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Promoting Classroom Social and Academic Functioning among Children at Risk for ADHD: The MOSAIC Program

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ABSTRACT

Objective: Social and academic functioning are linked in elementary school, and both are frequently impaired in children with elevated symptoms of attention-deficit/hyperactivity disorder (ADHD). This study evaluated the Making Socially Accepting Inclusive Classrooms (MOSAIC) program, a classroom intervention to support children's social and academic functioning, especially for children at risk for ADHD. Teachers delivered MOSAIC practices to the whole class and applied some strategies more frequently to target children selected for elevated ADHD symptoms and peer impairment.

Method: Participants were 34 general education teachers (grades K-5) and 558 children in their classrooms, randomized to MOSAIC or to a typical practice control group for one academic year. In the fall and spring, we assessed (a) peers' sociometric judgments of children, (b) children's self-report of supportive relationships with teachers and peers, and (c) teachers' report of children's social and academic competencies and impairments.

Results: Regarding whole class effects, relative to control group children, children in MOSAIC classrooms (target and non-target children) were rated by teachers in spring as having better competencies and lower impairment, after controlling for fall functioning. There were no main effects of MOSAIC on peer sociometrics or child perceptions of supportive relationships. Target status moderated some effects such that, in spring, target children in MOSAIC perceived greater support from their teachers but received poorer sociometrics than did target children in control classrooms.

Conclusions: We discuss the difficulty in changing peers' perceptions of children with ADHD symptoms, even in the presence of improvements in other aspects of social and academic functioning.

Many children with elevated symptoms of attention-deficit /hyperactivity disorder (ADHD; referred to as children at risk for ADHD) struggle in their peer relationships, teacher–student relationships, and social and academic competencies (Daley & Birchwood, 2010; Ros & Graziano, 2018). Some interventions for this population improve *adult* reports of children's social and academic competencies (Pfiffner et al., 2016), yet *peers'* sociometric judgments of these children have proven difficult to change (Hoza et al., 2005). Building on social referencing and social learning theories that highlight the influences teachers have on children's social and academic functioning, we created the Making Socially Accepting Inclusive Classrooms (MOSAIC) program (Mikami et al., 2020). This paper presents the initial test of the school-based version of MOSAIC compared to typical practice on children's social and academic functioning (as indexed by peer sociometrics, child self-report, and teacher report) for the whole class (universal supports), and differential effects for children at risk for ADHD (selective supports).

Importance of Social and Academic Functioning in Elementary School

Having socially competent behaviors and positive relationships with teachers and peers prepare elementary school-age children for good emotional and behavioral adjustment in adolescence (Wentzel et al., 2010). Children's social functioning is also linked with their academic functioning, incrementally predicting subsequent achievement and academic efficacy (Hughes & Chen, 2011). The contribution of social impairment to low achievement is thought to occur via a detrimental impact on academic enablers (i.e., skills, attitudes, and behaviors that facilitate academic performance), such as motivation and engagement (DiPerna, 2006).

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Children at risk for ADHD often show poor functioning in both social and academic areas. Teachers robustly rate them as having poor academic enablers and social skills (Daley & Birchwood, 2010; Ros & Graziano, 2018), and report strained relationships with these children (Kos et al., 2006; Rogers et al., 2015). When peers complete sociometric measures, children with ADHD receive fewer positive and more negative nominations compared to randomly selected classmates (Hoza et al., 2005). Children at risk for ADHD also perceive their relationships with teachers and peers as poorer than do typically developing children (Demaray & Elliott, 2001).

As is found in typically developing children, social and academic functioning in children at risk for ADHD are linked. Regarding peer sociometrics, Mikami and Hinshaw (2006) reported that poor social preference (i.e., receiving few positive and many negative peer nominations) incrementally predicted lower academic achievement 5 years later among girls with ADHD. Positive relationships with teachers are also crucial for children feeling connected to school, which ultimately supports academic learning. Rogers et al. (2015) found that children with ADHD perceived less closeness in the teacher–student relationship than those without ADHD, and this lack of closeness in turn predicted lower academic motivation. Further, Rushton et al. (2020) found that the association between children's higher ADHD symptoms and less engagement in school 2 years later was partially mediated by greater teacher-student conflict. Taken together, this literature underscores the importance of targeting social relationships with peers and teachers to improve academic functioning among children at risk for ADHD.

School-Based Interventions for Children at Risk for ADHD

There are some promising interventions to support social and academic functioning in children at risk for ADHD. For instance, the Collaborative Life Skills program (Pfiffner et al., 2016), which focuses on reducing deficient behaviors and improving skills in elementary school-age children with ADHD, improved teacher and parent ratings of social and academic competencies relative to a typical practice condition. Similarly, Banking Time (Williford et al., 2017) and BEST in CLASS (Sutherland et al., 2020), which focus on improving teacher–student relationships among children with adjustment difficulties (including ADHD), resulted in better teacher–student relationships and lower child behavior problems, according to teacher reports and some observed measures. Collectively, these results hold promise for helping children at risk for ADHD; however, they are not the same as improving peers' sociometric judgments. Our field has historically presumed that if children's competent behaviors increase, then better sociometrics will follow (Mikami & Normand, 2015). Yet, in the few studies with sociometric outcome measures, even the most potent interventions (i.e., combined medication and behavioral management) have no effect on peer sociometrics (Hoza et al., 2005). To our knowledge, the current study is the first to assess peers' sociometric judgments, teacher-rated social and academic competencies and impairment, and children's self-perceptions of relationships with teachers and peers, as outcomes of a classroom intervention in children at risk for ADHD.

Teacher Influences on Social and Academic Functioning

Existing interventions tend to target deficient behaviors within children at risk for ADHD but neglect the dynamics within the peer group (Mikami et al., 2020). Yet, many peers devalue or exclude children who are different, or resist altering negative impressions once established (Mikami & Normand, 2015). Thus, increasing competent behavior in children at risk for ADHD may be a necessary but not sufficient means to achieving positive peer sociometric judgments.

