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Exploring individual and organizational mechanisms of implementation of evidence-based practices for the inclusion of elementary students with autism: Study protocol

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ABSTRACT

The increased prevalence of autism in the United States (1 in 54 youth) requires educators to implement evidence-based practices (EBPs). However, it is unclear which EBPs, if any, general and special education teachers and paraeducators are commonly trained to use or whether they consistently use those EBPs to support the inclusion of students with autism. The purpose of this protocol is to understand EBP use in inclusive settings and examine the malleable individual and organizational factors that promote teachers' and paraeducators' use of EBPs to meaningfully include and retain children with autism in general education settings and how this use relates to children's outcomes. These data will support the identification of targeted implementation strategies for successful EBP use.

1. Introduction

1.1. Background and significance

The number of children with autism served in schools has dramatically increased, making the improvement of school-based autism services a priority in the world (Brookman-Frazee, Taylor, & Garland, 2010; Locke, Kratz, Reisinger, & Mandell, 2014). In the U.S., despite the growing number of children with autism in general education settings (Frederickson, Jones, & Lang, 2010; Sansosti & Sansosti, 2012), far less attention has been directed to supporting educators in these contexts in using evidence-based practices (EBPs) defined as practices and programs shown by research to have meaningful effects on outcomes, for students with autism (Rispoli, Neely, Lang, & Ganz, 2011). The extent to which teachers and paraeducators are trained to use EBPs and the types of EBPs most germane to inclusive settings are unknown (Finch, Watson, MacGregor, & Precise, 2013; Segall & Campbell, 2012). Though EBP use is required in U.S. public schools (Fixsen, Blase, Metz, & Van Dyke, 2013; Odom, Cox, Brock, & National Professional Development Center on ASD, 2013; Stahmer et al., 2015), research has shown that EBPs have not been successfully adopted, implemented, and sustained in these settings (Brookman-Frazee, Taylor et al., 2010; Hess, Morrier, Heflin, & Ivey, 2008; Stark, Arora, & Funk, 2011). There are gaps in our

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understanding, however, regarding what factors impede implementation, which could be addressed by more nuanced research. Understanding these usual care educational interventions along with individual and contextual factors in general education settings may provide a "road-map" for targeted efforts to improve the quality of education (Brookman-Frazee, Haine, Baker-Ericzén, Zoffness, & Garland, 2010; Stahmer, Suhrheinrich, & Mandell, 2016).

More focused research is needed on the *malleable* determinants of educators' behavior (that is, those elements that influence whether a behavior occurs and are within the control of the environment) that can be targeted to promote improved implementation of EBPs in schools (Lyon et al., 2019). Individual factors drawn from the Theory of Planned Behavior (TPB; Ajzen, 1991), a framework predicting and explaining human behavior, are theorized to influence EBP use. According to the TPB, an intention to engage in a behavior (for example, using an EBP) is the strongest predictor of a behavior. Intentions are an individual's motivation and willingness to perform a behavior, and are driven by their attitudes towards the behavior, perceived social norms about the behavior, and feelings of self-efficacy to engage in the behavior. Attitudes refer to the perceived advantages and disadvantages of performing a behavior, whereas norms comprise one's beliefs that peers or colleagues think they should (or should not) perform a behavior, such as a sense of social pressure to use or not use EBPs (Ajzen, 1991). Self-efficacy is the belief that an individual can perform a behavior even under difficult circumstances, such as the perceived ease or difficulty of using a specific EBP (Ajzen, 1991). Studies have documented the relevance of attitudes, norms, and self-efficacy in accounting for intentions (Demir, 2010; Hagger, Chatzisarantis, & Biddle, 2002; Sheppard, Hartwick, & Warshaw, 1988) and demonstrated that intentions account for a considerable amount of the variation in specific behaviors (Armitage & Conner, 2001), including implementation of EBPs for students with autism (Fishman, Beidas, Reisinger, & Mandell, 2018).

