Moderators of School Intervention Efficacy for Higher-Functioning Children with ASD

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Introduction

- Data suggest that individuals with HFASD (without intellectual disability) may be accounting for the increase in prevalence of ASD (CDC, 2014); this indicates an urgent need for effective school interventions for these children.

- A recent meta-analysis of social intervention RCTs in clinic/university settings for youth with HFASD suggested low-to-moderate effects and significant variability in outcomes, highlighting the need for ongoing intervention development and RCTs (Gates et al., 2017). Although reviews suggest some promise, the effects rarely transfer to schools leading to calls for studies of social interventions within schools (Kasari et al., 2016).

- Variability in responsiveness also indicates a need to determine which children benefit from an intervention (Reichow & Barton, 2014), yet there has been limited testing of moderators of treatment outcomes.

- Treating the multiple symptoms that characterize HFASD including the complex social and behavioral impairments is a significant challenge and it requires a comprehensive approach (Odom et al., 2010).

- Lopata, Thomeer et al. adapted a cognitive-behavioral summer treatment for children with HFASD into a comprehensive school intervention (schoolMAX) and tested it in a cluster RCT (Lopata, Thomeer et al., 2019). Linear mixed model analyses found schoolMAX was superior to services-as-usual (SAU) on primary measures of social-cognition (emotion recognition testing [CAM-C] by masked evaluators; $d=1.41$; $p<.001$) and ASD symptoms (parent-teacher ratings composite [SRS-2]; $d=-1.15$; $p<.001$) and secondary measure of social skills (parent-teacher ratings composite [ASC]; $d=1.29$; $p=.001$).

- This exploratory study examined the moderating effects of demographic, child, and school variables on outcomes from the schoolMAX cluster RCT for children with HFASD. Potential moderators were selected based on the available literature.

Methods

Participants
- The RCT included 103 children (6-12 years) with HFASD from 35 urban and suburban public elementary schools (17 schools [$n=52$ children] randomly allocated to schoolMAX and 18 schools [$n=51$ children] to SAU); 1 child withdrew from SAU (i.e., 102 completers).
- There were no differences between conditions on any child variable, parent education, baseline outcome measure, or school SES (demonstrating baseline equivalence).

Procedures
- Children in schoolMAX received social skills groups, emotion recognition instruction, and therapeutic activities (weekly), a behavioral reinforcement system (daily), and parent training (monthly) administered by school staff during the school year and children in SAU received their typical services. Staff in schoolMAX were trained and different members of each student's educational team were responsible for implementing an individual component (fidelity >92%).

Outcomes Measures
- Cambridge Mindreading Face-Voice Battery for Children (CAM-C; Golan & Baron-Cohen, 2006; test of emotion-recognition skills administered by masked evaluators)
- Social Responsiveness Scale, Second Edition (SRS-2; Constantino & Gruber, 2012)
- Adapted Skillstreaming Checklist (ASC; Lopata et al., 2008)

Moderator Variables
- Child age, sex, IQ (WISC-IV short-form; Wechsler, 2003), language (Comprehensive Assessment of Spoken Language short-form; CASL; Carrow-Woolfolk, 1999) and ASD symptoms (ADI-R; Rutter et al., 2003), parent education, school SES, and child baseline comorbid symptoms/adaptive skills (BASC-2; Reynolds & Kamphaus, 2004).

Table 1. *Descriptive Statistics for Moderators and Outcome Measures*

Characteristic/Variable	schoolMAX	SAU	schoolMAX	SAU
Family				
Parent Education: Mean (*SD*)	15.76 (2.08)	15.41 (2.14)		
Child: Mean (*SD*)				
Age	8.65 (1.29)	9.01 (1.45)		
WISC-IV IQ	103.82 (12.94)	100.94 (14.84)		
WISC-IV VCI	103.04 (14.39)	100.21 (14.07)		
WISC-IV PRI	103.82 (15.82)	101.50 (16.59)		
CASL Expressive	98.04 (15.10)	95.11 (14.52)		
CASL Receptive	103.84 (17.49)	100.19 (16.22)		
ADI-R Social	18.31 (5.91)	18.67 (5.72)		
ADI-R Communication	14.52 (3.91)	15.20 (5.43)		
ADI-R Repetitive	6.10 (1.72)	5.90 (2.24)		
BASC-2 Externalizing	57.12 (10.98)	57.96 (11.39)		
BASC-2 Internalizing	56.81 (14.32)	57.57 (13.07)		
BASC-2 Adaptive Skills	34.69 (8.61)	35.12 (7.59)		
Sex (male): *n* (%)	47 (90.4)	47 (92.2)		
Ethnicity (Caucasian) *n* (%)	50 (96.2)	49 (96.1)		
Child Outcome: Mean (SD)	**Baseline**	**Baseline**	**Follow-Up**	**Follow-Up**
CAM-C	46.04 (12.92)	46.09 (11.70)	58.73 (14.60)	48.76 (12.94)
SRS-2 Parent-Teacher	71.93 (9.98)	71.48 (7.04)	64.84 (8.13)	69.72 (9.23)
ASC Parent-Teacher	104.73 (17.98)	107.40 (13.33)	112.20 (17.13)	108.71 (14.03)

SAU=Services-As-Usual; WISC-IV=Wechsler Intelligence Scale for Children-4th Edition (short-form); VCI=Verbal Comprehension Index; PRI=Perceptual Reasoning Index; CASL=Comprehensive Assessment of Spoken Language (short-form); ADI-R=Autism Diagnostic Interview-Revised; BASC-2=Behavior Assessment System for Children-2nd Edition; CAM-C=Cambridge Mindreading Face-Voice Battery for Children; SRS-2=Social Responsiveness Scale, 2nd Edition; ASC=Adapted Skillstreaming Checklist.