A classroom social ecology reflects a complex, evolving interplay between children, their peers, and teachers. Social referencing theory suggests that elementary school teachers may be able to shape peer group dynamics as an "invisible hand" (Farmer et al., 2011). As one example, peers may take some cues about how to evaluate other children from how their teacher treats those children (Mikami & Normand, 2015). If peers perceive that a teacher likes a child, this could increase peers' liking of that child. Indeed, teachers' personal liking of children has predicted those children becoming more liked by peers over time, with downstream benefits for the recipients' academic functioning (Hughes & Chen, 2011; Sette et al., 2020). Further, if a teacher has a positive relationship with a child and behaves as if the child has social value, this may also set an example that affects peers' sociometric judgments. In an experimental paradigm, children who watched a video of a teacher giving positive attention to a child actor (relative to the teacher behaving neutrally) evaluated that actor more favorably (Brey & Shutts, 2018).

These existing studies have assessed peers' judgments of children who teachers naturally like already (Hughes & Chen, 2011; Sette et al., 2020), or of child actors (Brey & Shutts, 2018). However, perhaps efforts to build positive relationships between teachers and children at risk

for ADHD could affect the peer group dynamics, and result in more positive sociometric judgments of these children. To our knowledge, *no* intervention has tried to change teachers' positivity with children at risk for ADHD in their classroom (children who teachers may not naturally like) and measured the effects on peer sociometrics, as the MOSAIC program attempts to do.

The MOSAIC Program

The MOSAIC program was created based on theory that both (a) deficient behaviors in children at risk for ADHD, and (b) peer group dynamics such as social devaluation and exclusion of children at risk for ADHD and persistence of negative reputations, contribute to poor social and academic functioning in this population. MOSAIC contains teacher strategies that target each of these areas. The strategies to improve children's behaviors are based on social learning theory, with the putative mechanism of change that clear expectations and structures are useful for helping in children at risk for ADHD to act in socially acceptable ways (e.g., Pfiffner et al., 2016). The strategies to achieve inclusive peer dynamics draw from social referencing theory, with the mechanism of change being that the teacher can communicate to peers and to children themselves that children at risk for ADHD have social value and are worthy of inclusion (e.g., Farmer et al., 2011). This dual approach by teachers may be needed to affect peers' sociometric judgments, in addition to children's social and academic competencies and the teacher–student relationship. See Supplementary Figure 1. MOSAIC is a universal intervention where the teacher delivers all strategies to the whole class, with selective supports delivered (i.e., some strategies applied more frequently) to target children with elevated ADHD symptoms and peer impairment.

An initial pilot of MOSAIC occurred in a 2-week summer program. Previously unacquainted children with ADHD (n = 24) and typically developing peers (n = 113) were in classrooms randomly assigned to implement MOSAIC or behavioral management. Target children with ADHD received fewer negative sociometric nominations and higher liking ratings in MOSAIC relative to behavioral management (Mikami, Griggs et al., 2013), with similar benefits of MOSAIC found for peers (Mikami, Reuland et al., 2013). Further, children in MOSAIC reported more supportive relationships with their teachers (Mikami et al., 2019).

We then piloted a school-based version of MOSAIC with 12 general education teachers who implemented MOSAIC for an academic year with 194 children (grades K-4). Higher teacher implementation integrity of MOSAIC strategies predicted children receiving more positive sociometric ratings in the spring, after control of fall ratings (Mikami et al., 2020). Interestingly, the strategies managing disruptive behavior had more positive effects on sociometrics for target children compared to non-target children, while strategies calling attention to children's social value had more positive effects for non-target than for target children. Possibly, target children may benefit most from MOSAIC because they have room to improve in their functioning. However, this group may also have strong negative behaviors or reputations that drive peers' sociometric judgments and overshadow subtle teacher practices. Because no intervention to date has attempted to improve teacher-student positivity and assessed sociometric outcomes, it is unknown how peers interpret teachers' positive attention to classmates with ADHD behaviors. Given the results in Mikami et al. (2020), we wondered if teachers may not have given the intended higher dose of MOSAIC strategies highlighting target children's social value (i.e., those most critical to dismantling negative reputations that peers hold). Thus, in the current trial, we enhanced our emphasis on (and monitoring of) the dose of strategies delivered to target children.

The Current Study

This study extends the evaluation of the school-based version of MOSAIC on children's social and academic functioning in a randomized trial that compared MOSAIC to a typical practice control group. Our first hypothesis was that there would be main effects of MOSAIC (at the whole class level; universal supports) relative to the control condition on better peer sociometrics, teacher ratings of social and academic competencies and impairment, and children's self-perceptions of supportive teacher and peer relationships. Our second hypothesis was that target children (identified based on elevated ADHD symptoms and peer impairment) would show greater benefits from MOSAIC relative to non-target children (selective supports). We also examined teachers' implementation integrity and acceptability of MOSAIC.

Method

Participants

Participants were 558 children (grades K-5; 48.5% female) in the general education classrooms of 34 teachers during the 2018–2019 academic year. These classrooms were located in 11 schools, distributed across two sites: western Canada (n = 288 children) and midwestern United States (n = 270 children). See Table 1 for demographics of children and teachers.

Table 1. Participant demographics.