In addition to individual factors, organizational factors also provide an important context for understanding successful and unsuccessful use of EBPs in schools (Domitrovich et al., 2008; Forman et al., 2013; Hoagwood & Johnson, 2003; Lyon & Bruns, 2019; Owens et al., 2014). Several organizational constructs including general organizational culture and climate (Glisson & Green, 2011; Glisson et al., 2008, 2010), implementation climate, leadership, and citizenship behavior have been theorized to predict EBP use (Aarons, Ehrhart, & Farahnak, 2014; Beidas & Kendall, 2010; Damschroder et al., 2009; Ehrhart, Aarons, & Farahnak, 2014; Glisson & Green, 2011; Klein & Knight, 2005; Williams et al., 2019). In this study, we will focus on *implementation climate* (perceptions on whether use of an EBP is expected, supported, and rewarded) and *implementation leadership* (leader behaviors that support EBP implementation) for two reasons (Aarons et al., 2014; Ehrhart et al., 2014). First, recent studies have shown that both implementation climate and leadership are malleable organizational factors (Aarons, Ehrhart, Farahnak, & Hurlburt, 2015; Aarons, Ehrhart, Moullin, Torres, & Green, 2017; Aarons, Ehrhart, Torres, Finn, & Beidas, 2017). Second, implementation climate and implementation leadership may be more proximal to implementation success than other organizational factors such as culture, which may take years to change, if any change is achieved (Durlak & DuPre, 2008; Fixsen et al., 2005; Forman, Olin, Hoagwood, Crowe, & Saka, 2009, 2013; Lyon et al., 2018).

Understanding individual and organizational mechanisms of influence has direct implications for the development and testing of implementation strategies to enhance the use of EBPs for children with autism in their authentic inclusive settings (Lewis et al., 2018, 2020). Though schools are an opportune setting to study the individual and organizational factors related to the EBP use (Storch & Crisp, 2004), there is scant documentation and testing of implementation strategies in schools (Lyon & Bruns, 2019). There is some evidence, however, that implementation strategies addressing individual and organizational factors can be effective in improving the use of EBPs and associated child-level outcomes (Locke, Lawson et al., 2019). Efforts to implement and sustain EBP use for children with autism in schools will continue to fall short until professional development and training efforts specifically address the individual and organizational mechanisms that promote or hinder widespread use, which, to date, has not been clearly delineated within the

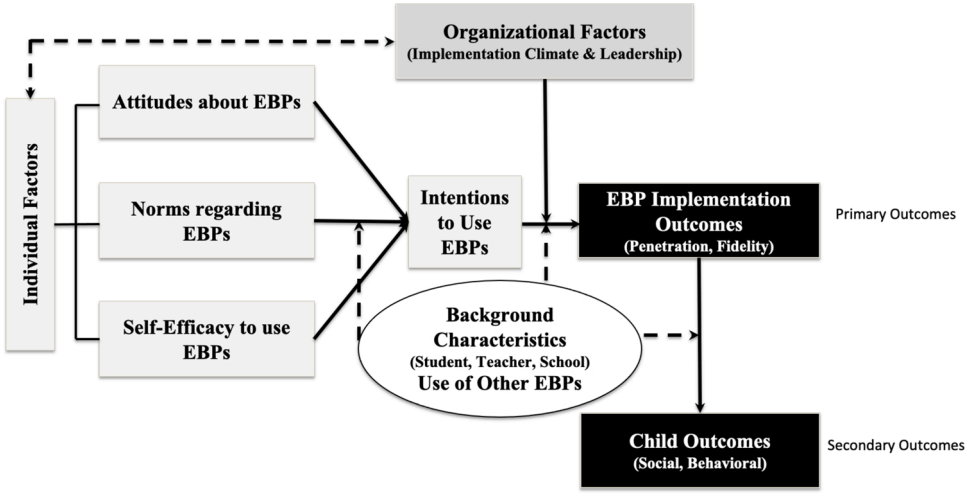

Fig. 1. Theory of Change.
Light grey boxes indicates individual factors, dark grey boxes are organizational factors, and black boxes are outcome variables.

