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Factors associated with implementation of a school-based comprehensive program for students with autism

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Abstract

The purpose of this study was to examine influences on the implementation of a school-based comprehensive program for autistic children. Following the conceptual framework suggested by the Exploration, Preparation, Implementation, Sustainment (EPIS) model, variables from the outer context, inner context, and also that were part of the comprehensive program were explored. An index approach was employed for assessing implementation. The study was part of a larger cluster randomized control trial and took place in 39 elementary schools in a southeastern state within the United States. Variables associated with implementation were transformational leadership style of the principal, percentage of students in the school who were white, and adequacy of coaching. Implications for practice and future research were identified.

Lay abstract

The purpose of this study was to identify influences on the implementation of a school-based, comprehensive program for autistic students. Influences from the community context, from within the school organization, and from features of the intervention itself were examined. The study took place in 39 elementary schools in a southeastern state in the United States. Transformational leadership style of the building principal, percentage of white students at the school (which was proposed as a broader community socioeconomic variable), and adequacy of coaching were all associated with implementation.

Keywords

autism, comprehensive program, education services, implementation, interventions, psychosocial/behavioral

The rising prevalence of autism has created a pressing need for effective programs that address learning goals for autistic students attending public school programs.[1] Responding to this demand, researchers have designed comprehensive programs to promote autistic children's development and learning. As these comprehensive programs move out of their efficacy testing phases and into adoption by service providers in the community, they are only as good as their implementation. One of the primary community contexts in which children with autism spend significant time is public schools (Lord et al., 2021). To date, there have been few examinations of variables that are associated with implementation of a comprehensive program in a public school context. The purpose of the current study is to employ a frequently used conceptual model of implementation, the framework (EPIS; Aarons et al., 2011), in the examination of factors associated with the implementation of a public school-based comprehensive program for autistic students.

The prevalence of autism has accelerated over the past three decades, with the prevalence in the United States, reported by the Center on Disease Control and Intervention (Maenner et al., 2021) being one in 44 elementary school-aged children. The defining impairments of autism, social, communication and restrictive/repetitive behavior (American Psychiatric Association, 2013), create lifelong challenges for many individuals with autism. Primary

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efforts and funding have been directed toward establishing practices and programs that are efficacious and generate positive effects for children and youth with autism. Two general classes of interventions exist—focused intervention practices and comprehensive programs (Odom et al., 2010).

Focused intervention practices address targeted, individual goals for autistic children (e.g. a prompting practice to promote a peer social communication goal). In a recent review of the autism intervention literature, Hume, Steinbrenner, et al. (2021) identified 28 focused intervention practices that met their criteria for evidence-based practice (EBP). Comprehensive programs consist of specific focused intervention practices organized within a conceptual framework (Odom et al., 2014). Examples of comprehensive programs are the Early Start Denver Model (Rogers & Dawson, 2010), the LEAP model (Strain & Bovey, 2011), the Lovaas model, and other similar early intensive behavioral interventions (Lovaas, 1987).

As the number of children and youth with autism has increased markedly in public school settings (Office of Special Education Programs, 2020), there is a corollary need for comprehensive programs to be employed in schools. There has been a long history of comprehensive programs employed in school contexts for preschool-aged children, with the LEAP model (Strain & Bovey, 2011) being a primary example of such research. For older autistic children, the intervention research in school settings has tended to examine more the implementation of individual evidence-based practices and teachers' uses of those practices with fidelity (Hume, Steinbrenner et al., 2021). In the recent autism intervention literature, examinations of school-based comprehensive programs have begun to appear. For example, pivotal response treatment (PRT, Koegel & Koegel, 2019; Schreibman & Koegel, 2005) is a comprehensive program originally used in clinic and community contexts. Suhrheinrich et al. (2020) extended their implementation of PRT to kindergarten classrooms in public schools, documenting the associations of contextual variables on implementation. In high-school programs, Hume, Odom, et al. (2021) examined the effectiveness of a comprehensive program for adolescents, finding effects on quality of the school program environment and autistic students' goal attainment. Similarly, in elementary schools, Sam et al. (2021) tested the efficacy of a comprehensive program originally designed and evaluated by the National Professional Development Center on Autism Spectrum Disorders (NPDC, Odom et al., 2013) and found an increase in school staff fidelity of EBPs and autistic students' goal attainment.

Examinations of implementation of comprehensive programs in public schools are unique in at least two ways. First, as Kainz and colleagues (2021) noted, the school context is itself dynamic (e.g. staff turnover and varying schedules) and complex (e.g. range of different implementers and autistic students having different learning goals). Second, comprehensive programs consist of a number of "moving parts" (e.g. multiple focused intervention practices, multiple implementers, etc.) that require an assessment of implementation that extends beyond only measurement of fidelity of one or two focused intervention practices. Third, because they are situated in a community context and also operate within a more immediate school building context, factors that are distal from and proximal to the settings in which teachers and service providers employ a comprehensive program may well affect implementation.