	MOSAIC		Control		Chi-square
	n (%)		*n* (%)		*p*
Teachers	17		17		
Years of Teaching Experience[a]	11.4 (7.5)		12.1 (10.4)		.837
Gender, Female	16 (94.1)		16 (94.1)		1.00
Degree					.055
Bachelor's	6 (35.3)		11 (64.7)		
Master's	11 (64.7)		5 (29.4)		
Unknown	0 (0.0)		1 (5.9)		
Race					.512
White/Caucasian	15 (88.2)		14 (82.3)		
Asian/Asian American/Asian Canadian	2 (11.8)		1 (5.9)		
Multiracial/Other	0 (0.0)		2 (11.8)		
Ethnicity, Non-Hispanic	17 (100.0)		17 (100.0)		1.00
	Non-Target	Target	Non-Target	Target	
Children	218	73	206	61	
Age in Years[a]	7.56 (1.3)	7.52 (1.4)	7.50 (1.2)	7.21 (1.4)	.291
Gender, Female	124 (56.9)	17 (23.3)	117 (56.8)	17 (27.9)	.682
Grade					.090
Kindergarten	15 (6.9)	6 (8.2)	14 (6.8)	5 (8.2)	
First Grade	26 (11.9)	11 (15.1)	18 (8.7)	9 (14.8)	
Second Grade	58 (26.6)	17 (23.3)	63 (30.6)	20 (32.8)	
Third Grade	71 (32.6)	20 (27.4)	81 (39.3)	19 (31.1)	
Fourth Grade	36 (16.5)	13 (17.8)	20 (9.7)	7 (11.5)	
Fifth Grade	12 (5.5)	6 (8.2)	10 (4.9)	1 (1.6)	
Race					.497
White/Caucasian	84 (38.5)	41 (56.1)	72 (35.0)	26 (42.6)	
Asian/Asian American/Asian Canadian	48 (22.0)	5 (6.8)	49 (23.8)	8 (13.1)	
Black/African American/Afro-Canadian	31 (14.2)	14 (19.2)	31 (15.0)	11 (18.0)	
American Indian/Alaskan Native/Aboriginal/First Nations	0 (0.0)	1 (1.4)	2 (1.0)	1 (1.6)	
Multiracial/Other	54 (24.8)	11 (15.1)	51 (24.8)	14 (23.1)	
Missing/Did Not Report	1 (0.5)	1 (1.4)	1 (0.4)	1 (1.6)	
Ethnicity					.010
Hispanic	30 (13.8)	3 (4.1)	41 (19.9)	9 (14.8)	
Non-Hispanic	168 (77.0)	58 (79.5)	142 (68.9)	41 (67.2)	
Missing/Did Not Report	20 (9.2)	12 (16.4)	23 (11.2)	11 (18.0)	

Control = typical practice control group; MOSAIC = MOSAIC group. Chi-square represents the difference between MOSAIC and typical practice control groups.
[a]Reflects the mean and standard deviation for the group and a *t*-test comparison between MOSAIC and typical practice control groups.

Study Procedures

rocedures were approved by the university and the school district review boards at each site. We shared information about the study at school staff meetings or asked principals to e-mail it to teachers. Interested teachers contacted our team and provided written consent. At the start of the school year, consented teachers sent information about the study to all parents of students in their classrooms. Parents provided written consent, demographic information, and ratings of children's ADHD symptoms on the Strengths and Difficulties Questionnaire (Goodman, 2001). The average classroom consent rate was 69% (range: 48–96%). A cutoff of 50% has been suggested to be the value needed to obtain valid sociometric data (McKown et al., 2011).

One month into the school year (fall assessment), teachers rated consented children's ADHD symptoms, impairment, and social and academic competencies. We suggested to teachers that the three to five consented children with the highest teacher ratings of ADHD symptoms and peer impairment be selected as targets. If there was a tie, we considered parent ratings of ADHD symptoms after teacher ratings. Consented children completed a sociometric procedure and a survey about supportive relationships with their teacher and peers. In

individual interviews, research assistants read each question to the child and checked for comprehension, used a graphic to explain rating scales, and recorded the child's answers. Teachers and children completed all measures again in the last month of the school year (spring assessment).

Intervention Procedures

Teachers were randomized within school to MOSAIC (n = 17) or to a typical practice control group (n = 17) for one academic year. MOSAIC teachers had a 2-hour orientation where we gave teachers the manual, introduced the program rationale, and described the strategies using pictures and video models from the previous pilot study. During the academic year, teachers took part in intensive coaching through consultation sessions. On average, teachers had 13.4 sessions (SD = 1.6, range = 9–16), with a duration of 39 minutes each. Consultants also observed teachers twice per month in their classrooms to obtain measures of implementation integrity and gain information for consultation. They emailed performance feedback based on these observations to teachers. The consultants were a postdoctoral fellow, graduate students in clinical or school psychology, and post-baccalaureate research associates with school experience.

In the structured consultation sessions, consultants reviewed the teacher's use of the strategies from the past observation (pointing out strengths in implementation and problem-solving any challenges), introduced new strategies, and developed a collaborative plan with the teacher for future strategy use. The audiotapes of a randomly selected 24.2% of consultation sessions were coded by an independent rater using an adherence checklist for each item within a session, and an average of 95.9% of session items were covered as intended (SD = 7.7). A randomly selected 49.1% of the single coded sessions were coded by a second independent rater; the average percent agreement between the two coders on adherence items was 93.2%.

MOSAIC strategies focus on: (a) increasing children's competent behaviors, and (b) enhancing inclusive peer group dynamics (see Measures). The MOSAIC manual is organized by time of year. In fall, we suggested foundational strategies along both foci. In the winter and spring, we introduced strategies to further the initial ones. MOSAIC strategies are meant to be infused into daily practices (not delivered at a specific time of day). We asked teachers to use all strategies with the whole class and to apply some strategies more frequently to target children.

Measures

Peers' Sociometric Judgments

Children completed a sociometric procedure (Coie et al., 1982) and were shown the names and pictures of consented classmates to facilitate recall. Children nominated an unlimited number of consented classmates whom they liked (positive nominations) and whom they did not like (negative nominations). Proportion scores of positive and negative nominations for each child reflected the raw number of nominations received divided by the number of peers who participated in the procedure. We created a composite score of social preference by subtracting the proportion of negative nominations from the proportion of positive nominations received.

Children's Self-Perceptions of Supportive Relationships with Teachers and Peers

Children completed the Classroom Life Measure (CLM; Johnson et al., 1985) about their perceptions of supportive relationships with the teacher and peers (including peers' inclusive behaviors). The CLM has acceptable psychometric properties (αs = .67 to .80; Johnson et al), and relates to children's classroom behavior and academic motivation (Wentzel et al., 2010). Items are rated on a scale from 1 (*never*) to 5 (*always*). We calculated composite scores reflecting the average of teacher support (8 items, α = .67) and peer support items (9 items, α = .85).