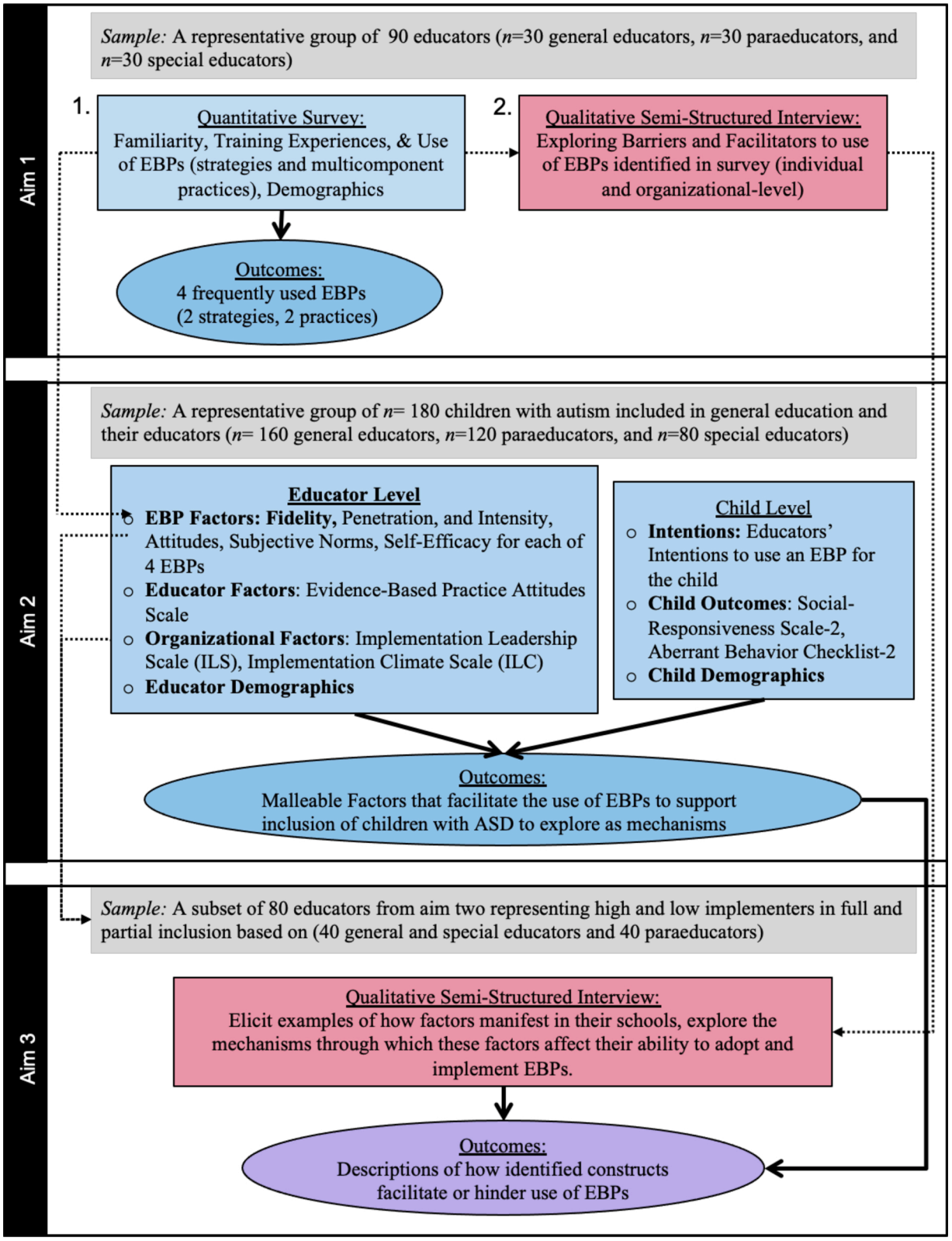

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Fig. 2. Data Collection, Integration, and Analysis Process.
Sample and data collected by method (quantitative in blue, qualitative in red) by aim. In Aim 2, data are collected at two levels (child and educator). Dashed arrows indicate that those data are used to determine future data collected at the end of the arrow. Solid arrows indicate data analysis for outcome interpretation.

school context.

