

## Targeting Brain Plasticity in Autism using a Reading Intervention

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**ARI Webinar; September 27, 2023**

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## Conflict of Interest

Some of the data I am presenting today are partly funded by the Lindamood-Bell Learning Processes. In addition, the reading intervention used in our studies (Visualizing and Verbalizing) was provided by the Lindamood-Bell Learning Processes through their various centers across the country. However, no representatives of the company were involved in data analysis or development of this presentation, nor did the company exert any control or restrictions regarding research activities.

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## Overview

1. Descriptions of Language and Communication in Autism
2. Brain, Language, & Reading Comprehension in Autism
3. Neuroplasticity
4. Using Reading Intervention to change the Brain




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# Descriptions of Language & Communication in Autism

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**PATHOLOGY**



**Leo Kanner's Participant 1: Donald Triplett**

To understand and prevent emotional problems is very difficult. Psychologists and educators have been struggling with their problems for years but we are still unable to measure emotional and personality traits with the accuracy with which we can measure intelligence.

"DONALD TRIPLETT IS OLDFATHER FOR CHILD LIFE"

**AUTISTIC DISTURBANCES OF AFFECTIVE CONTACT**

BY LEO KANNER

Often, he would utter random words or phrases. Words had a "literal, inflexible meaning" to Donald, and he was unable to recognize and apply the denotation of a word to another context; each word had a definite, designated definition and association in his mind. For the most part, conversations with Donald consisted of a barrage of questions.

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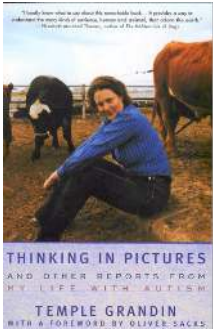
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"During the last couple of years, I have become more aware of a kind of electricity that goes on between people. I have observed that when several people are together and having a good time, their speech and laughter follow a rhythm. I have always had a hard time fitting in with this rhythm, and I usually interrupt conversations without realizing my mistake. **The problem is that I can't follow the rhythm**"



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### Descriptions of Language in Autism

1. **Absence of verbal abilities** (e.g., the failure to acquire spoken language during the lifespan), which is the outcome for between 50–75% of autistic individuals (Rapin, 1991)
2. **Early language delays**, with words first produced at an average age of 38 months (Howlin, 2003), rather than the typical time of 12–18 months.
3. **Atypical features** of language production, including echolalia and jargon (Tager-Flusberg & Calkins, 1990)
4. **High-level discourse and pragmatic abilities** (Bartak, Rutter, & Cox, 1975; Bartolucci, 1982; Lord & Paul, 1997).

Rapin & Dunn (2003); Brain Development

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Neuropsychiatric Disease and Treatment Dovepress REVIEW  
Open access to scientific and medical research

### Language and Speech Characteristics in Autism

Ioannis Vogindroukas<sup>1</sup>, Margarita Stankova<sup>1</sup>, Evripidis-Nikolaos Chelas<sup>2</sup>, Alexandros Proedrou<sup>1</sup>

1. **ASD with pragmatic language impairments without any other language difficulties (functional language difficulty)**
2. **ASD in comorbidity with DLD and other developmental disorders (a disorder in language and speech development)**
3. **ASD in comorbidity with intellectual disability with a global lag in language and general intelligence**
4. **ASD with severe difficulties in the development of social communication and social interaction and secondary language difficulties because of non-use of language as a communicative tool**

Vogindroukas et al. (2022); Neuropsychiatric Disease & Treatment

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### Joint Attention & Language Development



CORRELATION MATRIX FOR JOINT ENGAGEMENT AND WORD COMPREHENSION AT EACH TIME POINT

JOINT ENGAGEMENT	WORD COMPREHENSION						
	9	10	11	12	13	14	15
9 months	-.20	.05	.24	.27	.25	.21	.18
10 months	-.21	.09	.31	.39	.36	.34	.27
11 months	.14	.41*	.46*	.43*	.44*	.43*	.39
12 months	.53**	.46*	.31	.31	.43*	.52**	.58**
13 months	.17	.40*	.47*	.48*	.47*	.39	.27
14 months	.04	.15	.15	.13	.13	.16	.16
15 months	.10	.34	.26	.23	.24	.23	.26

\* p < .05, two tailed. \*\* p < .01, two tailed. Carpenter, Nagell, & Tomasello (1998)

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### The Homograph Task

- Homographs:** words with the same spelling but different meanings in different contexts.
- The girls were climbing over the hedge. Mary's dress remained spotless, but in Lucy's dress there was a big tear.