Teacher Reports of Children's Social and Academic Competencies and Impairment

To assess children's academic enablers, teachers completed three subscales (Engagement, Motivation, and Interpersonal) from the Academic Competence Evaluation Scales – Short Form (ASF). The ASF is an abbreviated version of the Academic Competence Evaluation Scales (DiPerna & Elliott, 2001), which retains strong psychometric properties, including high internal consistency, and convergent and discriminant validity (Owens et al., 2020). Each item is rated on a scale of 1 (*never*) to 5 (*almost always*); subscales represent the mean of items (see Owens et al., 2020). We created a composite (14 items, α = .95) reflecting the mean of the three ASF subscales, and supported by bivariate correlations between subscales (rs = .57 to .77, ps < .001). Engagement (4 items; α = .84) assesses active participation in class, Motivation (5 items; α = .96) captures persistence on challenging academic tasks, and Interpersonal (5 items; α = .94) reflects appropriate social behaviors in the classroom that are related to learning.

Teachers completed three impairment items (getting along with school professionals, getting along with peers, and performing academically) related to children's inattention and to children's hyperactivity/impulsivity on the ADHD-5 Rating Scale (DuPaul et al., 2016). Each item is rated on a scale of 0 (*no problem*) to 3 (*severe problem*). We created a composite by averaging the items to reflect total impairment associated with ADHD symptoms (6 items; α = .92). Correlations between the subscales were high (*r*s = .59 to .77, *p*s < .001).

Implementation Integrity

Trained, independent coders (unaware of teachers' intervention condition) observed MOSAIC and control teachers once per month, and consultants of the MOSAIC teachers observed their teachers two additional times per month. Each observation was 40 minutes, which corresponds to one class period (or activity) in our schools and is consistent with procedures in the previous MOSAIC pilot tests. A 40-minute observation was divided into 8-minute blocks to provide more fine-grained measurement than one 40-minute period. Intraclass correlations [ICC(3,k)] as a metric of inter-rater reliability between two raters, calculated for 34% of observations, were excellent (≥ .90) for all strategies described below. As in our previous pilot study (Mikami et al., 2020), we combined the data from independent coders and consultants because they did not differ once we accounted for the classroom activity (e.g., seat work, whole-class instruction). Below, we review the strategies that were meaningful in Mikami et al. (2020) and became the central focus of consultation with MOSAIC teachers in the current trial.

Reviewing and reinforcing expectations for behavior. The purpose is to encourage children to display more competent behaviors. Reviewing expectations consists of the teacher stating expectations for the social and academic behaviors that the teacher wants children to demonstrate (e.g., sit quietly, raise hand to speak). This occurs in advance of an activity and before problems occur. Reviewing expectations for any general behavior was tallied under this code, unless specific to inclusiveness (see below). Reinforcing expectations occurs when the teacher observes a child demonstrating a desired behavior and calls positive attention to it. We tallied each time the teacher reinforced any desired behavior, unless specific to inclusiveness.

Reviewing and reinforcing expectations for inclusiveness. This practice targets peers' inclusivity by encouraging more inclusive behaviors. We separately tallied the number of times the teacher reviewed or reinforced expectations for a behavior that was specific to inclusiveness. Examples are being respectful, cooperating with others, or showing kindness.

Greetings. To facilitate the teacher–student relationship and show peers that the teacher values the recipient, the teacher greets an individual child in a personalized, sincere way. This can be done when entering the class in the morning, after lunch, or upon leaving as a good-bye. We tallied the number of times the teacher engaged in such a greeting.

CARE time. This is a 3 to 5 minute one-on-one time between the teacher and child that is separate from instruction, where the teacher shows interest in the child. As with Greetings, the goal is to show the child and peers that the teacher values the recipient. We adapted this strategy to be appropriate for elementary school from the Banking Time intervention with preschoolers (Williford et al., 2017). The acronym "CARE" reminds teachers of its qualities: **C**hild-centered focus, **A**ffirms the child, where the teacher **R**eflects the child's feelings and behavior and **E**njoys the child. CARE Time was a strategy that we asked teachers to do 2 to 3 times more often with target children relative to non-target children. Observers tallied the number of occurrences of CARE Time and noted whether the recipient was a target or non-target child.

Highlighting positive attributes. The teacher points out a child's positive personal qualities that are unrelated to behavioral compliance, to show peers that the teacher values the child and to help peers notice these same qualities. The teacher is encouraged to identify genuine attributes in the child that endure over time, and that the teacher finds admirable (e.g., talented artist, quick at running). Teachers were asked to provide this strategy at 2 to 3 times the frequency to target children relative to non-target children. We tallied the number of times the teacher engaged in this practice and noted whether the recipient was a target or non-target child.

Discreet versus public corrections. When the teacher corrects a child's behavior, doing so discreetly (when possible) could involve calling a child aside, using a lower voice, or giving a subtle cue. Even though peers may be aware of the teacher's intentions, discreet corrections show that the teacher respects the recipient, and may reduce shame the child may feel and peers' negative impressions about the child. We tallied each time the teacher engaged in a discreet correction versus

a public correction where the teacher did not make effort to be discreet.

Perceived Feasibility and Utility

At the end of the fall, winter, and spring, we assessed teachers' acceptability of each MOSAIC strategy that was introduced in that time frame. Teachers were first asked if they used the strategy, and if so, to rate on a 6-point scale (1 = *strongly disagree*, 6 = *strongly agree*) their agreement with two statements: "(strategy) was feasible to use in my classroom" and "(strategy) was effective in helping my students succeed."

Data Analytic Plan

An a priori power analysis was conducted with ICC (as a metric of the variance at the classroom level) from the summer program dataset. A proposed sample of 416 children (128 targets) in 32 classrooms had 80% power to detect a minimum effect size of d= .46 (with ICC = .10) for whole-class effects of MOSAIC versus control. For analyses testing moderation of intervention effects by target status, the minimum detectable effect size was d = .54.

Analyses in the current sample were conducted in MPlus 8.0 (Muthén & Muthén, 2017). Of 558 children, the number with complete data ranged from 547 to 549 in fall (depending on the measure) and from 529 to 538 in spring. Missing data were attributable to children arriving after the school year began, or leaving before the year ended. Children with versus without missing data, both in fall and in spring, did not significantly differ on any demographic variable or on target status. We used Full Information Maximum Likelihood estimation to handle missing data. Models contained children (Level 1) nested in classrooms (Level 2). To reduce the number of analyses, we created five models, one for each composite variable in spring that best reflected the construct: social preference from peer sociometrics, CLM teacher support, CLM peer support, the average score for ASF enablers, and the average score for ADHD-5 impairment. If there was a significant effect for MOSAIC versus control (main effect or interaction with target status) on any composite variable, where possible we followed up with tests of each subscale in the composite to see what was driving the effect. Continuous variables were converted to z-scores for ease of interpretation, and parameters were estimated using robust standard errors.