1.2. Conceptual framework and approach

We situated this observational mixed methods study in the Exploration, Preparation, Implementation, and Sustainment (EPIS) framework (Aarons, Hurlburt, & Horwitz, 2011), a multi-level (inner individual and outer organizational contexts) and multi-phase (exploration, preparation, implementation, and sustainment) implementation science conceptual model. Fig. 1 shows our Theory of Change that applies this framework using our theoretically and research informed selection of malleable inner context factors (individual and organizational factors) that are particularly critical in the successful implementation of EBPs (Aarons et al., 2012; Beidas et al., 2013, 2014; Beidas et al., 2015; Bonham, Sommerfeld, Willging, & Aarons, 2014) and are understudied, particularly in school settings (Owens et al., 2014) and among children with autism (Locke et al., 2016). Thus, in this study, we will quantitatively and qualitatively measure individual (attitudes, norms, self-efficacy, and intentions to use EBPs; light grey boxes) and organizational (implementation climate and leadership; dark grey boxes) determinants to examine their association with implementation (primary outcomes) and child outcomes (secondary outcomes) in schools (black boxes). Because this is an exploration study, we note that there may be other characteristics (e.g., background; in white oval) that we will measure and account for as covariates in our models given their potential impact on implementation. Using these methods, we will explore the possibly distinct and varying determinants of EBP use at each of the EPIS framework phases. For example, in the adoption phase, a strong and knowledgeable leader may guide the selection of EBPs to support the inclusion of children with autism and help train educators to use those EBPs, whereas in the implementation phase, a supportive leader may provide the necessary training, education, and materials as well as recognition (e.g., praise) for using those EBPs. The protocol has been peer reviewed by the funding body during the funding process.

2. Research plan

We will use a mixed methods design to address all study aims. Large-scale primary data collection with general and special education teachers, paraeducators, and children with ASD will be supplemented with teacher and paraeducator interviews to estimate the effects of individual and organizational factors on general and special education teachers' and paraeducators' use of EBPs related to child outcomes and mechanisms of influence. Fig. 2 summarizes our approach for Aims 1–3 describing the different aims, samples, data collected, and integrated mixed methods analysis across aims. Given the complexities of this multiphase study, the research plan is detailed below in Section 2.1.

2.1. Research aims and methods/design

Aim 1 will address the following research questions:

1 Which EBPs for children with ASD have general and special education teachers and paraeducators been trained to use to support inclusion?
2 Which EBPs do teachers and paraeducators use to support included children with ASD?

An exploratory, mixed-methods design will be used to obtain educator-reported EBP training experience and usage. These data will allow us to understand usual care practices in schools, which will provide the foundation for studying the individual and organizational determinants in Aims 2 and 3.

2.1.1. Sample

To solicit a broad range of perspectives on the use of EBPs in general education settings and allow us to achieve data saturation (Guest, Bunce, & Johnson, 2006), we will use https://thegeneralizer.org, a free web-based tool to help researchers identify representative recruitment plans based on a wide variety of school factors (e.g., rurality, demographics, IEP status, etc.) to obtain a representative sample from 15 schools. This phase will include general educators ($n = 30$), paraeducators ($n = 30$), and special educators ($n = 30$) who serve at least one student with autism in a general education classroom.

2.1.2. Procedures

We will obtain approval from the university Institutional Review Board (IRB) as well as each school district's equivalent IRB. We will contact school district officials to obtain a list of elementary schools that have enrolled children with autism who are partially or fully included in a general education classroom and then email the school principal. Subsequently, we will distribute recruitment materials to teachers and paraeducators. Prior to participation, the research team will provide a full description to all participants of study procedures and all types of activities and a research team member will be available to meet should there be questions. Then, we

will ask participants to complete a modified Autism Treatment Survey (ATS; Hess et al., 2008) via an online survey. Subsequently, we will conduct an audio-recorded semi-structured interview (20−30 min) conducted at a convenient time for the participant (via videoconference). As an incentive for their participation, participants will be offered a $40 gift card, and schools will receive a resource kit of materials to use with children with autism.

