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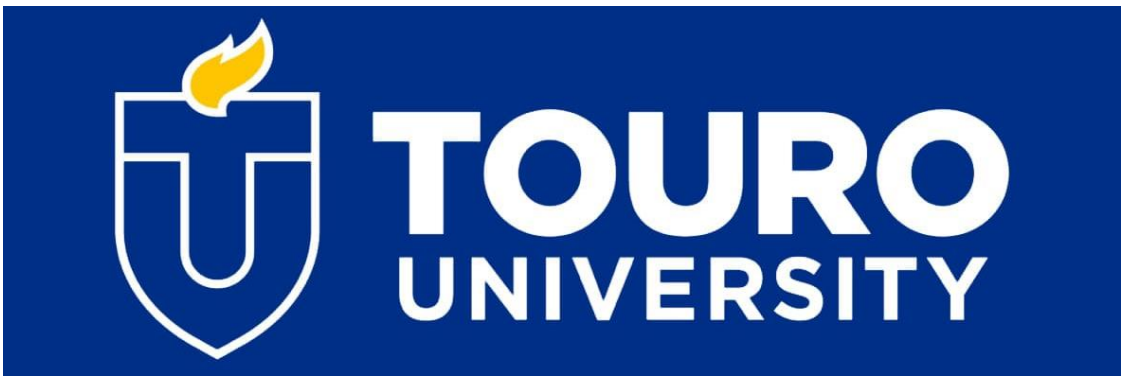
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# Using Inner Speech During Academic Tasks: A Metacognitive Training Study in Neurodivergent Students

## Introduction

A wealth of evidence shows that effective metacognitive skills predict academic performance (e.g., GPA; Ward & Butler, 2019; Young & Fry, 2012) even when factors like intelligence are accounted for (Ohtani & Hisasaka, 2018). Metacognitive skills are also essential for reading comprehension (Cain & Oakhill, 2007) and writing ability (Ramadhani & Yanda, 2021). However, the use of metacognitive skills is often challenging among neurodivergent populations—defined here as individuals with ADHD, Learning Disorder, or autism (Gersten et al., 2001), and/or those with executive function challenges (Poissant, 2005).

The current study is motivated by evidence that challenges in executive function relate to delays in the development of internalized language, or ‘inner speech’ (e.g. Berk & Potts, 1991; Douglas & Benezra, 1990). Inner speech helps us to construct rule-based representations necessary for developing EF skills (Zelazo, 2015). Young children use overt, audible ‘private’ speech to guide themselves, which gradually turns into covert, ‘inner’ speech (Vygotsky, 1934). Critically, individuals can enhance their use of ‘inner speech’ through training methods that mirror this path of development (Luria, 1961), and studies have shown language-based interventions that teach children to reflect on task properties lead to enhanced performance on these tasks (Espinete et al., 2013; Zelazo et al., 2018).

Yet, previous research on self-talk metacognition strategies with college aged neurodivergent students is scarce. Given this gap in the literature, the current study examines the effects of a self-talk strategy in this population.

## Research Questions

- 1) Does training neurodivergent college students to engage in self-questioning and ‘thinking-aloud’ during academic tasks lead to performance gains?
- 2) Are effects moderated by important, theoretically relevant criteria?  
E.g., prior verbal skills, EF ability, neurodivergent profiles?

## Method

## Participants

- 31 neurodivergent college students
  - Analytic sample = 24 (11 in training; 13 in control)
- Age: Range = 19 to 33 years old; Mean = 23.23 (SD = 3.56)
- Gender: 9 Male, 9 Female, 4 non-binary, 2 other
- Self-identified diagnoses (co-morbidity allowed and common):
  - ADHD = 21, autism = 9, learning disability = 9, anxiety disorder = 15

## Design

- Intervention study: Pre and Post assessment batteries ~8-10 weeks apart
  - Mean = 71.90 (35.04) days apart
  - See Table 1 for measurement details
- After recruitment, participants were **randomly assigned** to either a:
  - Treatment group – received self-talk training over **three, 45-minute** sessions
  - Control group – no contact between Pre and Post assessments

## Self-Talk/Metacognitive Training

Demonstrated and practiced with participants on using their ‘meta-speech’, e.g.:

### Reading:

- When they come across a word or sentence that they don’t understand, ask themselves, **“What does this mean?”** and answer in their own words.
- At the end of each paragraph, ask themselves **“what was this paragraph about?”** and provide a summary.