For each composite outcome variable in spring, we created an unconditional model that contained the same measure in fall, child target status (0 = *non-target*, 1 = *target*), gender (0 = *male*, 1 = *female*), and age as predictors at Level 1, and no predictors at Level 2, as in Mikami et al. (2020). Age and gender were associated with some outcome variables (see Table 2 footnote), which justifies their inclusion as covariates. ICCs reflecting the variance at the classroom level (Level 2) ranged from .02 to .21 (depending on the measure). We did not include school in the model at Level 3 because there are few clusters at this level and ICCs reflecting the variance

Table 2. Descriptive statistics of study measures.

	Social Preference			CLM Teacher Support			CLM Peer Support			ASF Enablers			ADHD-5 Impairment		
	MOSAIC M (SD)	Control M (SD)	ES	MOSAIC M (SD)	Control M (SD)	ES	MOSAIC M (SD)	Control M (SD)	ES	MOSAIC M (SD)	Control M (SD)	ES	MOSAIC M (SD)	Control M (SD)	ES
Whole Class															
Fall	0.17 (.27)	0.18 (.29)		4.50 (.51)	4.51 (.48)		3.81 (.87)	3.80 (.84)		3.74 (0.84)	3.66 (0.82)		0.58 (.70)	0.52 (.68)	
Spring	0.15 (.29)	0.15 (.27)	.00	4.55 (.47)	4.49 (.52)	.01	3.71 (.94)	3.61 (.89)	.00	3.95 (0.81)	3.69 (0.80)	.04	0.43 (.62)	0.56 (.69)	.03
Non-Target Children															
Fall	0.25 (.21)	0.26 (.22)		4.56 (.54)	4.55 (.44)		3.91 (.81)	3.85 (.79)		4.03 (0.69)	3.90 (0.73)		0.29 (.41)	0.30 (.48)	
Spring	0.23 (.23)	0.21 (.24)	.01	4.58 (.42)	4.56 (.45)	.00	3.79 (.87)	3.70 (.82)	.00	4.20 (0.71)	3.90 (0.75)	.04	0.20 (.38)	0.35 (.52)	.04
Target Children															
Fall	−0.04 (.30)	−0.08 (.34)		4.32 (.66)	4.39 (.58)		3.53 (1.00)	3.63 (.99)		2.88 (0.58)	2.88 (0.58)		1.42 (.67)	1.25 (.76)	
Spring	−0.12 (.32)	−0.04 (.28)	.06	4.47 (.57)	4.25 (.66)	.05	3.47 (1.11)	3.33 (1.02)	.02	3.22 (0.60)	3.02 (0.60)	.05	1.14 (.66)	1.27 (.74)	.05

ASF = Academic Competence Evaluation Scales – Short Form; CLM = Classroom Life Measure; Control = typical practice control group; ES = effect size; MOSAIC = MOSAIC group. Social preference ranges from −1 to 1; CLM ratings range from 1 to 5; ASF Enablers ratings range from 1 to 5; ADHD-5 Impairment ratings range from 0 to 3. ES represents the effect size of intervention on spring variable (partial η^2) taking into account baseline covariate, gender, and age, but no nesting. Partial η^2 conventions are 0.01 (small), 0.09 (medium), and 0.25 (large).

Older child age was correlated with lower social preference scores in the fall (but not spring), and lower self-perceptions of CLM peer support in the fall and the spring (rs = −.20 to −.09, ps = .001 to .048). Age was uncorrelated with the other primary outcome measures. Girls received higher social preference scores and were rated by teachers as having better ASF enablers and lower ADHD-5 impairment, compared to boys, in both the fall and spring. Girls had higher self-perceptions of CLM teacher support in spring (but not fall), but there were no gender differences in perceptions of CLM peer support. Statistics for the significant findings for gender ranged from $F(1, 547) = 65.90$; $p < .001$ (teacher ratings of ADHD-5 impairment) to $F(1, 527) = 8.84$; $p = .003$ (self-perceptions of CLM teacher support).

at Level 3 were small (.0001 to .0028), with the exception of CLM teacher support which was .01. As a robustness check, we conducted analyses for CLM teacher support with and without nesting in school and found that MOSAIC resulted in children's higher perceptions of teacher support as a main effect when nesting in school (but not without nesting in school), and that this finding was stronger for target than for non-target children (both with and without nesting in school); see Results. There were no intervention condition by site interactions, so we collapsed across site.

To test our first hypothesis, we placed intervention condition (0 = *control*, 1 = *MOSAIC*) at Level 2. The significance of γ01 in this model assessed the main effect of MOSAIC on the outcome measure in spring, after statistical control of that measure in fall, for the whole class. To test our second hypothesis, we added the cross-level interaction between intervention condition and target status to the previous model. The significance of γ11 tested whether MOSAIC had differential effects on the outcome measure for target relative to non-target children. Following recommendations of Enders and Tofighi (2007), we used grand mean centering in models testing the main effects of intervention condition, and group mean centering in models testing the cross-level interactions between intervention condition and target status. Thus:

Level 1: Spring measure = β0j + β1j (target status) + β2j (gender) + β3j (age) + β4j (fall measure) + rij
Level 2: β0j = γ00 + γ01 (intervention condition) + u0j
β1j = γ10 + γ11 (intervention condition)
β2j = γ20
β3j = γ30
β4j = γ40

Results

Descriptive Statistics

Significant positive bivariate correlations were found between the fall and spring values of the same measure (*r*s = .44 to .76, *p*s < .001). All of the measures of social and academic functioning had small to medium correlations with one another within a timepoint (*r*s = .11 to .77 in fall, *r*s = .12 to .74 in spring, *p*s ≤ .01), such that better adjustment on one measure was associated with better adjustment on another measure (even as reported by different informants).