In implementation science, formal models of implementation have proliferated over the last two decades (Albers et al., 2017). To examine factors affecting implementation of comprehensive programs in school-based contexts, the EPIS model developed by Aarons and colleagues (2011) provides a useful conceptual framework. The model consists of outer (distal) and inner (proximal) context factors, bridging factors, and innovation factors (i.e. specific features of the program or practice) that may affect the degree to which a program is implemented. Also, there are precedents for using the EPIS conceptual framework in examinations of implementation factors in school-based interventions (Suhrheinrich et al., 2020), early intervention (Bustos et al., 2021), and community-based mental health programs (Brookman-Frazee et al., 2020).

For school-based comprehensive programs, outer context factors might include the urbanicity (e.g. urban and rural), which has been associated with autism program quality (Kraemer et al., 2020) and the socioeconomic status (SES) or by proxy the racial/ethnic demographic of students in the school (i.e. better-resourced schools may be better able to support implementation). Internal contextual factors could include the leadership style within the school, with the principal being the titular leader in the schools. The multifactor leadership questionnaire (MLQ; Bass & Avolio, 1995) has been used to identify three leadership styles, with the transformational style expected to support implementation and the transactional and passive styles to be not or negatively associated with implementation (Kensbock & Boehm, 2016; Maier et al., 2016). In addition, the quality of the overall autism program environment and specifically the quality of collaboration among professional team members could be inner environment constructs positively associated with implementation (Donaldson & Stahmer, 2014). Another inner context variable previously discussed as having a positive association with implementation is practitioner attitude toward evidence-based practices, as often measured by the Evidence-based Practices Attitude Scale (EBPAS; Aarons et al., 2012; Locke et al., 2019). Last, coaching by project staff for teachers or other practitioners is often seen as an important construct significantly associated with implementation

(Suhrheinrich, 2011). The adequacy of coaching provided may be associated with the degree to which implementation occurred (i.e. adequate coaching positively associated with implementation and inadequate coaching negatively associated with implementation).

The current study was conducted as part of a larger cluster randomized controlled trial (CRCT) that examined the efficacy of the comprehensive program developed by the NPDC, previously noted, and delivered in elementary schools in a southeastern part of the United States (Sam et al., 2021). Sixty elementary schools were randomly assigned on a 2:1 ratio to the NPDC (i.e. actually only 39 schools in this condition with one dropping out) or services as usual condition (SAU). Only the schools implementing the NPDC program are included in this study. A key feature of the NPDC program is the formation of an implementation team (i.e. called the autism team or A-team) before the school year begins. Members of the A-team were special and general education teachers, speech-language pathologists, school psychologist, other related service providers, and a member of the school administrative team (i.e. often an assistant principal). Other features of the NPDC program included initial training for the A-team before the school year, assessment of the autism program environment and development of an action plan for improving school quality, identification of autistic students' learning goals, linking specific EBPs to identified learning goals, monitoring progress and weekly coaching on use of EBPs with performance-based feedback on teacher fidelity (i.e. as measured by the percentage of steps completed correctly on EBP fidelity checklists). The program was implemented in inclusive and special education classrooms in the schools and involved autistic students across grade levels. A detailed description of the NPDC program and efficacy study may be found in Sam et al. (2021).

The aim of the current study was to examine variables associated with implementation of the NPDC program in elementary schools. The research questions were: (1) Are there outer context variables associated with implementation of the NPDC programs? We predicted that there would be a positive association between variables reflecting socioeconomic resources in the community and implementation. Based on previous research, also we anticipated a positive correlation between urbanity and implementation. (2) Are there inner context variables associated with implementation of the NPDC program? We predicted that leadership style (i.e. positive association for transformative, neutral or negative for transactional and passive), autism program environment quality and the specific domain of team collaboration (i.e. positive association), and teacher attitude toward EBPs (i.e. positive correlation). (3) Is there an association between the adequacy of coaching, as an innovation variable, and implementation? We predicted a significant association between adequacy of coaching and implementation.

Methods

Setting and community participation

As noted, the current study included the 39 publicly funded, community-based elementary schools in the NPDC program intervention condition from the study of Sam et al. (2021). These schools were purposively recruited to represent the demographics of the state in which it occurred and the diverse demographics of the students and families. Before random assignment in the CRCT, superintendents or district supervisors were first contacted and indicated their agreement to participate. They then referred the research staff on to principals, who communicated with their teachers and then agreed for their school to participate. The study was first approved by the Human Subjects Committee at the host university, and informed consent was obtained from all school personnel and for all autistic student participation (via parent consent and student assent).

The schools were located in a southeastern state in the United States with representation from urban (n = 16), suburban (n = 12), and rural (n = 11) locales. An inclusion criterion was that schools provided special education services for children in both separate special education settings and inclusive general education settings. On average, 44% of schools' total student population was identified as white (i.e. 56% from various racial and/or ethnic groups), and 55% of students qualified for free and reduced lunch (FARL). The majority of schools (71.8%) were identified as Title One schools.

