

Language and Executive Functioning In Youth With and Without ASD

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Background

- Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder that is characterized by deficits in social communication and restricted and repetitive behaviors and interests (American Psychological Association, 2013).
- Executive Functioning (EF) refers cognitive processes needed to reach a goal or complete a task, including working memory, mental flexibility, and inhibition (Rogers and Bennetto, 2000).
- Language development centers around the ability to communicate, understand, and problem solve through verbal communication.
- Previous studies in typically developing (TD) children have found a moderate relationship between language ability and EF in children, as attention plays a regulatory role in language (Berninger, V., Abbott, R., Cook, C. R., & Nagy, 2017).
- If there are significant impairments in EF with working memory and mental flexibility, this might impact an individual's ability to communicate and process language. In a similar manner, language impairments may reduce the ability to practice sorting and processing information. The aim of this study is to analyze the correlation between language development and EF in individuals with and without ASD.
- Females with ASD often present less socio-communicative symptoms than males and may put more effort into skills that make them appear more socially typical (Lai, M. C. et.al, 2011).
- Hypotheses:
 - ASD youth will have greater impairments in language and EF compared to TD youth
 - EF and verbal language skills will be correlated in both groups.
 - Females will have higher EF and language scores than males.

Methods

323 participants (ASD - 162), 8-17 years old from the NIH funded ACE GENDAAR study were included in the analysis. Within the sample, there were 172 males and 151 females. ASD diagnosis was confirmed via standardized measures.

Measures:

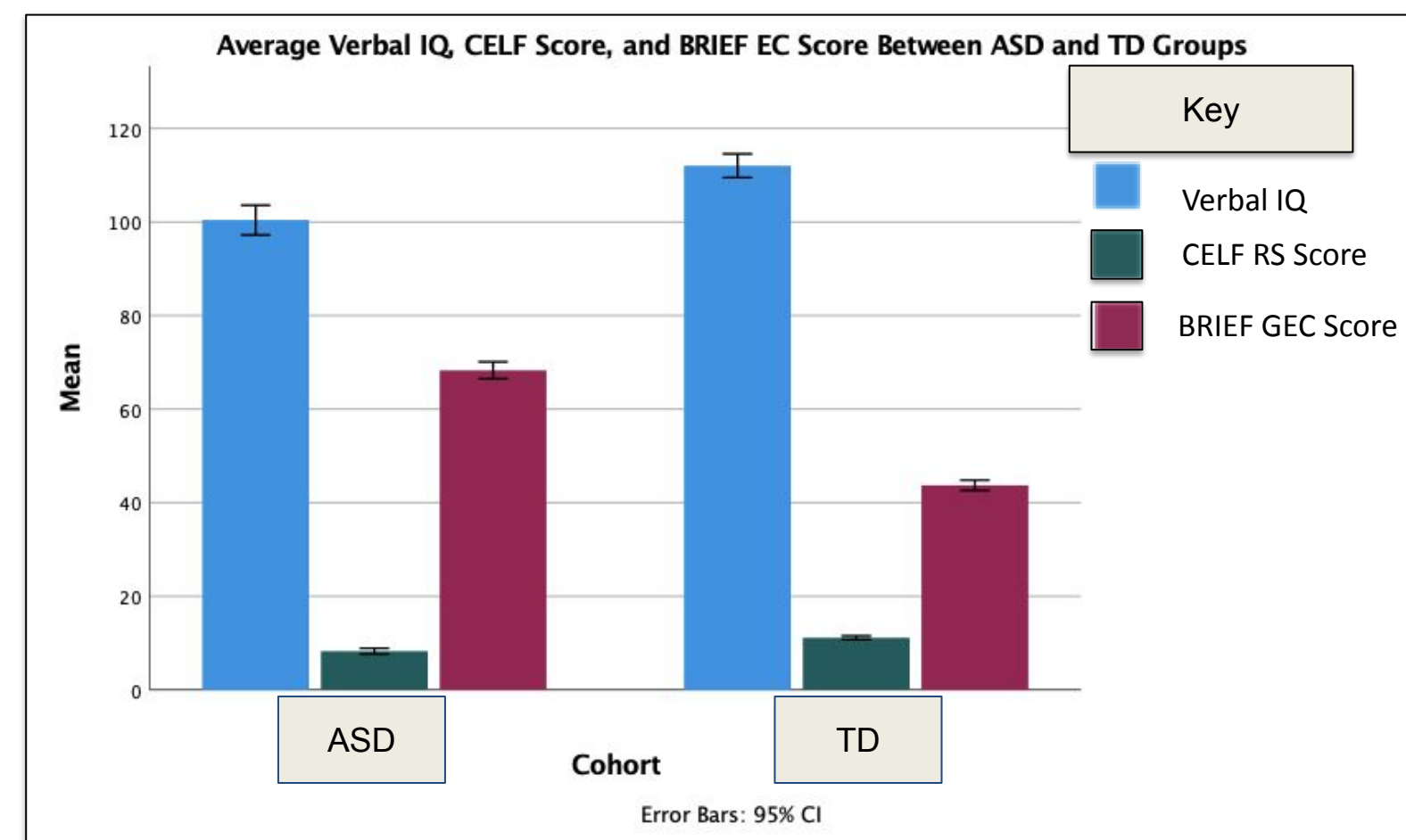
- Clinical Evaluation of Language Fundamentals (CELF) - A clinician administered test of expressive and receptive language ability.
 - We utilized the Recalling Sentences subscore (RS) which measures the ability to recall sentences while maintaining the sentence structure and word morphology.
- Behavioral Inventory of Executive Functioning (BRIEF) - This 58- item questionnaire is completed by a parent and measures executive functioning ability in specific areas (e.g., working memory, emotional control)-and are combined to create the Global Executive Composite (GEC) utilized in this analysis.
 - A higher BRIEF score indicates higher levels of dysfunction in an area of executive functioning.
- Differential Ability Scales II Edition (DAS II) - A cognitive assessment used to measure cognitive ability (IQ), including verbal IQ. All participants included had an IQ > 70.

