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 to cognitive processes needed to reach a goal or complete a task, including working memory, mental flexibility, and inhibition (Rogers & Bennett, 2006).
- 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 process and organizing 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:

1) ASD youth will have greater impairments in language and EF compared to TD youth.
2) EF and verbal language skills will be correlated in both groups.
3) 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:

1) Clinical Evaluation of Language Fundamentals (CELF) - A clinician administered test of expressive and receptive language ability.
   a) We utilized the Recalling Sentences sub-score (RS) which measures the ability to recall sentences while maintaining the sentence structure and word morphology.
2) 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) A higher BRIEF score indicates higher levels of dysfunction in an area of executive functioning.
3) 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.

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.

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 executive functioning in both the ASD and TD 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.

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 questionnaires, 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.