As this study took place in a single state, investigators employed the Generalizability Index to determine the extent to which findings from the current study could be generalized to other schools in the United States (Tipton & Miller, 2016). The Generalizability Index assesses the degree to which the sample is representative of a population (Tipton, 2014). It produces scores which range from 0 to 1 with scores between 1.0 and 90 representing very high generalizability, 0.90 and 0.80 as high generalizability, 0.80 and 0.50 as medium generalizability, and scores below 0.50 as low generalizability. The schools in the current study were very highly representative of other schools in the United States with a Generalizability Index score of 0.92.

Participants

School personnel participants were the 369 members identified as members of the A-team. There was an average of 9.4 members per A-team. The majority of A-team members were white, non-Hispanic, and women (see Table 1). In the NPDC program study condition from the study of Sam et al. (2021), 344 autistic children participated. The demographics for those children and their families appear in Table 2. Demographics for the entire sample were reported in Sam et al. (2021).

Table 1. A-team demographics.

	Total	
	N	%
Race and ethnicity		
American Indian/Alaska native	2	0.50
Asian	4	1.1
Black	55	14.9
Hispanic	8	2.2
Multiracial	2	0.50
Other	1	0.30
White	305	82.7
Gender		
Male	19	5.1
Female	350	94.9
Education		
High-school diploma	2	0.5
Associates degree	4	1.1
Bachelor's degree	162	43.9
Master's degree	190	51.5
Above Master's degree	11	3.0
Role		
Special education teacher	142	38.5
General education teacher	147	39.8
Paraprofessional	6	1.6
Speech-language pathologist	35	9.5
Occupational therapist	7	1.9
Counselor	2	0.5
Psychologist	6	1.6
Administrator	17	4.6
District/building specialist	1	0.5
Other	5	1.4

Table 2. Child and family demographics.

	NPDC	
	N	%
Child race and ethnicity[a]		
Asian	21	6.1
Black	89	25.9
Hispanic[b]	56	16.3
Multiracial	22	6.4
Other	6	1.7
White	150	43.6
Child gender		
Male	266	77.3
Female	78	22.7
Child grade		
Kindergarten	53	15.4
1st	59	17.2
2nd	69	20.1
3rd	53	15.4
4th	53	15.4
5th	55	16.0
Other	2	0.6
	M	SD
Child age	8.40	1.83
Estimate of annual household income[c]	58,533	24,558
Nonverbal IQ	78.91	24.89
Adaptive behavior ABC	68.72	17.40
Social communication questionnaire lifetime	20.97	7.03

[a]No report of race/ethnicity for one student.
[b]Self identified as White/Hispanic.
[c]Annual household income estimated from families address and census information because of degree of missing data from parent self-report.

Implementation variable

Given that an index approach is somewhat unique in autism intervention research, a short rationale is provided here. Comprehensive programs that are applied school-wide are like complex social interventions from other disciplines (Kainz et al., 2021) in that they consist of multiple dimensions. The implementation index (IIdx) approach was designed to assess those multiple dimensions. Based on Cordray's (Cordray et al., 2013; Nelson et al., 2010) conceptualization of implementation of educational interventions in school context, the IIdx assesses (1) the intervention delivered to the school personnel (e.g. training and coaching); (2) the intervention that the school personnel deliver to the student; and (3) the intervention received by the individual students. Reflecting this conceptualization, the current IIdx included information at the school (e.g. training and coaching provided), staff (e.g. fidelity and teaming), and student (e.g. planning and dosage) levels. In a previous study, Steinbrenner et al. (2020) designed and employed an index like this for a comprehensive program for autistic adolescents in high schools, and Hume, Odom, et al. (2021) found that it discriminated between schools employing the intervention programs and schools under the SAU condition.

For the current study, the IIdx consists of six core features of the NPDC program: (1) A team formation; (2) participation on the A-team; (3) professional development for the A team; (4) program quality activities; (5) goal attainment scaling (GAS) goal development; and (6) EBPs (see Sam et al., 2021 for more detailed information). Each item was scored on a 3-point rating scale with 1 as incomplete, 2 as partially complete, and 3 as complete. Research staff collected records and information needed to complete the scale across the entire year. Examples of data are consent forms, attendance at training academies, and completion of GAS. The specific data sources may be found on the IIdx form itself, located in the Supplementary Materials. In the spring of the year, the research team assembled the data, and the research project director used the data to score a rating for each item (see Sam et al., 2021 for additional details). The internal consistency reliability of the scale, as measured by Cronbach's alpha, was 0.88. To

assess discriminant validity, Sam et al. (2021) completed the IIdx rating on 20 elementary schools that served as the SAU comparison in the CRCT. They found significantly higher IIdx ratings for schools under the NPDC program condition as compared with school under the SAU condition.

Predictor variables

As noted, in the EPIS model, Aarons and colleagues (2011) identified critical implementation influences that occur in the outer and inner contexts as well as innovation practices. In the efficacy study described in Sam et al. (2021), variables that reflected some of these implementation influences were collected, which allowed an examination of their association with implementation of the NPDC program.