	ASD		TD	
	Male	Female	Male	Female
Sample Size	91	71	81	80
Interview Age (Months)	148.76 ± 35.080	150.46 ± 33.301	159.13 ± 33.674	152.23 ± 37.117
Verbal IQ	99.91 ± 20.600	101.46 ± 20.389	113.06 ± 17.016	111.05 ± 14.645
CELF RS Score	7.72 ± 3.946	8.97 ± 3.899	10.87 ± 2.503	11.42 ± 2.685
BRIEF GEC Score	67.57 ± 11.588	69.25 ± 11.593	43.22 ± 6.980	44.32 ± 6.799

Results

Hypothesis 1: Are there differences in Language Ability, and Executive Functioning between ASD and TD Youth?

An independent sample t-test was run to compare the means of Executive Functioning GEC scores, CELF RS scores and Verbal IQ of ASD and TD individuals.

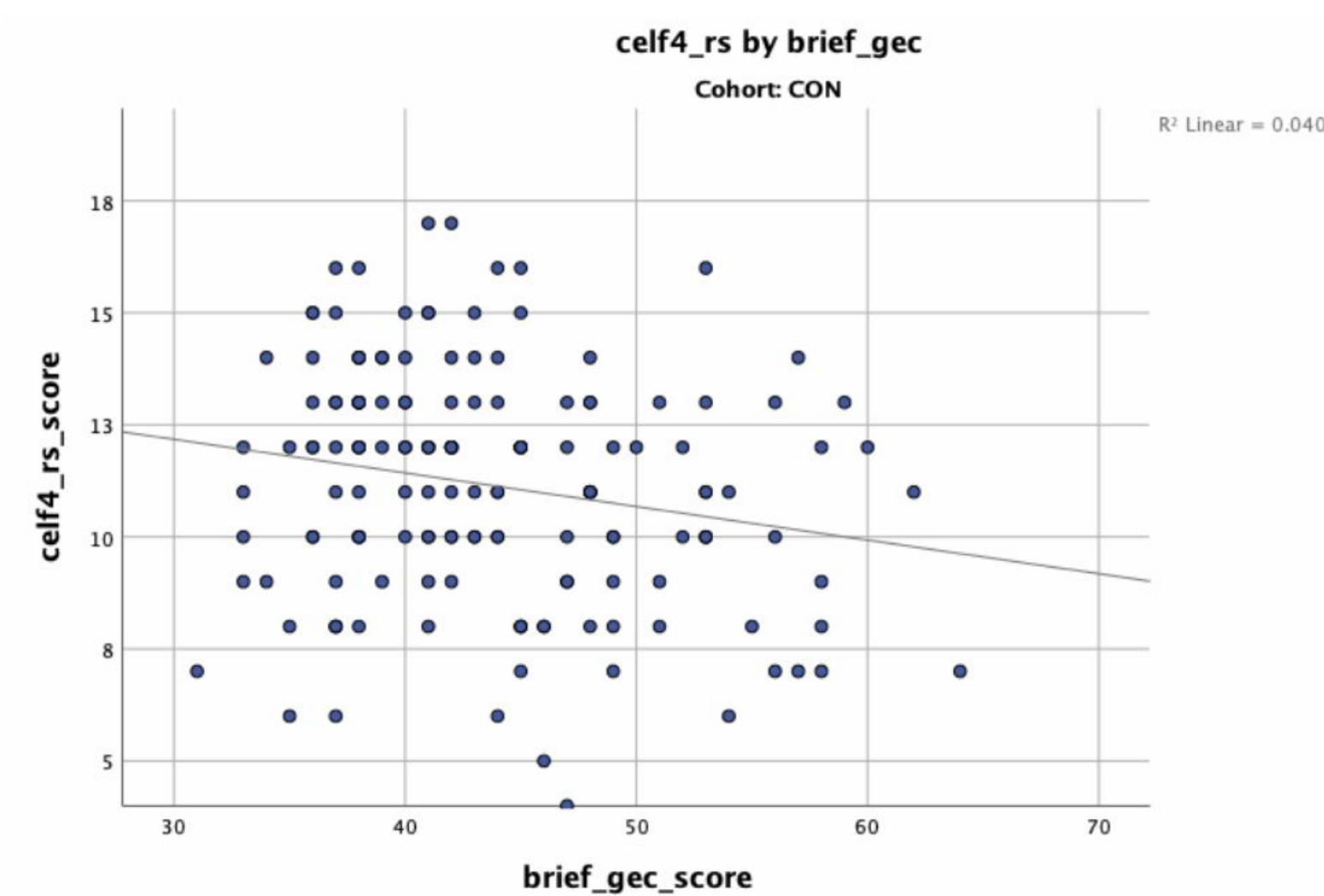


- ASD youth had **greater executive functioning impairments**; ($F(1,321)= 36.152, p < 0.01$); lower verbal IQ ($F(1, 321) = 9.856, p < 0.01$); and lower CELF RS Scores ($F(1,316)= 34.35, p < 0.01$), indicating **higher language impairments** than TD youth.