Table 2. *Analysis of Moderators of Treatment Outcomes*

Moderator	Outcome					
	CAM-C		SRS-2		ASC	
	p	R^2	*p*	R^2	*p*	R^2
Parent Education	.204	.006	.248	.005	.764	.000
School SES	.920	.000	.538	.001	.855	.000
Age	.070	.010	.750	.000	.137	.010
Sex	.382	.003	.741	.000	.923	.000
WISC-IV IQ	.870	.000	.911	.000	.307	.005
WISC-IV VCI	.926	.000	.886	.000	.653	.001
WISC-IV PRI	.507	.002	.780	.000	.347	.004
CASL Expressive	.493	.002	.700	.001	.558	.002
CASL Receptive	.335	.003	.792	.000	.943	.000
ADI-R Social	.376	.003	.136	.001	.707	.001
ADI-R Communication	.434	.002	.077	.011	.459	.003
ADI-R Repetitive	.097	.010	.799	.000	.560	.002
BASC-2 Externalizing	**.032**	**.015**	.450	.002	.566	.001
BASC-2 Internalizing	.156	.007	.139	.008	.651	.001
BASC-2 Adaptive Skills	.337	.003	**.010**	**.022**	.541	.002

WISC-IV=Wechsler Intelligence Scale for Children-4th Edition (short-form); VCI=Verbal Comprehension Index; PRI=Perceptual Reasoning Index; CASL=Comprehensive Assessment of Spoken Language (short-form); ADI-R=Autism Diagnostic Interview-Revised; BASC-2=Behavior Assessment System for Children-2nd Edition; CAM-C=Cambridge Mindreading Face-Voice Battery for Children; SRS-2=Social Responsiveness Scale, 2nd Edition; ASC=Adapted Skillstreaming Checklist.

Statistically significant values bolded and underlined.

Data Analyses and Results

- Data were analyzed with linear mixed effects models with intervention group (schoolMAX vs. SAU) as a fixed effect, and school as a random effect. Outcomes were assessed by testing the mean change (baseline-to-follow-up) between-conditions. Moderation analyses were conducted by testing the addition of an interaction term including the potential moderator by condition.

- Table 1 provides descriptive statistics for demographics and outcome measures and Table 2 provides summary statistics for the moderator analyses.

- Moderation effects were not evident in demographics, child IQ, language, or ASD diagnostic symptoms, or school SES.

- There was evidence of moderation effects with two of the behavioral scales (BASC-2):

  - Externalizing behaviors appear to have impacted the treatment such that children in the treatment group who were lower in externalizing behaviors at baseline experienced a larger improvement in social-cognitive skills (CAM-C scores $p=.032$)

  - Children who were initially lowest in Adaptive Skills demonstrated a greater reduction in ASD symptoms (SRS-2 $p=.010$)

  - No other comorbid symptoms or adaptive skills ratings moderated outcomes on the three measures; and the R^2 change values were uniformly small, including the two interactions with *p*-values <.05.

Discussion and Conclusions

- schoolMAX is one of the only comprehensive school interventions specifically for children with HFASD that has yielded significant and robust gains in social-cognitive skills, ASD symptoms, and social skills (Lopata, Thomeer et al., 2019).

- Moderation analysis is essential to determine for whom an intervention may be more or less effective (Lecavalier et al., 2017), yet almost nothing is known about moderators of school intervention outcomes for children with HFASD.

- Results were consistent and suggested no moderating effects of demographic variables and child screening measures on the three outcome measures.

- Baseline comorbid symptoms and adaptive behaviors were also largely unrelated to outcomes; there were two exceptions (externalizing behaviors moderated social-cognitive improvement and adaptive skills moderated ASD symptom improvement); however, these effects were small.

- Overall, the pattern of results suggests that outcomes were largely unaffected by third variables. Additionally, the two that were statistically significant had narrow (each affected only a single outcome measure) and small effects.

- This provides tentative support for the generalizability of treatment outcomes across a broad set of variables and suggests that schoolMAX will likely require minimal adaptation.

- Given the exploratory nature of this study and large number of comparisons, the findings should be interpreted with caution and replication is needed.

- It will be important to test moderators for individual interventions to ensure important moderators do not go undetected due to variability in samples and intervention components across studies (when testing moderators via meta-analyses).

Conflict of Interest: None