### Writing:

- **“What am I writing about?”**
- **“What do I think or know about this topic/subject?”**
- Instructed to speak a sentence out loud before writing.

**Table 1.** List of Constructs, Instrument Names, and Timeline of Assessments

Construct	Instrument	When?
Reading comprehension	Nelson Denny	Pre & Post
Writing ability	Short essay prompts; (scored using National Council of Teachers rubric)	Pre & Post
Receptive Vocabulary	Peabody Picture Vocabulary Test (PPVT)	Pre
Executive Function (inhibition)	Computerized Flanker task	Pre
Word Decoding	Word Attack (sub-test of Woodcock-Johnson IV)	Pre
ADHD symptomology	Adult ADHD Self-Report Scale (ASRS)	Pre
Gender, ethnicity, diagnosis(es)	Self-report demographics survey	Pre
Use/perceived effectiveness of training	Self-report survey	Post

## Results

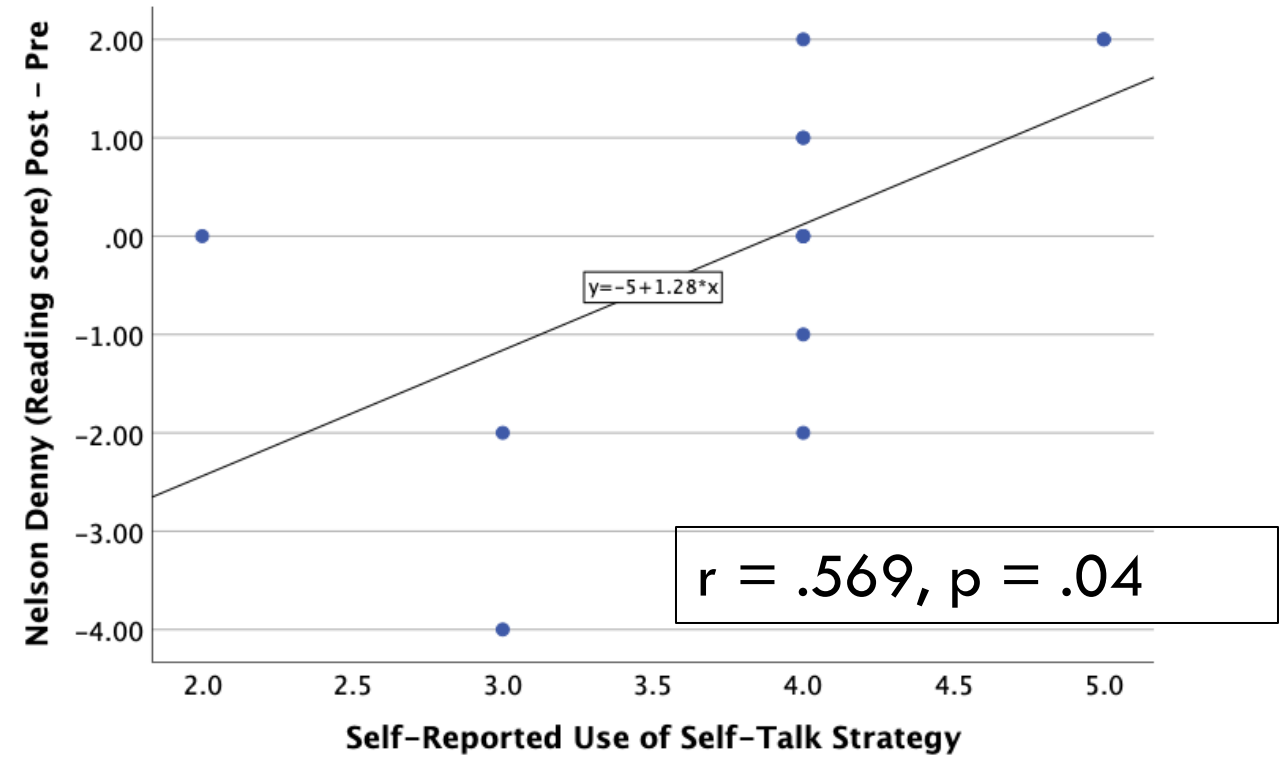
**Table 2.** Descriptive Statistics (means and SDs) on Reading and Writing Outcome Measures by Group and Assessment time