EPIS variables (outer context). The outer context variables describe the community setting demographics, the racial diversity of the school student body, the socioeconomic demographics of the community, and relatedly the state's classification of the school as a Title 1 school (or not). These data were collected at the beginning of the academic year. The community in which the school resided was classified as urban or rural (as defined by the National Center on Educational Statistics, https://nces.ed.gov/programs/maped/LocaleLookup/). The racial/ethnic diversity of the school was defined as the percentage of the study body identified as white, which by inference indicates the percentage of students from diverse (nonwhite or Hispanic) racial/ethnic groups. The data sources did not provide a further breakdown of race/ethnicity demographics at the school level. However, the number of autistic students in specific ethnic groups in this implementation study is reported in Table 2. The percentage of children qualifying for FARL reflected the socioeconomic status of families from the community that was the catchment area for the school. State criteria for qualification for FARL were based on federal eligibility guidelines for the year the school participated in the study (see https://www.fns.usda.gov/cn/income-eligibility-guidelines). Similarly, the state designated schools as Title 1 based on the student socioeconomic and achievement factors, which provides the schools with additional resources (than non-Title 1 schools) for the educational mission for all students.

EPIS variables (inner context). To explore the inner context of the EPIS model, variables related to school leadership, A-team staff attitudes toward EBPs, and program quality were used. Leadership was measured using the MLQ (Bass & Avolio, 1995). The MLQ assesses behaviors representative of key leadership and effectiveness behaviors. It includes 45 items rated on a 5-point scale indicating the frequency of specific leader behaviors. The MLQ has demonstrated high internal consistency in the normative sample (α's = 0.63–0.92; Bass & Avolio, 1995) and implementation studies (α's = 0.68–0.96; Stadnick et al., 2019) of EBPs in elementary schools for students with autism. In the current sample, the MLQ demonstrated high internal consistency (Cronbach's alphas = 0.88–0.93). The MLQ generates three leadership styles: (1) transformational (characterized as charismatic and intellectually stimulating); (2) transactional (characterized as individualized consideration and contingent reward); and (3) passive (characterized as laissez-faire and reactive). Members of the A-team completed the MLQ (N = 358) on the school principal, who is the traditional educational leader at the school building level, in the spring semester of the academic year. Because individual A team members are nested within schools, the MLQ scores were averaged across respondents, generating one profile for each school.

To assess A-team members' attitudes about EBPs, A-team members completed the EBPAS (Aarons et al., 2012) in the fall of the academic year. The EBPAS is a 15-item scale, with the items having a 0–4 rating Likert-type form. It provides a total score and scores for four subscales, with both having strong psychometric evidence. The EBPAS has been used previously to examine the association of teacher attitude and use of interventions for autistic children (e.g. Suhrheinrich et al., 2020). For the purposes of this study, the total score was used.

It was possible that implementation might be related to the existing quality of the schools before the implementation began (e.g. high-quality schools might be higher implementers than low-quality schools). For this study, quality was defined as the degree to which school program features and service meet the learning needs and characteristics of autistic students. To examine program quality at the beginning of the year, research staff used the preschool/elementary version of the autism program environment rating scale (APERS-PE) (Odom et al., 2018). The APERS-PE is a 59-item rating scale organized into 10 domains (learning environment, positive learning climate, assessment and IEP development, curriculum and instruction, communication, social competence, personal independence, family involvement, and teaming). Items are scored on a 5-point Likert-type rating continuum with a "1" rating indicating poor quality, a "3" rating indicating acceptable quality, and a "5" item indicating excellent quality. Raters complete the scale after observing in classes, interviewing key informants (e.g. teachers, parents, and A-team members), and reviewing documents. The APERS-PE was collected in both separate special education and inclusive settings at each school by research staff, and a weighted total APERS-PE score was calculated (see Sam et al., 2021). In previous research, Odom et al. (2018) found high levels of internal consistency, adequate interrater agreement, and evidence of construct validity (i.e. from exploratory and confirmatory factor analyses)

for the APERS. Similar internal consistency ($a = 0.93$ and 0.96 for special education and inclusive setting) and high interrater agreement from 20% of the classes (intraclass correlation coefficient (ICCs) = 0.97 and 0.98 for special education and inclusive classes) for the current study were previously reported in Sam et al. (2021).

The APERS total score was the metric employed for the school quality variable, with a prediction of a positive association with implementation. Also, the APERS has a domain identified as teaming, which reflected general collaboration among school personnel providing services to autistic students, and it was possible that schools with preexisting high-quality teaming and collaboration among staff could have been better implementers, which was the prediction for this study.

Innovation. Implementation science indicates that coaching is a key influence on program implementation (Walunas et al., 2021). The adequacy of coaching was used as an indicator of the innovation feature of the EPIS model. For the NPDC program, coaches were to spend 6 hours/week at each intervention school and followed the NPDC professional development program for coaching (see Sam et al., 2021). Coaching consisted of a preobservation meeting, observations, and postobservation debriefs (see Kucharczyk et al., 2012). Thirteen professionals with previous experience in schools were recruited to be coaches, trained to deliver the coaching feature of the program, and supervised by the project director and a second coaching supervisor. Despite initial training, the two supervisors determined that inadequate coaching was occurring for four of the coaches who were responsible for nine schools. The inadequacies in coaching were defined by failing to follow coaching protocol, inadequate coaching plans and engaging in interactions that resulted in complaints from teachers about professional behavior. This resulted in termination for one staff member, retraining other staff members, and surveillance with direct feedback for the staff members that remained. Given the importance of coaching, this disruption could have affected the overall implementation of the NPDC program. A dichotomous variable (0–1 coding) was established as a school that had adequate (0) or not-adequate coaching (1) support across the year. As such, we predicted a negative association between disruption in coaching and implementation (i.e. because of this reverse scoring, it also inferred a positive association of adequate coaching and implementation).