There was a big **tear** in her dress  
There was a big **tear** in her eye

Homograph Task Results  
comparing normal and autistic groups

Happe (1997)

Brock & Caruana (2015)

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### What components of Reading Comprehension fail in Autism

- Difficulty in reading comprehension may be associated with the cognitive profile of the reader. The difficulty can emerge from:
  - Difficulty in perspective-taking (Baron-Cohen et al., 2001)
  - Difficulty in Inference construction (Saldana & Frith, 2007)
  - Difficulty in mentalizing (theory-of-mind)
  - Difficulty in linguistic information processing (Gold et al., 2010)
  - Difficulty in pragmatic aspects of language (Joliffe & Baron-Cohen, 2000; Duvall et al., 2023)

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### Decoding vs. Comprehension in Autism

Brown et al. (2013); Journal of Autism & Developmental Disorders

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“Reading skill is acquired quickly, but the children read monotonously and a story or moving picture is experienced in unrelated portions rather than its coherent totality.”  
 (Kanner, 1943, p. 250)



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Brain, Language, & Reading Comprehension  
 in Autism Spectrum Disorder  
 (evidence from brain imaging)

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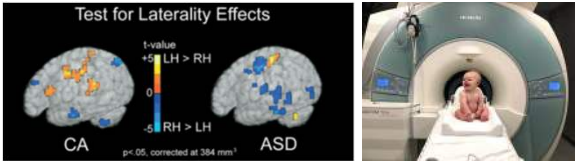

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**Deviant Functional Magnetic Resonance Imaging Patterns of Brain Activity to Speech in 2-3-Year-Old Children with Autism Spectrum Disorder**  
 Elizabeth Redcay and Eric Courchesne

Test for Laterality Effects

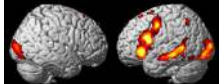



Sam ran from the **bank** when the angry robber hurried out with the money



Autism

Sam ran from the **bank** when the huge alligator jumped out with a fish



Control

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RESEARCH PAPER SOCIAL NEUROSCIENCE  
<https://doi.org/10.1080/17470919.2023.2282995>

**The neurobiological map of theory of mind and pragmatic communication in autism**  
 Lauren Duvall<sup>1</sup>, Kaitlyn E. May<sup>2</sup>, Abby Waltz<sup>2</sup> and Rajesh K. Kana<sup>1</sup>

Routledge  
Taylor & Francis Group

The figure consists of four brain maps arranged in a 2x2 grid. The top row shows 'PRAGMATICS' (left) and 'TD > ASD' (right). The bottom row shows 'ToM' (left) and 'TD > ASD' (right). Each map shows lateral and medial views of the brain with colored regions indicating activation. A legend indicates ASD is blue and TD is red.

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### Brain & Language in Autism

- **More Wernicke's and less Broca's area activation** (perhaps less integrated sentence level processing).
- **More right hemisphere activation** (suggesting greater difficulty effect).
- **More parietal and occipital activation** (suggests visually oriented language processing: thinking in pictures).

The image shows a lateral view of the brain with Wernicke's area highlighted in red and Broca's area in orange. A label 'More right hemisphere activation' points to the right side of the brain.

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### Targeting Brain Plasticity in Autism

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### Neural deficits in children with dyslexia ameliorated by behavioral remediation: Evidence from functional MRI

Elise Temple<sup>1\*</sup>, Gayle K. Deutsch<sup>2</sup>, Russell A. Poldrack<sup>3</sup>, Steven L. Miller, Paula Tallal<sup>1,2</sup>, Michael M. Merzenich<sup>1,2</sup>, and John D. E. Gabrieli<sup>1\*</sup>

2860-2865 | PNAS | March 4, 2003 | vol. 100 | no. 5

**A Children with no remediation**

Normal reading children while rhyming

Dyslexic reading children while rhyming before remediation

**B Dyslexic children increases after remediation**

Right Left

THE UNCOMMON  
 IS NOT DESCRIBED  
 TO REVEAL WHAT  
 IT WOULD BE LIKE TO  
 READ TO REACH YOU  
 WERE DESCRIBED TO  
 DESCRIBED TO REVEAL  
 THE FEELING OF READING  
 WITH UNUSUAL BY  
 SCALING THE READING  
 THE OF THE READER  
 COME TO A SPEED OF  
 WITH SCIENTIFIC WITH  
 HAS DESCRIBED WOULD  
 READ