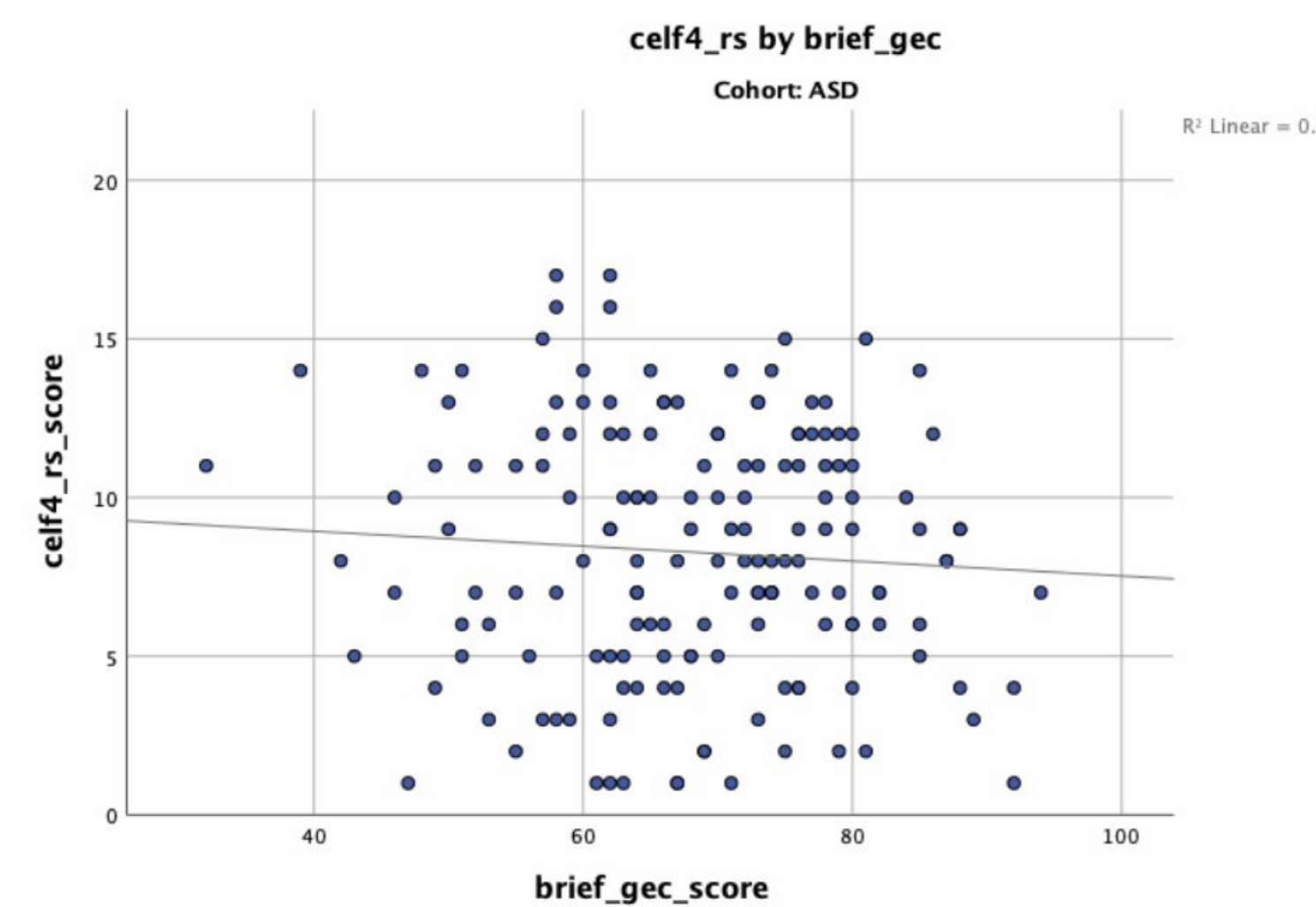
Hypothesis 2: Is there a correlation between Language Ability and Executive Functioning in Both Groups?

A correlational was run to determine the relationship between language skills and and executive functioning in both the ASD and TD groups.