2.1.3. Measures

2.1.3.1. Modified autism treatment survey (ATS; Hess et al., 2008). The ATS was designed to measure teachers' use and training experiences with a comprehensive list of EBPs for children with autism (Hess et al., 2008). Hess et al. (2008) used piloting and cognitive interviewing to establish validity of the tool. Our research team also piloted the modified ATS with two non-participating educators. Given the increased research evaluating the efficacy of practices since the origination of the ATS, we have updated the ATS as follows: a) we now include practices that have been identified as evidence-based for students with autism since its publication according to the National Professional Development Center on Autism (NPDC; Steinbrenner et al., 2020), b) we separate evidence-based *strategies* (e.g., modeling) from *multicomponent practices* (e.g., Peer-Based Intervention), c) we used updated practice definitions that align with the NPDC that have been validated via cognitive interviewing in more recent research (Hugh, 2020), and d) we break down components of the implementation strategy – training – to inform later implementation support development (i.e., who provided the training, what type of training). We are taking a novel approach to autism EBP exploration by attending to both multicomponent practices and strategies. Distinguishing practice and strategy was necessary to better understand the possible limited use of multicomponent practices rather than excluding these if participants report frequent use of strategies only (Brock, Dynia, Dueker, & Barczak, 2020; McNeill, 2019).

2.1.3.2. Semi-structured interview. To complement the modified ATS and more thoroughly explore EBP use for supporting inclusion of

Table 1
List of multicomponent practices and strategies, and their definitions.

	Definition
Practice	
Antecedent-Based Interventions	Modifying the environment to decrease an identified interfering or inappropriate behavior and increase engagement.
Functional Communication Training	A positive behavior support intervention designed to reduce problem behaviors by replacing them with meaningful or functional communication, whether verbal or gestural.
Naturalistic Intervention	A specific collection of practices including environmental arrangement, interaction techniques, and behavioral strategies designed to encourage specific target behaviors based on learners' interests by building more complex skills that are naturally reinforcing and appropriate to the interaction.
Peer-Based Instruction and Intervention	Explicitly training peers to provide social learning opportunities through interaction, modeling, and reinforcement as a way to improve social reciprocity in more natural social contexts.
Self-Management	Teaching learners to discriminate between appropriate and inappropriate behavior, accurately monitor and record their own behaviors, and reward themselves for appropriate behavior or use of skill.
Social Narratives	A description of social situations for learners by providing relevant cues, explanation of the feelings and thoughts of others, and descriptions of appropriate behavior expectations.
Social Skills Training	A specific form of group or individual instruction designed to teach learners ways to appropriately interact with peers, adults, and other individuals.
Direct Instruction	A systematic approach to teaching using a sequenced instructional package with scripted protocols or lessons that employs systematic and explicit error correction procedure.
Discrete Trial Training	A one-to-one instructional approach used to teach skills in a planned, controlled, and systematic manner. It often is characterized by repeated, or massed, trials that have a definite beginning and end.
Strategy	
Augmentative, Alternative Communication	Teaching the use of a system of communication that is not verbal/vocal including aided (e.g., gestures) and unaided communication systems (e.g., exchanging objects, using a technological device).
Behavioral Momentum Intervention	The organization of behavior expectations in a sequence in which low probability, or more difficult, responses are embedded in a series of high probability, or less effortful, responses to increase persistence and the occurrence of the low probability responses.
Extinction	A procedure whereby a behavior that was formerly reinforced is no longer reinforced.
Modeling	A specific demonstration of a desired target behavior that results in imitation of the behavior by the learner and leads to the acquisition of the imitated behavior
Prompting Procedures	Systematic use of supports that provide help to the learner that assists them in becoming independent in using a specific skill.
Reinforcement	Something that is done or provided after a behavior that increases the likelihood that the target behavior/skill will occur again in the future.
Response Interruption/Redirection	A procedure that involves introduction of a prompt, comment, or other distractors when an interfering behavior is occurring.
Task Analysis	The process of breaking a skill into smaller, more manageable steps in order to teach the skill.
Technology-Aided Instruction and Intervention	Instruction or interventions in which technology is the central feature supporting the acquisition of a goal for the learner.
Time Delay	A practice that focuses on systematically fading the use of prompts during instructional activities.
Video Modeling	A mode of teaching that uses video recording and display equipment to provide a visual model of the targeted behavior or skill.
Visual Supports	Concrete supports used to support a learner's understanding or expression.