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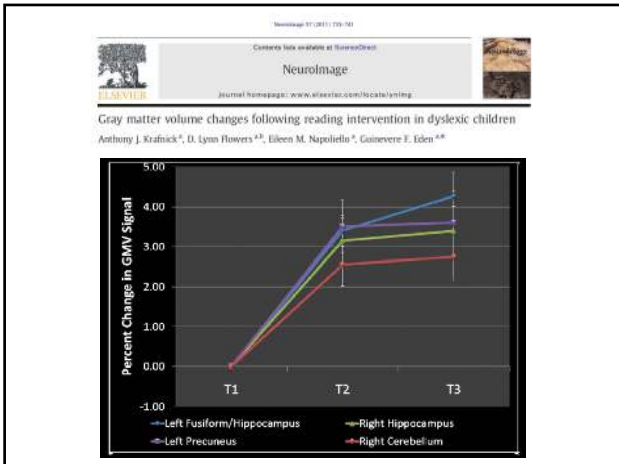
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"I accept the obvious truism that language played a critical role in our giant leap as a species, but language never worked its magic alone and it cannot do so now. Instead, it has always depended on a silent partner that provides it with something to talk about, a general cognitive system that had evolved to a high level before it invited language in as a co-player in the evolutionary scene.

I see language as a benevolent, octopus-like parasite whose tentacles invaded the brain and was empowered by it to survive and thrive to the point where it could contribute something useful to its host. Nonverbal mind and verbal mind thus became interlocked in a synergistic relation that evolved into the nuclear power source of our intellect."

-Allan Paivio (2006)

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## Visualizing & Verbalizing Reading Intervention in Autism Spectrum Disorder

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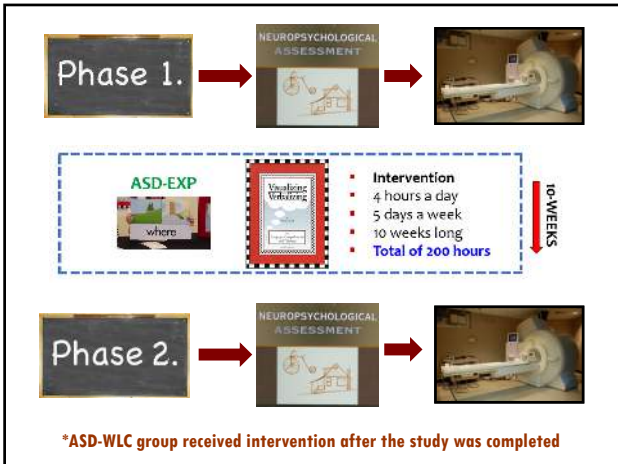
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ASSESSMENT PROTOCOL	
CONSTRUCT	MEASURE
Intellectual Ability	WASI (30 min) <b>VIQ = &gt; 75</b>
Reading Comprehension Screening Measures	Slosson Oral Reading Test - Revised (SORT-R) (10 min) <b>&gt; 37<sup>th</sup> %</b> Gray Oral Reading Test - 4 <sup>th</sup> Edition (GORT-4) (20 min) <b>&lt; 37<sup>th</sup> %</b>
Receptive Language	Peabody Picture Vocabulary Test – 4 <sup>th</sup> Edition (PPVT-4) (15 min)
Expressive Language	Expressive Vocabulary Test – 2 <sup>nd</sup> Edition (EVT-2) (15 min)
Oral Language Comprehension and Word Association Knowledge	Detroit Tests of Learning Aptitude – 4 <sup>th</sup> Edition (DTLA-4) Oral Directions and Word Opposites subtests (20 min)
Phonological Processing	Symbol Imagery Test (10 min) Woodcock Reading Mastery Test – Revised (WRMT-R) – Word Attack subtest (10 min)
Problem Solving Skills	Elementary Test Of Problem Solving – 3 <sup>rd</sup> Edition (TOPS-3) (25 min)
Verbal and Visual Memory	Wide Range Assessment of Memory and Learning – 2 <sup>nd</sup> Edition (WRAML-2) (30 min)
Symptom Severity	Social Responsiveness Scale (SRS) – Parent Rating (10 min) Social Communication Questionnaire (SCQ) – Parent Rating (10 min)
<b>TOTAL ASSESSMENT TIME (child)</b>	<b>3 hours, 8 min (185 min)</b>

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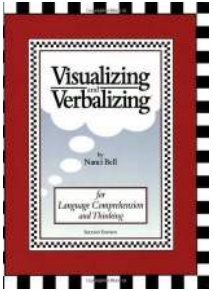
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## READING INTERVENTION

**Visualizing and Verbalizing for Language Comprehension and Thinking (V/V) Intervention Program**



**The sequential steps of the program:**

1. Picture to Picture
2. Word Imaging
3. Sentence Imaging
4. Sentence by Sentence Imaging
5. Sentence by Sentence with Interpretation
6. Multiple Sentence Imaging, Paragraph Imaging, Paragraph by Paragraph Imaging