	Reading		Writing	
	PRE	POST	PRE	POST
Control	9.15 (2.44)	8.62 (2.40)	14.85 (2.68)	14.88 (3.93)
Treatment	9.73 (2.15)	10.00 (1.95)	15.27 (2.71)	16.09 (1.80)

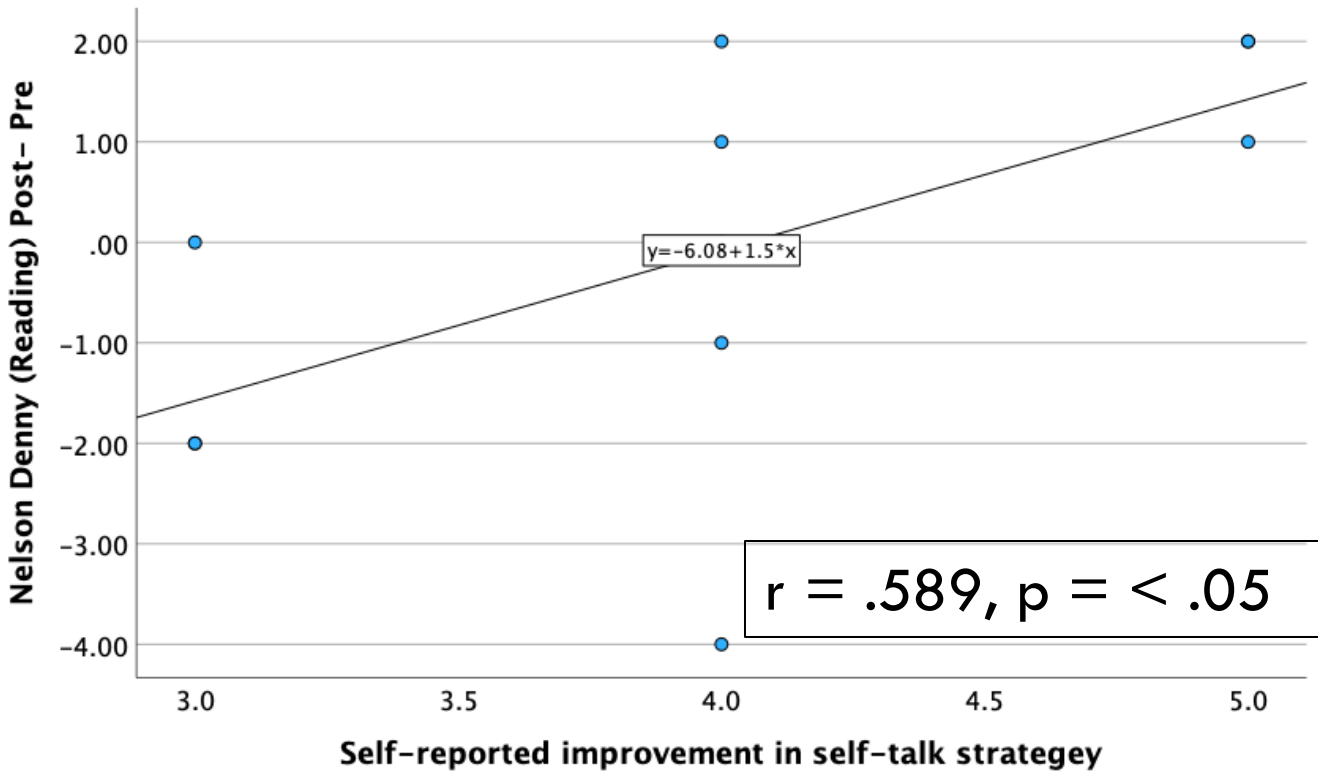
group x time:  
 $F(1,22) = .688, p = .42, n^2 = .03$