children with autism, we will develop a systematic and comprehensive interview guide with questions that identify: 1) what the terms "evidence-based practice" and "evidence-based strategy" mean to participants; 2) which EBPs participants have been trained to use and what types of training they received; 3) how participants select EBPs; 4) how to make EBPs more acceptable to educators and more feasibly implemented in education settings; 5) how to tailor EBPs to better fit general education classrooms, if needed; 6) the limitations of using EBPs in general education settings; and 7) the time and opportunity costs of using EBPs for children with autism in inclusive settings. Questions will be carefully constructed to elicit clear information without assigning valence to EBP use. Synthesis of this information will point to key professional development areas for teachers and paraeducators to increase their ability to use EBPs to successfully include and retain children with autism in general education classrooms.

2.1.4. Data analysis

We will descriptively analyze the modified ATS. For interview data, we will use a modified grounded theory approach (Bradley, Curry, & Devers, 2007) as certain codes will be conceptualized during the interview guide development (i.e., deductive approach) and other codes will be developed through a close reading of the initial set of transcripts (i.e., inductive approach). We will construct hypotheses and theories about our data through the collection and analysis of interview data. The coding scheme will be refined throughout the data analytic process (Bradley et al., 2007). First, we will independently code an initial set of transcripts to identify codes and meet as a group to discuss recurring codes that emerge from the data. Then, we will develop a codebook with operational definitions and examples of when to code and not code. To capture data complexity, avoid errors, reduce groupthink, and circumvent some researcher biases, we will use a consensus process in which all reviewers independently code 20 % of the transcripts and meet to compare their coding to arrive at consensus judgments through open dialogue to develop the codebook (DeSantis & Ugarriza, 2000; Hill, Thompson, & Williams, 1997, 2005). Following the development of a stable codebook, we will train coders to $\geq$90 % point-by-point agreement for at least 2 consecutive transcripts. Then, coders will overlap on 20 % of randomly selected transcripts to determine interrater reliability across the coding process to reduce coder drift. Consistent with previous studies (Locke et al., 2017; Locke, Lee et al., 2019), during data comparison, we will use the approach of inductive thematic saturation to determine when there are no new emerging codes or themes, meaning data saturation has been reached (Saunders et al., 2018). The information gleaned from Aim 1 will be a precursor to Aim 2.

2.1.5. Outcomes of Aim 1

The heterogeneous presentation of autism characteristics may require the use of a multitude of EBPs to support inclusion. Aim 1 will allow us to explore the various evidence-based multicomponent practices (e.g., social narratives) and strategies (e.g., visual supports) most germane to general education settings (Table 1). The four most frequently used EBPs (two practices and two strategies) to support inclusion will be identified in Aim 1 and quantitatively measured in Aim 2, and the qualitative results will provide structure to the development of the interview protocol used in Aim 3 (See Fig. 2; Ivankova & Kawamura, 2010; Nastasi et al., 2007).

Aim 2 will address the following research questions:

1 What is the association of individual factors (attitudes, norms, and self-efficacy) on intentions to use EBPs?
2 What is the association of EBP implementation on child outcomes?
3 How do organizational factors (implementation climate and leadership) moderate the relationship between intentions to use EBPs and EBP implementation (fidelity)?