Data analysis

Descriptive statistics were used to examine the distribution of the IIdx items and domains across the NPDC schools. Bivariate correlations were first examined among the IIdx, and predictor variables as just defined. In that associations were predicted to occur in a specific direction (i.e. positive or negative), one-tailed tests were used with an alpha of $p < 0.05$. In a subsequent table, the predicted direction of the analysis is noted. It is important to note that measures completed by individual respondents in the school (e.g. EBPASs, MLQ) were aggregated (i.e. nested) at the school level to create comparability with other school-level variables (i.e. APERS-PE and IIdx). Significant predictors of IIdx scores from the bivariate correlation analysis were then selected for a final multiple regression analysis.

Results

Implementation index

The mean IIdx rating for the NPDC classes was 2.50, with a range of 2.09–2.91 across schools. However, the IIdx provides more detailed information about the specific features of implementation that were relatively strong or a challenge, which is found on the profile in Figure 1. The mean ratings (with one standard deviations range) indicated that the relatively strong features of implementation were the A-team, preparation of the A-team, program quality, and using EBPs. Professional development and measurement of student outcomes were the lower scoring domains. Disaggregating the scores into the percentage of schools that received ratings on individual items allows a closer examination of program features that were relatively strong and those that were more limited in implementation (see Table 3). For example, for 17 or the 22 implementation items (i.e. bolded in the table), over 80% of the schools were rated either two or three levels of implementation. Features of implementation that were low (i.e. more than 20% of school scored a "1") were involvement of related services professionals on the A-team, completing autism-focused intervention materials and resources modules (AFIRMs, Sam et al., 2020; https://afirm.fpg.unc.edu/), and goal writing. Notably, a high percentage of schools' staff did not collect sufficient data to establish baseline performance on the GAS, but conversely, when research staff checked the accuracy of the GAS rating by observing and completing the GAS independently, the levels of agreement were high.

Bivariate correlation

Pearson product moment correlations were computed among the total IIdx rating and predictor variables. The predictor variables for were including the outer context were percentage of White students at schools, percentage of students qualifying for FARL, and urbanicity. For the inner context, the variables were leadership types (i.e. transformational, transactional, and passive leadership), attitudes about use of EBPs (EBPAS), and school program quality (APERS-PE total mean rating and teaming domain), The adequacy of coaching was the single

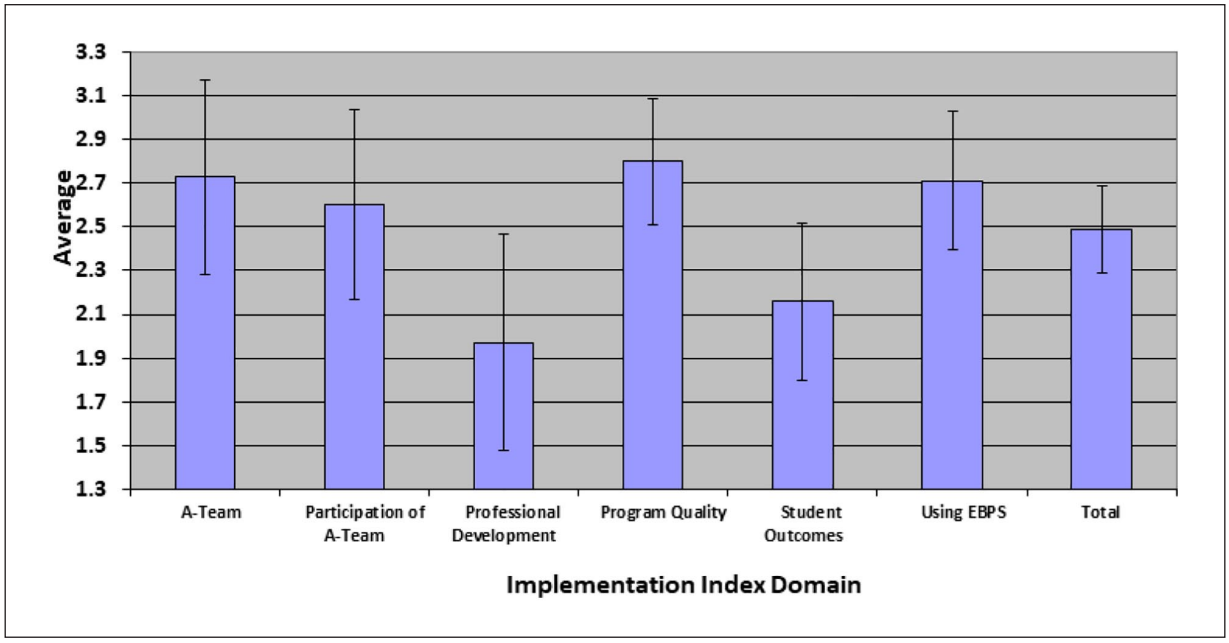

Figure 1. Mean rating with one standard deviation range for IIdx profile and total ratings.

