveld, Henry W. W. Potts, and Jane Wardle. 2010. “How are habits formed: Modelling habit formation in the real world.” *European Journal of Social Psychology* 40:998–1009.

15. Jansen, Brenda R.J. et al. 2013. “The influence of experiencing

success in math on math anxiety, perceived math competence, and math performance." *Learning and Individual Differences* 24:190–197

16. Houweling, S., A. Daffertshofer, B.W. van Dijk, and P.J. Beek. 2008. "Neural changes induced by learning a challenging perceptual-motor task." *NeuroImage* 41(4):1395–1407.

17. See Lally et al. 2010.

18. See Dudukovic et al. 2009.

19. See Poldrack et al. 2005.

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