2.1.6. Sample

In this aim, we will recruit 360 educators (n = 160 general educators, n = 120 paraeducators, and n = 80 special educators) from 60 schools. Criteria for participation will be similar to Aim 1, however, to avoid bias from practice effects, Aim 1 participants will be excluded from participating in Aim 2. In addition, approximately 180 elementary-aged children with an educational qualification of autism who are partially or fully included from the same classrooms as a general education teacher and paraeducator will participate. Given their prevalence in the population of children with autism, we anticipate that approximately 80 % of the sample will be male and 20 % female (Blumberg et al., 2013). Consistent with our state data, we expect the ethnic distribution of children with autism will be 45.6 % White, 16.4 % African American, 12.4 % Hispanic/Latino, 15.8 % Asian, and 9.8 % Other.

2.1.7. Procedures

Recruitment and informed consent procedures for educators will follow those proposed in Aim 1. Additionally, we will provide recruitment materials (e.g., informational handouts) to the school to distribute to the families of children with autism and follow the informed consent process proposed in Aim 1. Educators will be asked to complete all study measures outlined below (EBPAS, attitudes, norms, self-efficacy, and intentions to use EBPs, ILS, ICS, penetration, fidelity and intensity of EBP use, SRS-2, and ABC-2; approximately 60−75 min). Participants will receive a $60 gift card and a resource kit of materials to use with children with autism.

2.1.8. Measures

2.1.8.1. Attitudes towards EBPs. General attitudes about the use of EBPs will be measured using the school-based version of the Evidence-Based Practice Attitude Scale (EBPAS; Cook et al., 2018), a 16-item measure that assesses four general attitudes toward adoption of EBPs: appeal, requirements, openness, and divergence (Aarons, 2004; Aarons, McDonald, Sheehan, & Walrath-Greene,

2007, 2010). Studies suggest moderate to good internal consistency for the EBPAS total score (Cronbach's α = .79) and subscale reliabilities ranged from .67 to .91 (Aarons, 2004; Aarons et al., 2007, 2010). The score for each subscale is created by computing a mean score for the items that load on a given subscale (Cook et al., 2018).

The items in the following three measures will undergo cognitive response testing with a small set of non-participant educators (n = 5) to clarify ambiguous wording, awkward instructional sets, and difficult sections prior to large-scale administration (Lapka, Jupka, Wray, & Jacobsen, 2008). The item stems have been used to measure a variety of behaviors and demonstrated strong psychometric properties (Albarracín, Johnson, Fishbein, & Muellerleile, 2001; Armitage & Conner, 2001; Fishbein & Ajzen, 2011; Sheeran, 2002; Sheppard et al., 1988) including among teachers of children with autism (Fishman et al., 2018). However, we will conduct basic psychometric analyses to ensure measure adequacy (e.g. internal consistency, factor analyses, inter-item correlations, convergent validity among measures). We will include the four most frequently used EBPs (two practices and two strategies) identified in Aim 1. Based on our previous work (Locke et al., 2015; Mandell et al., 2013; Stahmer, Suhrheinrich, Reed, Bolduc, & Schreibman, 2011), we expect that the majority of participants will be familiar with one or more of these EBPs.

2.1.8.2. Attitudes, norms, self-efficacy, and intentions. Using the TPB and following standard procedure (Kaplan, 1972), we will use standard question stems (Ajzen & Sheikh, 2013; Lyon et al., 2019) to calculate mean scores for participants' attitudes (n = 6 items), perceived norms (n = 5 items), self-efficacy (n = 2 items), and intentions (n = 3 items) to use each autism EBP. Participants will select a response on a 7-point bipolar adjective scale ranging from "strongly agree" to "strongly disagree." For example, to gather participants' attitudes toward an EBP, respondents will rate performance of [EBP] as extremely unpleasant to extremely pleasant and as extremely difficult to extremely easy. For perceived norms, an example item asks participants to rate the statement, "Most other people in my position use [EBP] with their included student(s) with autism." To gather participants' self-efficacy to use a specific EBP, participants will rate statements such as, "I am confident that, if I wanted to, I could use [EBP] with my included student(s) with autism." Participants will complete two items for each EBP (8 items total) and the mean score for each EBP will be calculated to measure self-efficacy. Intentions will be measured using three items (e.g., "I intend to use [EBP] with my included student with autism in the next two weeks").