Implementation Integrity and Perceived Feasibility

Relative to control teachers, MOSAIC teachers were observed to use more Reviewing and Reinforcing Expectations for Inclusiveness and Greetings (*p*s < .05). On the two strategies for which we tracked the target status of the recipient (CARE Time and Highlighting Positive Attributes), MOSAIC teachers were also observed to use these strategies more with both the whole class and with target children, relative to control teachers (*p*s < .05). These MOSAIC versus control group differences were evident in both the fall and the spring, showing no evidence of contamination of strategies into the control group over the school year. MOSAIC teachers gave two to three times more CARE Time and Highlighting Positive Attributes to target children relative to non-target children, whereas control teachers generally did not implement these strategies with any children. There were no MOSAIC versus control group differences on Reviewing and Reinforcing Expectations for Behavior, or Discreet and Public Corrections.

MOSAIC teachers also reported high perceptions of strategy feasibility and effectiveness. With the exception of CARE Time, across all strategies, 81% to 100% of those using them "agreed" or "strongly agreed" that the strategy was feasible. For CARE Time, 60% (in winter) and 47% (in spring) agreed it was feasible. Across all strategies, 81% to 100% of those using them "agreed" or "strongly agreed" that the strategy was helping their students succeed.

Aim 1: Whole Class Effects of Intervention Condition (Universal Supports)

These results of intervention condition for the whole class (non-target plus target children), including estimates of effect sizes, can be found in Table 2. On average, all children in MOSAIC classrooms were rated by teachers as having better competence on the ASF enablers composite in spring (γ01 = .22, SE = .11; p = .038), relative to children in control classrooms, after statistical control of fall competence. The effect size was between small and medium. Given this main effect, we investigated which subscales might be driving this finding. The effect was significant for the Engagement subscale (γ01 = .25, SE = .11; p = .020) but not the Interpersonal and Motivation subscales (although they were γ01 = .15, SE = .11; p = .150, and γ01 = .20, SE = .11; p = .070, respectively, both in favor of MOSAIC).

Similarly, on average, all children in MOSAIC classrooms were rated by teachers as having less impairment associated with ADHD symptoms on the ADHD-5 composite in spring (γ01 = −.23, SE = .11; p = .035), relative to those in the control classrooms, after statistical control of fall impairment. The effect size was also between small and medium. In follow-up analyses on subscales, children in MOSAIC had less impairment in getting along with school professionals (γ01 = −.26, SE = .12;

p = .024) and in getting along with peers (γ01 = −.22, SE = .11; p = .041), but no differences in impairment in academic performance (although trends were in favor of MOSAIC; γ01 = −.16, SE = .11, p = .131).

We considered the clinical significance of the whole class findings on the ADHD-5 scale. Using cutoffs recommended by Power et al. (2017), Table 3 shows that the percentage of children in MOSAIC who were rated as having moderate or severe impairment in each domain of functioning dropped by one-third to one-half from fall to spring, whereas the percentage of children with moderate or severe impairment in control classrooms remained similar. The ASF does not yet have the population norms or cutoffs to allow us to calculate clinical significance.

There were no main effects of MOSAIC at the whole class level on the composite scores of social preference, CLM teacher support, or CLM peer support. These measures had effect sizes associated with MOSAIC that were close to zero at the whole class level.

Table 3. Children rated as having moderate or severe impairment associated with ADHD symptoms on the ADHD-5.

	MOSAIC % Moderate or Severe		Control % Moderate or Severe	
	Fall	Spring	Fall	Spring
Whole Class				
Getting along with school professionals	13.4%	7.9%	14.2%	15.7%
Getting along with peers	15.1%	10.3%	10.9%	13.1%
Performing academically	27.1%	16.2%	22.5%	22.8%
Non-Target Children				
Getting along with school professionals	2.8%	1.8%	4.9%	7.3%
Getting along with peers	3.2%	0.9%	2.4%	4.9%
Performing academically	16.1%	7.8%	13.1%	12.6%
Target Children				
Getting along with school professionals	45.2%	26.0%	45.9%	44.3%
Getting along with peers	50.7%	38.4%	39.3%	41.0%
Performing academically	60.3%	41.1%	54.1%	57.4%

Control = typical practice control group; MOSAIC = MOSAIC group.

Aim 2: Effects of Intervention Condition on Target Children (Selective Supports)

Table 2 shows the impact of MOSAIC for target versus non-target children, and effect sizes. There was an interaction between intervention condition and target status on the outcome variable of social preference (γ11 = −.46, SE = .12; p < .001), such that target children received lower social preference in MOSAIC classrooms in spring, relative to target children in control classrooms, after accounting for fall social preference. The effect sizes suggested that MOSAIC was associated with negligible difference in social preference for non-target children, but with poorer social preference for target children (small to medium effect size). Given this result, we examined subscales of positive and negative nominations. There were interactions between intervention condition and target status on positive (γ11 = −.24, SE = .12; p = .049) and negative nominations (γ11 = .54, SE = .14; p < .001), such that target children in MOSAIC received both less positive and more negative nominations relative to target children in control classrooms.

Target status also moderated the effects of intervention condition on children's self-perceptions of teacher support on the CLM (γ11 = .45, SE = .19; p = .017). Here, target children in MOSAIC classrooms reported more teacher support in spring than did target children in control classrooms, after accounting for fall support, with an effect size between small and medium. There was little difference in perceptions of teacher support among non-target children in MOSAIC versus control classrooms. No interactions with target status were found on CLM peer support, ASF enablers, or ADHD-5 impairment. The effect sizes (Table 2) and clinical significance (Table 3) suggested no iatrogenic effects of MOSAIC on these outcomes and, if anything, had trends of stronger benefits of MOSAIC for target relative to non-target children.

Exploratory Analyses: Integrity

Because MOSAIC was associated with poorer sociometrics yet better perceptions of supportive teacher–student relationships for target children, we explored how continuous levels of MOSAIC strategies from the integrity observations, regardless of intervention condition, predicted the outcomes on which moderation was found. We conducted multilevel models with social preference or CLM teacher support in the spring as the outcome, the same measure in fall and gender and age as controls at Level 1, and the continuous MOSAIC strategy at Level 2.