innovation (see Table 4 for the correlation matrix). A "+" or "−" indicator signaled the anticipated direction of the correlation, with the anticipated hypothesized directions for the correlation noted in previous sections, which allowed us to conduct a one-tailed test of significance. The IIdx was significantly correlated with transformational leadership ($r=0.28$, $p=0.04$, $R^2=0.078$), Coaching ($r=-0.29$, $p=0.04$, $R^2=0.084$), and percentage White students at the school ($r=0.31$, $p=0.03$, $R^2=0.096$). See Table 4 for the full correlation matrix. In addition, variables designed to assess similar constructs, such as leadership profiles, teacher beliefs, classroom quality, and community demographics often correlated with one another if not necessarily the IIdx. For example, the variables that were indicators of socioeconomic status of the community in which the schools were located (i.e. FARL, Title 1 schools) as well as percentage of white students in the school.

Multiple regression

To understand the influences associated with implementation and suggested by the EPIS framework, a multiple regression analysis was conducted. Because this was a relatively small sample and power was an issue, we selected the three predictors that were significantly associated with the IIdx (i.e. transformational leadership, percentage of white students within a school, and coaching) rather than loading all predictor variables into the regression model. Overall, the regression analysis was significant, $F(3, 35)=3.66$, $p=0.021$. Together these predictors accounted for 17.4% of the variance in implementation. This percentage of variance was greater than for any of the single variable in isolation. Table 5 includes the coefficient parameters from the model.

Discussion

Following the conceptual framework suggested by the EPIS model, this study examined a variety of variables associated with the implementation of the NPCD program for elementary-aged students with autism. The first research question asked if there were variables from the outer context associated with implementation. The single outer context variable associated significantly with implementation was the percentage of white students enrolled in the elementary schools. That is, implementation was more successfully accomplished in schools that had higher proportions of white students as compared with schools having a relatively higher proportion of students who were nonwhite. This variable may also be a proxy for a larger variable related to socioeconomic status of the community in that percentage of white students was significantly negatively correlated with FARL and Title 1 school classification. Outside of the autism literature, others have discussed the association between community socioeconomic status and resources available to schools (Hanson et al., 2011; Sirin, 2005). Alternatively, schools with a higher percentage of white students may have had greater pressure from the community (e.g. parents) to employ innovative services for children with autism. It is also possible that if implementation of a comprehensive program is a barometer, this could be an indirect reflection of inequities in services that might exist for students who have been

Table 3. Frequency of schools (percentage of schools) for each implementation index rating.

Implementation index item	1	2	3
1. Included program teacher representatives of study students with ASD	**1 (2.6)**	**8 (20.5)**	**30 (76.0)**
2. Included at least one administrator or representative from school	**2 (5.1)**	**0 (0)**	**37 (94.9)**
3. Included relevant related service professionals for study students	8 (20.5)	2 (5.1)	29 (74.4)
4. % of A-team members attending team meetings during the year	**6 (15.4)**	**11 (28.2)**	**22 (56.4)**
5. A-team met at least 4 times during the school year	**0 (0)**	**1 (2.6)**	**38 (97.4)**
6. % of A-team attending training academy	**7 (17.9)**	**9 (23.1)**	**23 (59.0)**
7. % A-team members completed 4 online sessions on ASD	**7 (17.9)**	**8 (20.5)**	**24 (61.5)**
8. % of staff responsible for writing study student goals attending GAS training/coaching	23 (59.0)	7 (17.9)	9 (23.1)
9. A-team members complete at least one AFIRM web-based EBP training	20 (51.3)	6 (15.4)	13 (33.3)
10. Pre-APERS/debrief completed within 10 weeks of start of school year	**3 (7.7)**	**2 (5.1)**	**34 (87.2)**
11. SIAP developed in 2 needs areas based on APERS results	**0 (0)**	**3 (7.7)**	**36 (92.3)**
12. % of SIAP activities completed	**6 (15.4)**	**8 (20.5)**	**25 (64.1)**
13. Post-APERS completed within 8 weeks of end of school year	**0 (0)**	**0 (0)**	**100 (39)**
14. Student team (primary teacher(s), research staff) identified three priority IEP goals across each student's need areas (e.g. academic, behavior, social, and communication)	**0 (0)**	**24 (61.5)**	**15 (38.5)**
15. Student team wrote priority goals (single target) in measurable and observable manner	11 (28.2)	14 (35.9)	14 (35.9)
16. Student team scaled priority goals using PET-Goal Attainment Scaling following criteria	**4 (10.3)**	**14 (35.9)**	**24 (53.8)**
17. Student team scaled priority goals based on stable baseline data (trend with 3 data points)	35 (89.7)	3 (7.7)	1 (2.6)
18. Teacher GAS ratings found to be consistent with observational checks of 20% of goals	**2 (5.1)**	**5 (12.8)**	**32 (82.1)**
19. Student team identified EBPs to address student goals (at least one EBP per goal) at the beginning of the school year	**0 (0)**	**1 (2.6)**	**35 (97.4)**
20. NPDC coach spends an average of 6 hours/week at each intervention school when school is in session (not assessment times)	**0 (0)**	**12 (30.8)**	**27 (69.2)**
21. Coach communicates (maintains contact) every week with each student team to address needs during coaching and intervention time (not assessment times)	**4 (10.3)**	**3 (7.7)**	**32 (82.1)**
22. Coach and team assessed EBP fidelity of implementation	**7 (17.9)**	**7 (17.9)**	**25 (64.1)**

