

Title: Everyday Executive Function in Children with Fetal Alcohol Syndrome or Autism Spectrum Disorder

Authors: Sara Kover¹, Julia Mattson², and John Thorne^{1,3}

Introduction: Among other developmental difficulties, children with fetal alcohol syndrome (FAS) experience executive function deficits, including in the areas of shifting, planning, and working memory (Rai et al., 2017). Executive function is also an area of challenge for many children with autism spectrum disorder (ASD; Rosenthal et al., 2013). Recent work has shown that parent ratings of everyday executive function are related to a range of outcomes, such as social functioning in children with ASD (Torske et al., 2018). Cross-syndrome comparisons of everyday executive function can inform the specificity of deficits in executive function (Wilde & Oliver, 2017). Further, comparisons between FAS and ASD have revealed both overlapping and distinct skills (Bishop et al., 2007), but have not addressed executive function or its relation to social function. Utilizing parent report, the current study asked: **(1)** Do children with FAS and ASD show relative strengths and weaknesses across clinical scales of everyday executive function relative to normative expectations and cut-offs for clinically significant symptoms? **(2)** Does everyday executive function correlate with parent-reported social function in children with FAS and ASD?

Method: Participants with FAS ($n = 20$; 8 girls) were 5 to 9 years old ($M = 88$ months, $SD = 17$). Participants with ASD ($n = 24$; 6 girls) were 5 to 11 years old ($M = 92$, $SD = 27$ months). Nonverbal IQ was assessed with the Leiter-3 (Roid & Miller, 2013). Nonverbal IQ scores ranged from 71 to 120 in participants with FAS ($M = 102$; $SD = 12$) and from 67 to 133 for participants with ASD ($M = 99$; $SD = 16$). The groups did not differ in age, $t(42) = .49$, $p = .621$, $d = .15$, or in nonverbal IQ, $t(37) = .52$, $p = .600$, $d = .17$. Participants' parents completed the Behavior Rating Inventory of Executive Function (BRIEF; Gioia et al., 2000; Gioia et al., 2015) and the Social Responsiveness Scale (SRS-2; Constantino, & Gruber, 2012), yielding T-scores. For BRIEF and SRS-2 T-scores, higher values indicate greater impairment. The BRIEF is comprised of distinct clinical scales (inhibit, shift, emotional control, initiate, working memory, plan/organize, organization of materials, and monitor) and yields an overall composite score (Global Executive Composite; GEC). A BRIEF T-score of 50 is the normative mean for typical development; a T-score of 65 or above is considered clinically noteworthy.

Results: **(1)** For both groups and all scales, BRIEF T-scores exceeded the normative mean of 50, $p < .001$ (GEC $M = 72$, $SD = 10$ for FAS; $M = 71$, $SD = 9$ for ASD). Relative to the clinically significant cut-point of 65, participants with FAS had elevated scores for GEC, $t(19) = 3.12$, $p = .005$, working memory, $t(19) = 3.22$, $p = .004$, and plan/organize, $t(19) = 2.64$, $p = .016$. Likewise, participants with ASD had GEC scores significantly greater than 65, $t(23) = 3.40$, $p = .002$, as well as higher shift scores, $t(23) = 2.21$, $p = .037$, but lower scores on organization of materials, $t(23) = 2.21$, $p = .037$. The proportion of participants exceeding a score of 65 for GEC for participants with FAS ($17/20 = 85\%$) and ASD ($19/24 = 79\%$) did not statistically differ, Fisher's exact test, $p = .710$. More participants with FAS than ASD exceeded the clinical cut-point for organization of materials ($13/20$ for FAS; $7/24$ for ASD), Fisher's exact test, $p = .032$. **(2)** For participants with FAS and participants with ASD, GEC scores were significantly and positively correlated with SRS-2 T-scores, $r(17) = .69$, $p < .01$ for FAS, $r(20) = .65$, $p < .01$ for ASD.

Discussion: As expected, participants with both FAS and ASD were rated by parents as having deficits in everyday executive function. Areas of weakness were distinct for FAS and ASD. In line with existing literature, participants with FAS had elevated scores for working memory and plan/organize; participants with ASD had elevated scores for shift (Rasmussen et al., 2007; Rosenthal et al., 2013). Despite those distinctions, for children with FAS and ASD, everyday executive function was correlated with social function according to parent report: those with executive function difficulties were rated as having more social impairment in both groups, extending previous findings to FAS (Torske et al., 2018). Future research should (1) incorporate direct assessments of executive function because of their potential to diverge from parent report for children with FAS (Mohamed et al., 2019) and (2) address whether the association between executive function and specific aspects of social interaction and communication differs between FAS and ASD (Hutchinson, Mueller, Iarocci, 2019). The current findings highlight weaknesses specific to FAS or ASD, as well as overlapping deficits and a shared relation between executive function and social function.

References:

- Bishop, S., Gahagan, S., & Lord, C. (2007). Re-examining the core features of autism: a comparison of autism spectrum disorder and fetal alcohol spectrum disorder. *Journal of Child Psychology and Psychiatry*, 48(11), 1111-1121.
- Freeman, L. M., Locke, J., Rotheram-Fuller, E., & Mandell, D. (2017). Brief report: Examining executive and social functioning in elementary-aged children with autism. *Journal of autism and developmental disorders*, 47(6), 1890-1895.
- Hutchison, S. M., Müller, U., & Iarocci, G. (2019). Parent Reports of Executive Function Associated with Functional Communication and Conversational Skills Among School Age Children With and Without Autism Spectrum Disorder. *Journal of autism and developmental disorders*, 1-11.
- Leung, R. C., Vogan, V. M., Powell, T. L., Anagnostou, E., & Taylor, M. J. (2016). The role of executive functions in social impairment in autism spectrum disorder. *Child Neuropsychology*, 22(3), 336-344.
- Mohamed, Z., Carlisle, A. C., Livesey, A. C., & Mukherjee, R. A. (2019). Comparisons of the BRIEF parental report and neuropsychological clinical tests of executive function in Fetal Alcohol Spectrum Disorders: data from the UK national specialist clinic. *Child Neuropsychology*, 25(5), 648-663.
- Rai, J. K., Abecassis, M., Casey, J. E., Flaro, L., Erdodi, L. A., & Roth, R. M. (2017). Parent rating of executive function in fetal alcohol spectrum disorder: A review of the literature and new data on Aboriginal Canadian children. *Child Neuropsychology*, 23(6), 713-732.
- Rasmussen, C., McAuley, R., & Andrew, G. (2007). Parental ratings of children with fetal alcohol spectrum disorder on the behavior rating inventory of executive function (BRIEF). *J FAS Int*, 5(e2), 1-8.
- Rosenthal, M., Wallace, G. L., Lawson, R., Wills, M. C., Dixon, E., Yerys, B. E., & Kenworthy, L. (2013). Impairments in real-world executive function increase from childhood to adolescence in autism spectrum disorders. *Neuropsychology*, 27(1), 13.
- Torske, T., Nærland, T., Øie, M. G., Stenberg, N., & Andreassen, O. A. (2018). Metacognitive aspects of executive function are highly associated with social functioning on parent-rated measures in children with autism spectrum disorder. *Frontiers in behavioral neuroscience*, 11, 258.
- Wilde, L., & Oliver, C. (2017). Brief report: Contrasting profiles of everyday executive functioning in Smith–Magenis syndrome and Down syndrome. *Journal of autism and developmental disorders*, 47(8), 2602-2609.

¹ University of Washington

² Seattle Children's Hospital

³ Center on Human Development and Disability