No teacher strategy predicted social preference in spring on the whole class level (as a main effect), either positively or negatively, after accounting for fall social preference. Two strategies (CARE Time to the whole class [γ11 = −.15, SE = .03; p < .001] and to targets [γ11 = −.16, SE = .04; p < .001], and Highlighting Positive Attributes of targets [γ11 = −.11, SE = .05; p = .043]) showed interactions with target status, such that greater teacher use of these strategies was associated

with poorer social preference for target children but either no effect or a trend toward better social preference for non-target children. The interaction was in the same direction for Highlighting Positive Attributes of the whole class (γ11 = −.11, SE = .07; p = .095). Interestingly, teacher use of more Public Corrections was associated with higher social preference for target children but poorer social preference for non-target children (γ11 = .18, SE = .06; p = .004). Reviewing and Reinforcing Expectations for Behavior and for Inclusiveness, Greetings, and Discreet Corrections did not predict social preference.

Greater teacher use of Reinforcing Expectations for Inclusiveness (γ01 = .08, SE = .03; p = .014), Greetings (γ01 = .08, SE = .03; p = .004), and CARE Time (γ01 = .08, SE = .03; p = .015), each predicted higher perceptions of supportive teacher–student relationships among all children as a main effect at the whole class level in spring, after controlling for fall support. The association for Public Corrections with teacher support at the whole class level tended to be negative (γ01 = −.07, SE = .04; p = .059). Four strategies had an interaction with target status: Reinforcing Expectations for Inclusiveness (γ11 = .22, SE = .10; p = .025), Greetings (γ11 = .16, SE = .05; p = .001), CARE Time to whole class (γ11 = .16, SE = .06; p = .004) and to targets (γ11 = .14, SE = .05; p = .008), and Highlighting Positive Attributes of targets (γ11 = .19, SE = .08; p = .021). The interaction was in the same direction for Highlighting Positive Attributes of the whole class (γ11 = .14, SE = .07; p = .060). In all cases, greater use of these strategies predicted higher perceptions of teacher support among target children, but no effect on teacher support for non-target children. Reviewing and Reinforcing Expectations for Behavior and Reviewing Expectations for Inclusiveness did not predict perceptions of teacher support.

Discussion

This study presents the results of a small randomized trial of MOSAIC, a classroom intervention to bolster the social and academic functioning of elementary school-age children (universal supports), particularly those children at risk for ADHD (selective supports). At the universal level, we found that all children in MOSAIC showed better social and academic competencies and lower impairment in spring (after statistical control of fall functioning), as rated by teachers, relative to children in a typical practice control group. At the selective level, target children (those with elevated ADHD symptoms and peer impairment) in MOSAIC classrooms also reported more supportive relationships with teachers, but were less favorably regarded by peers on sociometric measures, relative to target children in control classrooms. The contrary findings for sociometrics relative to other measures of functioning for target children stimulates further consideration of our theory of change and the perspective of the informant.

Whole Class Effects (Universal Supports)

That on average, both non-target and target children in MOSAIC had better teacher-rated social and academic competencies and lower impairment is encouraging. MOSAIC teachers perceived better functioning in both social (e.g., ADHD-5 impairment in getting along with school professionals, and with peers) and academic domains (e.g., ASF engagement). This is consistent with hypotheses and provides support for the theory of change linking children's social and academic functioning, and the promise of intervention based on social referencing and social learning theories to address difficulties in both areas. Nonetheless, these outcomes are reported by teachers, who are aware of intervention condition and may be motivated to report MOSAIC-related improvements. There were no whole class effects on sociometrics, or on children's self-perceptions of peer and teacher support. Still, a teacher's positive impression of a child's functioning could affect teacher expectations and have downstream beneficial effects on the child's behavior or relate to reduced teacher stress and burnout. Thus, these teacher-reported changes in children's competencies and impairments may be clinically meaningful.

Effects on Target Children (Selective Supports)

For this high-risk group, the MOSAIC condition was associated with target children perceiving more supportive teacher–student relationships, yet, simultaneously, receiving poorer sociometric judgments from peers. The exploratory integrity analyses confirmed this pattern. That is, teachers' greater use of MOSAIC strategies was associated with both higher perceived teacher support, and also poorer social preference, for target children. Children at risk for ADHD are well-known to have conflictual relationships with teachers, and to dislike school (Kos et al., 2006). That this group of children is noticing the efforts made by MOSAIC teachers to connect with and to socially value them is encouraging, as such perceptions may raise children's feelings of academic motivation, engagement, and connection to school (Rogers et al., 2015; Rushton et al., 2020). Our findings extend the promising results from interventions

to increase teacher positivity with children who have adjustment difficulties (Sutherland et al., 2020; Williford et al., 2017) to the population of school-age children at risk for ADHD, and to a child self-report outcome measure. Importantly, there are not yet any empirically supported interventions for ADHD populations that improve the teacher–student relationship (Kos et al., 2006).

However, MOSAIC may have some iatrogenic effects on peers' sociometric judgments of target children. Post hoc, we speculate that perhaps peers become irritated or resentful when children with ADHD behaviors receive positive attention from teachers. A study found that when peers observed parents praising their children, this resulted in peers disliking the recipient if the recipient had behaved aggressively, even when the praise was for positive behavior (Jack et al., 2011). Another possibility is that peers do not find teacher positive attention to be believable if the recipient has ADHD behaviors, and think that the teacher is doing so out of obligation.

Although the results for children's perceptions of more teacher support are consistent with those obtained in the summer program pilot (Mikami et al., 2019), those for sociometrics are contrary (Mikami, Griggs et al., 2013). In the summer program, children were previously unacquainted, the program was only 2 weeks, and the program content was nonacademic. It may be easier for peers to buy into teachers' positive attention toward children at risk for ADHD if peers do not have a history with these children or if they will not interact with these children for much time. Children's ADHD symptoms may also have been less noticeable to peers in that environment, so peers would not be as bothered by teachers' positivity toward these children.