AFIRM: autism-focused intervention materials and resources module; APERS: autism program environment rating scale; ASD: autism spectrum disorder; EBP: evidence-based practice; GAS: goal attainment scaling; IEP: Individualized Education Plan; NPDC: National Professional Development Center; SIAP: school improvement action plan. Bold indicates items for which over 80% of school scored 2 or 3 rating.

Table 4. Pearson product moment correlations between variables.

	IIdx	Transformational leadership	Transactional leadership	Passive leadership	EBPAS total	APERS teaming	APERS total	Coaching	% White	FARL	Title I	urban
Transformational leadership (+)	0.28*	—										
Transactional leadership (−)	0.12	0.63**	—									
Passive leadership (−)	−0.26	−0.70**	−0.23	—								
EBPAS total (+)	0.08	0.20	−0.08	−0.29*	—							
APERS teaming (+)	0.26	0.18	−0.02	−0.28*	0.20	—						
APERS total (+)	0.23	0.12	−0.04	−0.24	0.17	0.84**	—					
Coaching (−)	−0.29*	−0.08	0.08	0.12	0.09	−0.04	−0.01	—				
% White (+)	0.31*	0.06	0.07	−0.01	−0.05	0.24	0.14	−0.00	—			
% FARL (−)	−0.04	−0.14	−0.01	0.08	−0.09	−0.40**	−0.43**	0.03	−0.56**	—		
Title I (−)	−0.08	−0.31*	−0.15	0.18	−0.18	−0.27	−0.29*	0.01	−0.46**	0.72**	—	
Urban (−)	−0.19	−0.10	−0.22	−0.064	0.23	−0.05	0.07	−0.18	−0.52**	0.08	0.06	—
Rural (+)	0.23	0.10	0.28*	−0.001	0.09	0.05	−0.17	0.11	0.60**	−0.02	−0.11	−0.52**

EBPAS: Evidence-Based Practices Attitude Scale; FARL: free and reduced lunch; IIdx: implementation index.
* = $p < .05$, ** = $p < .01$

historically marginalized. This issue should certainly be addressed in future work.

The second research question was related to inner context factors. Inner context variables assessed in this study were leadership style, teacher attitude and beliefs about EBPs, and autism program quality. The single inner context variable significantly associated with the IIdx was transformational leadership style. This finding is consistent with other studies that have found leadership to be a primary influence on implementation (Melgarejo et al., 2020; Stadnick et al., 2019; Stahmer et al., 2019; Suhrheinrich et al., 2020). Notably, the type of leadership is the key factor. Authors of the MLQ (Bass & Avolio, 1995) characterize transformational leadership as "a process (that) . . . changes their associates' awareness of what is important" and "seeks to optimize individual, group, and organizational development . . . not just to achieve performance at expectations" (p. 103). These qualities are quite consistent with the dimension of leadership that Aarons et al. (2014) identified as facilitative of implementation. Transactional leadership, while focusing on clear expectations and contingent rewards, lack the inspirational qualities of transformational leadership. In addition, passive/avoidant leadership "does not respond to situations or problems systematically" and "avoids specifying agreement, clarifying expectations, and providing goals and standards" (p. 105). As noted, the previous literature suggested that both of these styles of leadership are either neutrally or negatively associated with implementation (Kensbock & Boehm, 2016; Maier et al., 2016). The results of this study are consistent with these previous findings.

The other inner context variables were not associated with the IIdx. Previous literature and program developers have suggested that teachers' attitudes and beliefs about EBPs are associated with implementation (Drahota et al., 2012; Locke et al., 2019; Suhrheinrich et al., 2021). This association was not found in the current study, which does not mean that the relationship is not important or does not exist in other contexts. It is possible that the teacher belief-implementation relationship could be affected by other variables. In the current study, the EBPAS data were aggregated across members of the A-team to account for nesting within schools. Previous studies had analyzed data at the individual respondent level, and this methodological difference may have affected the results. Attitudes and beliefs are complex variables in the implementation equation and certainly deserve further focused study.

The third question addressed the association between coaching and implementation. Coaching has been seen as a primary variable affecting implementation (Suhrheinrich, 2011), but there has been little discussion in the education implementation literature about variation in the delivery of coaching. In the current study, a subset of coaches on this research project "under-performed" to the extent that an

Table 5. Coefficients of regression model of implementation index.