group x time:  
 $F(1,22) = .580, p = .50, n^2 = .02$

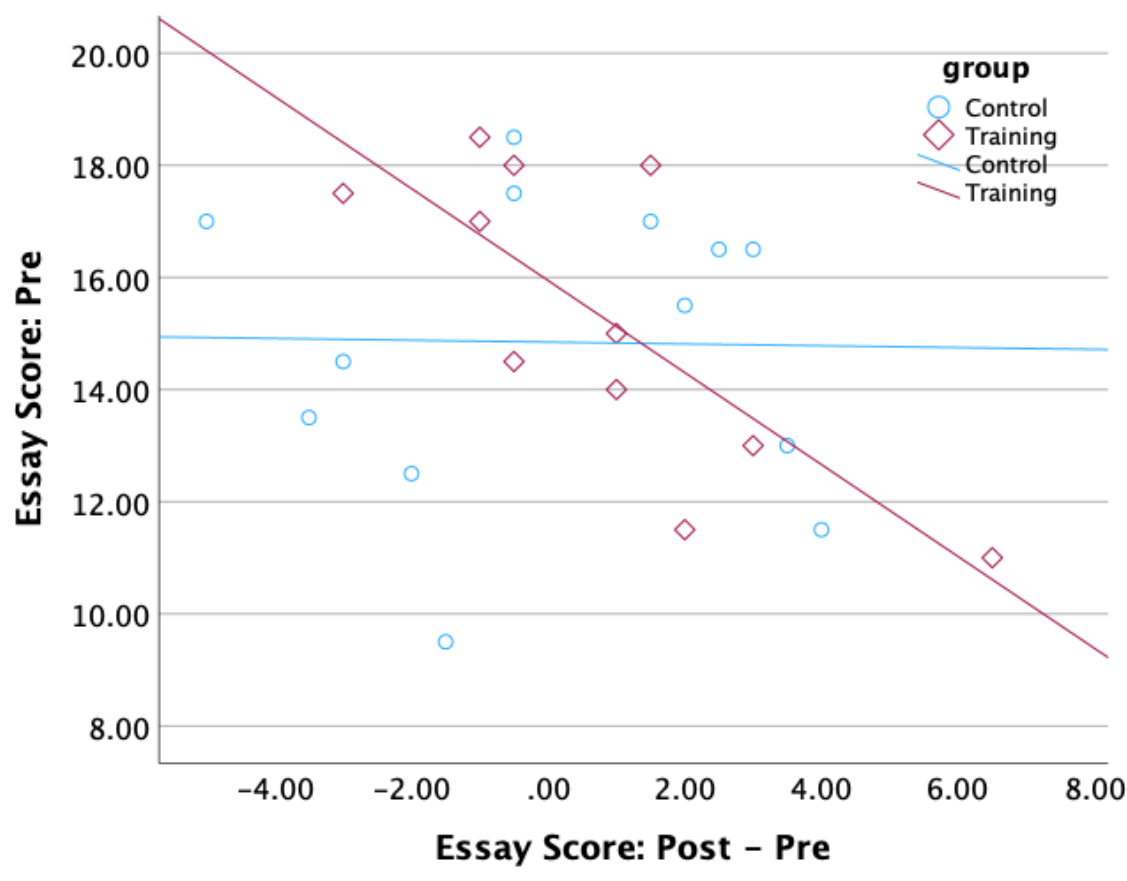
**Figure 1.** Relationship Between Gains in Reading Scores and Participant Reported Use of the Self-Talk Strategies



**Figure 2.** Relationship Between Gains in Reading Scores and Participant Reported Improvement in Using Self-Talk Strategies.



**Figure 3.** Relationship Between Gain in Writing Scores and Pre-Test Writing Scores by Group



**Control:**

$r = -.018$   
 $p = .954$

**Training:**

$r = -.765$   
 $p = .006$

## Discussion

- **Results showed no difference in overall improvement for the training compared to control** on either reading comprehension or writing. However, there was significant participant variability in application of the strategy.
- **A strong positive relationship** was observed between gains in reading scores and self-reported **use** and perceived **improvement** of the self-talk strategies.
- In the training group, **gains in writing scores and initial writing scores were negatively correlated (lower pretest score → more gain), but not** in the control group.
- Both sets of results are suggestive that the strategy may be **most effective for certain profiles of students**:
  - Those that reliably employ the strategy, and/or
  - Those that have the most room to grow on these skills
- These self-talk strategies may **need to be individualized**
- Metacognitive skills are **not “all or none;”** they can be used selectively for difficult tasks, getting unstuck, or modifying approach or plan.

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