TD Group:



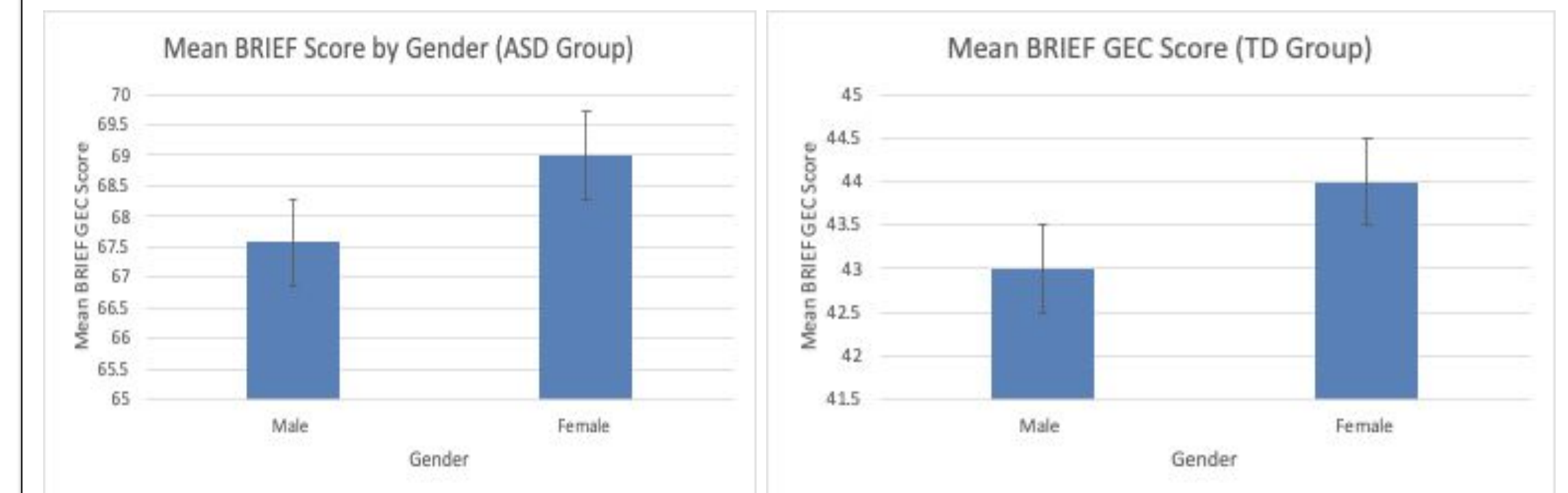
ASD Group:



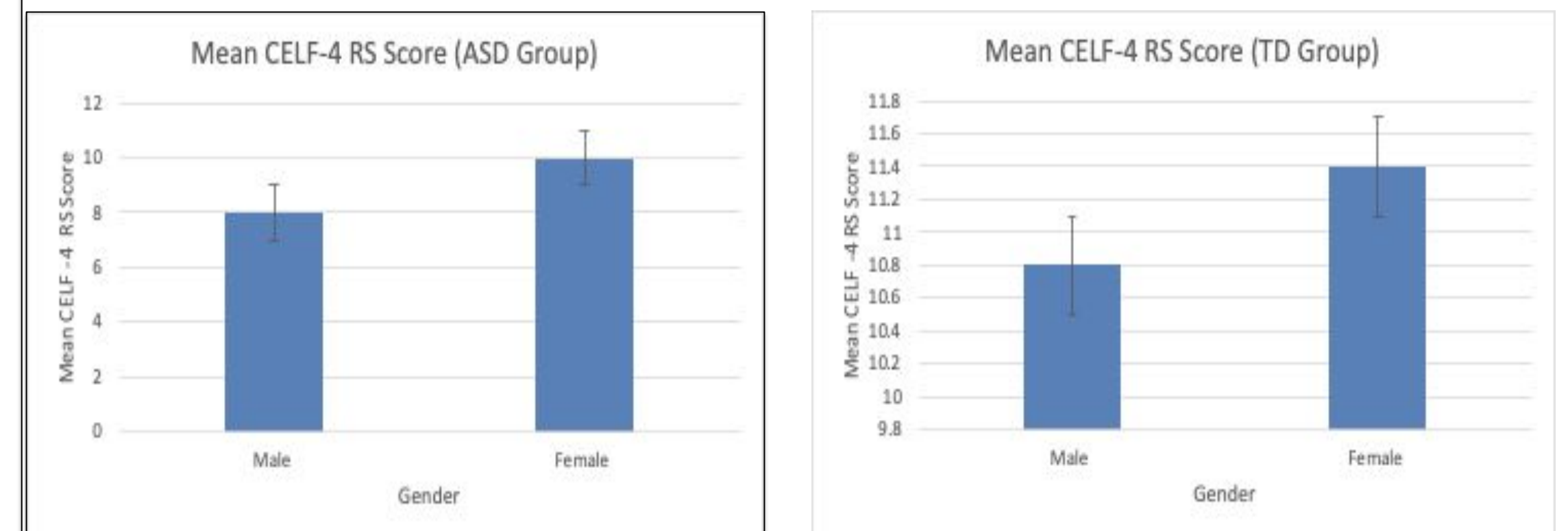
- ASD youth **did not show significant correlation** between EF scores and CELF language ($r = 0.069, p = 0.385$).
- TD youth **showed a significant negative correlation** between EF scores and CELF language ($r = -0.199, p < 0.05$).
 - As EF impairments increase, language ability decreases.
- No significant correlations** were observed for Verbal IQ language scores and EF for ASD ($r = -0.026, p = 0.744$) or TD ($r = 0.018, p = 0.818$) groups.