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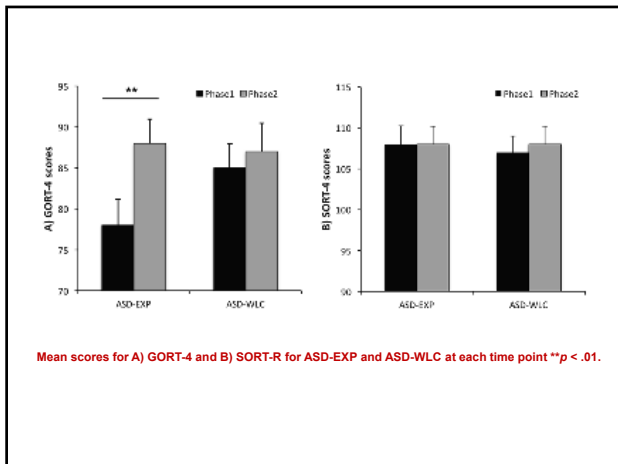
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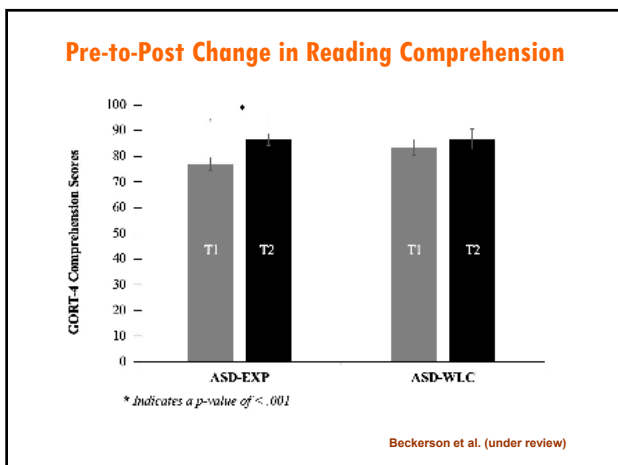
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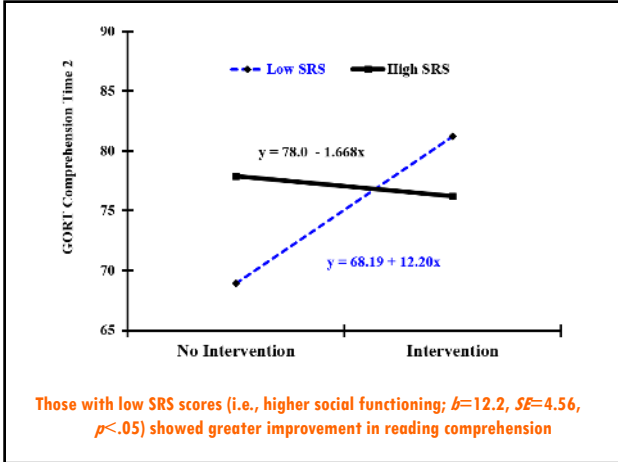
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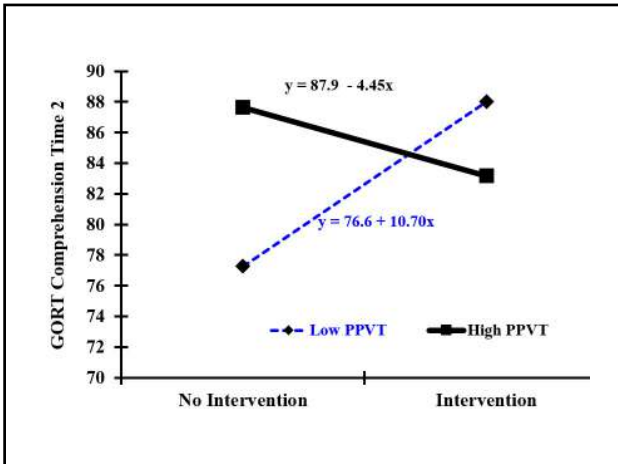
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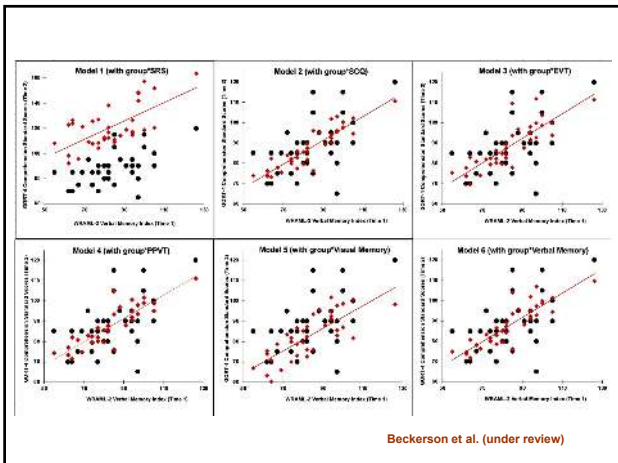
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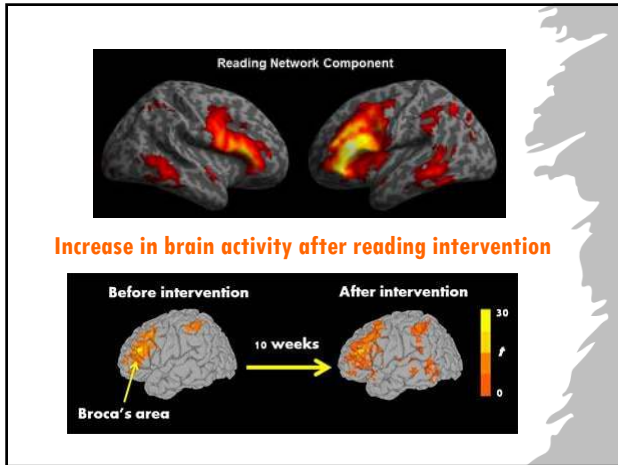
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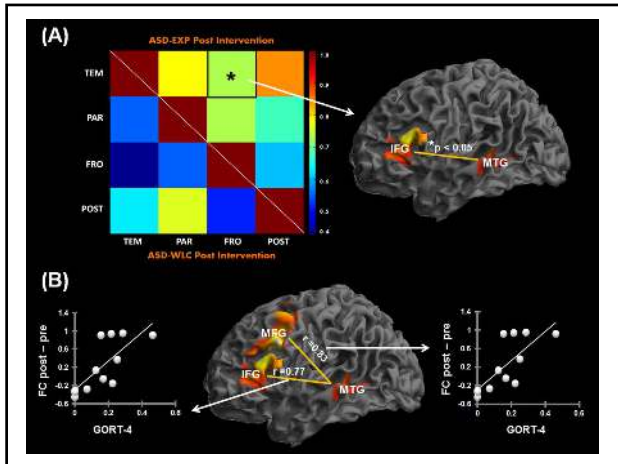
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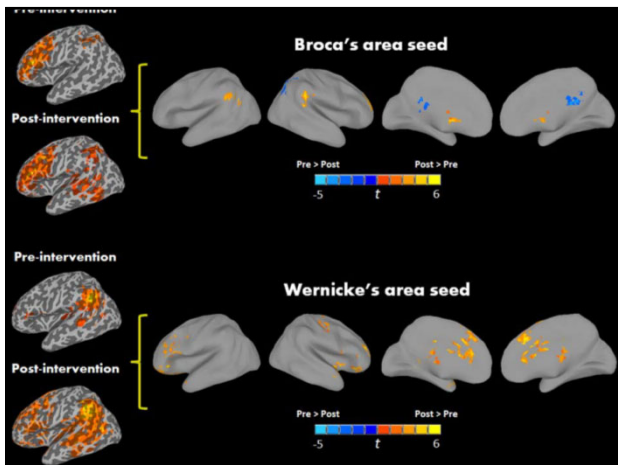
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**BRAINREAD:**  
How Does the Brain Learn to Read?




We are seeking children diagnosed with autism ages 7-13 years to participate in an MRI study at UAB that includes a complimentary 10-week intervention for improving reading comprehension.

**What will you be doing?**  
You will complete a family history interview and survey, and your child will complete cognitive & neuropsychological tests, an fMRI, and a reading comprehension assessment.



**What are the benefits?**  
Your child gets the opportunity to participate in an intensive intervention program at no cost, which may improve their comprehension. You will also help us learn more about how children understand what they read. Your child will be paid up to \$200 for their participation.

**Who can participate?**  
Participants should have strong reading fluency and difficulty in reading comprehension. Must be diagnosed with ASD, native English speaker, and must not have dyslexia, hearing, or claustrophobia.



**Contact Us!**  
Call, text, or email the Cognition, Brain, & Autism Lab  
(205) 202-0616  
tbrals@ua.edu

• **Dr. Rajesh Kana**  
• **Email: [rkkana@ua.edu](mailto:rkkana@ua.edu)**

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University of Alabama College of A&S



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