

# A Brain-Based Intervention Program That Changes Cognition: Implications for Academic Achievement

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## Abstract

As a cognitive-based intervention program, the Arrowsmith Program (AP) is designed to strengthen deficit cognitive functions underlying specific learning disabilities (SLD) rather than providing achievement intervention or compensatory strategies. Pre- and post-intervention cognitive data was collected on 15 students enrolled in the AP program. NPStat non-parametric randomization tests revealed single-subject improvements across all cognitive domains except verbal ability (Gc) and long-term retrieval (Glr). Paired samples t-tests revealed improvements in short-term memory (Gsm), auditory processing (Ga), fluid reasoning (Gf), and processing speed (Gs)

## Background

- Neuroimaging literature (Aylward, 2003, Finn et al., 2013) suggests systematic intervention targeting weak academic areas changes brain function and normalizes atypical learning patterns in children with SLD
- Designed to remediate specific cognitive processing deficits underlying SLD in children, the AP is built upon a neuroscience foundation and evidence of neuroplasticity
- It is unclear if strengthening neuropsychological functions underlying academic achievement could improve reading, writing, and mathematics by targeting the primary cause (i.e., cognitive deficit) rather than the symptoms (i.e., achievement deficit)

## Research Questions

- Do children with base-line cognitive deficits show improvements in underlying cognitive skills following an AP intervention program?
- Does participation in the AP result in improved cognitive performance at the single subject and group level?

## Participants and Methods

- Woodcock-Johnson III Cognitive data was collected on 15 students (11 males; 4 females; *M* age = 9.3 years; *SD* = 1.36) pre and post entry into the AP Program (*M* duration = 28 months; *SD* = 8.36 months)
- NPStat non-parametric randomization tests, which approximate multivariate analyses in the absence of normal data, were used to judge changes in cognitive function for each participant
- Paired sample *t*-tests (alpha level set at .001 to guard against Type I error) were used to compare pre-post group means

## Results

- Inspection of individual response curves and NPStat nonparametric randomization test results revealed significant single-subject treatment response across WJIII Cognitive variables (*F* range 8.92 to 114.05; *p* < .001)
- Paired samples *t*-tests revealed improvements in Ga, Gf, Gs, Gsm (*t* range 4.40 to 12.92; *p* < .001)
- No significant differences between pre and post results for Verbal Ability (Gc), Visual-Spatial Thinking (Gv), Long-Term Memory (Glr)

Table 1. Pre- and Post Mean Analysis for WJ III Cognitive Variables

CHC Factors	Subtests	Mean	<i>t</i>	<i>p</i>
Auditory Process	Sound Blending	Pre 102.00	2.01	<.001
		Post 115.87		
Fluid Reasoning	Concept Formation	Pre 103.73	5.61	<.001
		Post 114.27		
Processing Speed	Visual Matching	Pre 69.47	12.92	<.001
		Post 89.00		
	Decision Speed	Pre 79.87	5.85	<.001
		Post 95.47		
Short-Term Memory	Numbers Reversed	Pre 87.33	5.14	<.001
		Post 96.87		
Phonemic Awareness	Memory for Words	Pre 94.20	7.27	<.001
		Post 111.67		
		Pre 84.73		
Post 102.80				
Working Memory	Auditory WM	Pre 96.20	4.40	<.001
		Post 101.80		

## Discussion

- Children with baseline cognitive difficulties showed significant improvement across cognitive domains in short-term memory, auditory processing, fluid reasoning, and processing speed
- Given that these cognitive domains are associated with processing weaknesses that underlie most SLDs, improvement should ameliorate achievement deficits in children with SLD
- Results suggests that targeted and individualized interventions designed to remediate cognitive deficits may lead to improved academic performance across a broad range of domains
- Brain plasticity allows for restructuring of cognitive processes, thereby enabling improved cognition and academic performance

## Future Direction

- Brain-based intervention programs that target underlying cognitive weaknesses associated with academic achievement could lead to better learning in children with and without SLD
- Research studies on AP outcomes show preliminary positive findings, but carefully controlled studies are needed to support program treatment efficacy
- Future research with larger sample sizes and different SLD subtypes is needed
- Research is necessary to determine how strengthening cognitive deficits impacts academic achievement across reading, writing, mathematics, and language domains, and/or has the potential to ameliorate SLD.

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