Hypothesis 3: Do females demonstrate higher executive functioning skills or language skills in both ASD and TD groups?

A univariate analysis of variance between subject factors was run to compare the mean CELF RS scores and BRIEF GEC scores between cohorts, and biological sex to examine the interaction between cohort and biological sex.



- Although ASD males and females had elevated, EF scores, there was **no statically significant difference** between females and males in EF across the sample; ($F(1,319)=1.706$), ($p=0.192$).
- There was **no significant interaction** by biological sex and cohort; ($F(1,319)=0.074$), ($p=0.786$).



- There was significant difference** in language ability (CELF scores) between females and males across the sample; ($F(1,314)=5.742$ and ($p=0.017$). TD Females scored higher in CELF than ASD females.
- There was **no significant** cohort * biological sex interaction; ($F(1,314)=0.869$) and ($p=0.352$).

Discussion

- Our results show that ASD youth have greater impairments in EF and verbal language when compared to TD youth, supporting our first hypothesis. TD youth performed better on the CELF-4 RS, BRIEF GEC, and the DAS II Verbal IQ. This significant difference between groups was expected based on prior reports. This sample had high cognitive and verbal ability, which may have limited the relationship between language and EF.
- We also found correlations between executive functioning and language ability in TD individuals. This indicates that there may be parts of executive functioning, such as the ability to switch between ideas or concepts, that aid in language ability. Language may in turn help individuals learn to sort and process information more efficiently, thereby improving their EF abilities.
- We did not find significant correlations between EF and language in the ASD group, most likely due to not considering that other subscores within EF might correlate better with language.
- We did not find significant differences in EF scores between females and males.
- There was a statistically significant difference in the mean CELF-4 Recalling Sentences Score between boys and girls in both the TD and the ASD group. The higher language score in both groups may be due to a higher social motivation in girls with and without ASD. Previous research has demonstrated that, girls are more motivated to initiate social interaction, which may allow for more practice with language (Sedgewick, Hill, Yates, Pickering, and Pellicano, 2015).
- Future research:
 - Given that language is driven by key parts of EF such as working memory and shifting ability, we may look at those scores in relation to language, rather than the BRIEF GEC. Looking at a direct assessment of EF, rather than parent questionnaire, might also be more accurate.
 - We might also explore how certain addition intervention techniques, EF treatment, or language therapy might impact the relationship between language and executive functioning.