The literature suggesting that peers increase their sociometric liking of the classmates who teachers like is based on teachers' natural liking of children (Hughes & Chen, 2011; Sette et al., 2020), as opposed to the result of an intervention to increase teacher-student positivity with children who may be difficult to like. One possibility is that children who are naturally liked by the teacher possess likeable qualities that the teacher can help peers notice, over time. However, when teachers change their behavior to show positivity toward children who they do not already like, the teacher's actions are not compelling relative to other factors leading peers to dislike these children. Peers may even interpret the teacher's behavior in ways that result in resentment or disliking. It is also possible that teachers are increasing positive behaviors toward children at risk for ADHD, but not their internal liking, and this is noticed by peers. Thus, perhaps for children at risk for ADHD, positive teacher–student relationships do not necessarily result in peers' positive sociometric judgments, even if they bring other important benefits such as fostering a connection to school. Indeed, there is no intervention that meets evidence standards for improving *peers'* sociometric judgments of children at risk for ADHD (Evans et al., 2018).

However, it is important to distinguish between inclusive peer behaviors (the explicit target of MOSAIC) relative to sociometric judgments, which we had hoped would be an eventual outcome. The former reflects the way peers treat others, whereas the latter reflects their internal, affective evaluations. All evidence from our data suggests that peers' inclusive behaviors are the same if not improved in MOSAIC. On the ADHD-5, teachers reported less impairment in getting along with peers for children in MOSAIC (target and non-target), with trends showing that target children if anything, had stronger benefits from MOSAIC on this outcome (see Table 3). Although nonsignificant, target children in MOSAIC tended to perceive more peer support than those in the control group; thus, no evidence of iatrogenic effects on this measure. It may be that teachers are encouraging peers to behave in respectful ways, but this may differ from peers' internal opinions. Anecdotally, teachers tell us that they say, "You don't have to be friends, but you have to be friendly to your classmates." This finding may represent this sentiment.

Clinical Implications and Future Directions

MOSAIC contains strategies to address the deficient behaviors of children at risk for ADHD, some of which are similar to strategies in the Collaborative Life Skills program (Pfiffner et al., 2016) that are found to be efficacious on this outcome. MOSAIC also contains strategies to create a more inclusive peer climate, based on the idea that the teacher showing positivity to children at risk for ADHD demonstrates these children's social value. These strategies are similar to those found in BEST in CLASS (Sutherland et al., 2020) and Banking Time (Williford et al., 2017) to improve the teacher–student relationship. However, MOSAIC is unique in its combination of both types of strategies, as well as its focus on peer group dynamics as a means to improving children's social and academic functioning. It is promising that MOSAIC improved both teacher-rated social and academic competencies and perceptions of a supportive teacher–student relationship among target children, suggesting the potential benefits of this dual approach. However, our results also underscore the difficulty in changing peers' sociometric judgments,

particularly about children at risk for ADHD who peers may already dislike.

Although exploratory, the findings from the integrity data may indicate ways to refine MOSAIC. The strategies with detrimental impact on peers' judgments of target children were ones where the teacher paid individualized positive attention to these children (CARE Time and Highlighting Positive Attributes). Yet, these same strategies, along with Greetings and Reinforcing Inclusiveness, also raised target children's self-perceptions of teacher support. One future direction may be to vary the schedule of reinforcement so that the teacher's positive attention is distributed more equally among target and non-target children, while maintaining a preponderance of positivity with both groups. Such an approach may make it appear less as if teachers are giving special positive attention to children with ADHD behaviors.

Another future direction may be to address other contributors to peers' sociometric judgments, besides a teacher's positivity toward a child. The Contact Theory framework holds that intergroup contact creates positive relationships between ingroup and outgroup members, particularly when: (a) children are considered to be equals (minimizing status differences), (b) they work in pursuit of a superordinate goal, and (c) inclusivity is supported by authority figures (e.g., teachers; Johnson et al., 1985). The MOSAIC strategies aimed to reduce status differences (via the teacher showing that children at risk for ADHD have social value) and to encourage inclusivity (via the teacher reviewing and reinforcing expectations for inclusiveness). However, MOSAIC did not emphasize superordinate goals. By contrast, cooperative learning instructional strategies follow directly from the Contact Theory framework, and contain activities where children must work together in order to achieve a superordinate goal. Cooperative learning has been shown to improve children's self-perceptions of supportive peer relationships in addition to having academic benefits (Van Ryzin & Roseth, 2018), although it is unknown whether this affects sociometric outcomes for children at risk for ADHD. Emphasizing cooperative learning strategies in MOSAIC in the future might improve efficacy for changing sociometric judgments.

It is worth considering if the benefits for target children in terms of improved teacher-rated competencies and lower impairment, and in self-perceptions of higher teacher support, outweigh the negative sociometric effects. We are hesitant to dismiss the sociometric outcomes, and they raise ethical issues about exposing future children to intervention practices which may have some negative side effects, even if associated with other benefits. But, the question of which outcomes to prioritize for children at risk for ADHD is relevant for practitioners. It is common to weigh benefits versus side effects associated with medication for ADHD; families and teachers should also do so for psychosocial interventions. Unknown is whether in the long term, improved social and academic competencies and teacher-student positivity from MOSAIC will lead to better sociometrics, or conversely, whether poorer sociometrics will lead to poorer competencies. Finally, although the current study used consultants who were members of the research team, perhaps school psychologists or teachers previously trained in MOSAIC could take on this role in the future, which would be needed for broader adoption of MOSAIC.

Study Strengths and Weaknesses

Study strengths include the randomized design, use of multiple informants, adequate integrity data, and high ratings of strategy acceptability by teachers. However, target children were not diagnosed with ADHD, nor were clinical comorbidities assessed. To maximize external validity, we selected target children about whom teachers were most concerned. Thus, we do not know how results apply to children with diagnoses of ADHD, or how comorbidities may have affected the results. In addition, one (of the 34) classrooms was slightly below the 50% consent rate required for sociometrics, and the most severe children may not have consented. Further, both MOSAIC and control teachers were implementing other social emotional learning and behavioral management programs. This may have affected our signal to detect the impact of MOSAIC. Finally, there are other factors that influence children's social and academic functioning (e.g., school climate, teacher beliefs) that we did not measure.

Summary

The MOSAIC program led to teacher ratings of better social and academic competencies and lower impairment in children at the whole class level. For target children at risk for ADHD, MOSAIC was also associated with child self-perceptions of more supportive relationships with teachers but poorer sociometrics. Results highlight the difficulty in changing peers' sociometric judgments, and the need to

understand this as an intervention outcome in future studies.

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