Predictors	Unstandardized coefficients		Standardized coefficients	t	*p*	95% confidence interval for B	
	B	Std. error	Beta			Lower bound	Upper bound
(Constant)	2.09	0.20		10.50	<0.001	1.68	2.49
Transformational leadership	0.10	0.06	0.24	1.63	0.11	–0.03	0.23
% of white students at schools	0.003	0.001	0.30	2.00	0.05	0.00	0.01
Coaching	–0.12	0.06	–0.27	–1.85	0.07	–0.25	0.01

administrative decision was made to take corrective actions and this classification of inadequacy was associated negatively with implementation. The implication of the negative association of inadequate coaching with the II is that a certain level of "adequate" coaching may be associated with sufficient implementation. This was a serendipitous finding that deserves further study. Other researchers in the field are increasingly recognizing the importance of the knowledge about EBPs competencies needed for technical assistance providers (Morin et al., 2021), competencies needed for personnel supporting implementation (Schultes et al., 2021), and training models for implementation teams (Damschroder et al., 2021).

It is important to note that in this study implementation was not perfect nor would one expect it to be. Comprehensive, school-based programs, such as the NPDC program, are similar to complex service programs seen in other disciplines (Kainz et al., 2021; McGaghie, 2011). Implementation consists of multiple features rather than a single implementation outcome such as a fidelity assessment of a single focused intervention practices. The advantage of the index approach used in this study is that it provides a summative metric of overall implementation and also displays the "peaks and valleys" of implementation components. The implementation profile indicated generally strong engagement (i.e. adoption) of the school personnel, which Proctor et al. (2011) have noted as an important implementation feature. Also, there was a strong focus on program quality, which Odom et al. (2013) noted as a key feature of the NPDC program. The relatively less strong implementation features were delivery of professional development (i.e. A-team members attending training on goal attainment, completion of online trainings on autism and EBPs), and measurement of student outcomes (i.e. influenced mainly by the absence of teachers' data collection during instruction). However, even with these "valleys," in the Sam et al. (2021) report, teachers' delivery of EBPs was relatively high (2.5/3.0).

In their systematic review, Moullin et al. (2019) noted that there have not been empirical examinations of the association of the EPIS model with implementation. In the current study, the EPIS model served as the conceptual framework for examining variables associated with the implementation of the NPDC program in community schools. Outer, inner, and innovations variables proposed in the EPIS model were associated with implementation. While this study did not empirically validate the EPIS model, it did demonstrate the model's value as a heuristic process for examining variables related to influence on implementation.

The current study had several limitations. The first primary limitation is that there were only 39 schools in the sample, which limited the power to detect some correlations that may have been significant if there have been more schools in the study. Second, all of the schools in the study were in one state, and although the context features of the schools as indicated by the Generalizability coefficient were representative of the larger population of schools in the United States. However, the Generalizer analysis does not assess state regulations or policies that are unique to this state and could affect external validity. Third, even when significant individual correlation coefficients tended to be relatively small. This indicated that other variables account for variance in implementation. Fourth, in this study of implementation authors were somewhat limited by the variables collected in the larger CRCT. A direction for future research could be to conduct a more prospective study in which variables could be more directly aligned with or reflective of the EPIS or other implementation model selected to guide the study. In addition, the modest correlations could be attributed to the error variance associated with the IIdx. However, the index did have a high level of internal consistency and some evidence of discriminative validity. Last, a large number of correlations were computed in this analysis, which could have led to, if it had been an experimental study, type 1 errors. Generally, the high correlations among variables within the outer and inner context variable, respectively, and the absence of significant correlations across the two context variable classes (and the innovation variable) could provide some confidence that the findings were not spurious.

In conclusion, drawing practical implications and recommendations for future research from a correlational study is risky in that one is does not have causal evidence generated from experimental demonstrations of effects. Given that caveat, the findings from the current study reinforce the messages that have come out of the

implementation science literature previously, but now as applied to school-based programs. First, the demographics of the community and students in a school may influence the success of implementation, possibly due to the availability of resources, although there could be other influential factors as well (e.g. school culture and parent advocacy). Second, leadership at the school level is important, with transformational leadership styles appearing to be most influential for implementation. Third, adequate coaching is important. The assumption that assigning a coach to a school and expecting implementation to automatically occur, without monitoring the quality of coaching, may be faulty. These are all factors about which school leaders should be aware when implementing new programs for autistic students in school settings and also important directions for future research.

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Supplemental material

Supplemental material for this article is available online.

Note

1. In this document, we will use a mixture of terminology when referring to autism and persons identified as autistic. A common form of description has been called "person-first," in which the person (e.g. child) appears before the condition (e.g. autism), such as child with autism. Many autistic self-advocates and advocacy groups now prefer an identify-first form, such as autistic child (Brown, 2011; Kenny et al., 2016). In addition, autistic advocates have spoken about the desirability of using the term "autism" rather than autism spectrum disorder (Brown, 2011). At the time of this writing, terminological issues have not been settled. To honor the advocates and professionals in the field, as well as other groups of individuals with disabilities who prefer the person-first term, we will be mixing terminology throughout the manuscript, using both person-first and identity-first terminology with the primary descriptor being autism or autistic.

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