2.1.8.3. Implementation climate. To measure implementation climate, we will use the Implementation Climate Scale (ICS; Ehrhart et al., 2014), an 18-item rating scale that measures employees' shared perceptions of the policies, practices, procedures, and behaviors that are expected, supported and rewarded in order to facilitate effective EBP implementation. The ICS has six subscales including: 1) focus on EBPs (commitment to use EBPs); 2) educational support for EBPs (support for learning and using EBPs); 3) recognition for EBPs (praise and acknowledgment are provided for EBP use); 4) rewards for EBPs (financial or tangible rewards are provided for EBP use); 5) selection for EBPs (employees are selected for their knowledge of EBPs); and 6) selection for openness (employees are selected for their flexibility and openness to use EBPs). The ICS is a psychometrically validated and reliable instrument (α = 0.81−0.91; Ehrhart et al., 2014) and has been successfully adapted for use in schools (Lyon et al., 2018; Locke, Lawson et al., 2019).

2.1.8.4. Implementation leadership. To identify specific leader behaviors, we will use the Implementation Leadership Scale (ILS; Aarons et al., 2014), a 12-item rating scale with four subscales that assess the degree to which a leader is knowledgeable (understands EBP and implementation), supportive (supports EBP adoption/use), proactive (anticipates and addresses implementation challenges), and perseverant (responsive to challenges) in implementing EBPs. The ILS is a psychometrically validated and reliable instrument (α = 0.95−0.98). The factor structure and psychometrics have held when used in schools (Lyon et al., 2018; Locke, Lawson et al., 2019). Implementation leadership is scored using aggregate individual ratings.

3. Primary implementation outcome: fidelity

3.1. Fidelity

In this study, we propose to examine two aspects of fidelity as noted by Proctor et al. (2011): 1) adherence to the EBP protocol (the extent to which the intervention occurred as intended); and 2) intensity of EBP use as noted by Pellecchia et al. (2015). Although we intend to control for the use of other EBPs in our models, there are feasibility constraints to individually measuring fidelity to 22 EBPs included in this study (n = 9 practices, n = 13 strategies). Therefore, we will measure fidelity (adherence to the EBP protocol) using self-rated fidelity measures applied to the four most frequently used EBPs identified in Aim 1. We will ask participants to rate *general* fidelity of EBP implementation using the **Evidence-Based Practices Implementation Outcomes Scale (EBPIOS**; Ehrhart, Aarons, & Farahnak, 2015), a 4-item fidelity tool that assesses use, adherence, intensity, and competence of EBP delivery for each EBP they use. Internal consistency for these ratings is high (α = .97; Ehrhart et al., 2015). A mean score will be calculated to measure fidelity. We have used this tool in previous work that examined *multiple EBPs* in schools (Lyon et al., 2018).

We also will measure teachers' and paraeducators' intensity of EBP use through self-report. Intensity is commonly used as an indicator of fidelity of autism EBPs and will complement the adherence fidelity tools (Locke, Lawson et al., 2019; Mandell et al., 2013; Williams et al., 2019) and higher intensity is associated with higher fidelity overall (Pellecchia et al., 2015). Teachers and paraeducators will be asked to reflect on their EBP use for each included student with autism across the previous week. Intensity of EBP use will be coded using a Likert scale ranging from "0" to "4" with the following criteria for each score: "0" (less than one time per week), "1" (one time per week), "2" (two to four times per week), "3" (one time per day), and "4" (two times per day). A sum score will be

calculated.

4. Secondary implementation outcome: penetration

Penetration will be gathered via quantitative survey. We will ask participants about their use of each EBP across classroom activities (e.g., math, music, small group) for students with and without autism. For all of these, we will divide the total number of endorsed options (e.g., total activities, number of students with autism in the class) by the total number of possible options (Proctor et al., 2011).

5. Secondary outcomes: child social and behavioral skills

5.1. Children's social skills

The Social Responsiveness Scale-2 (SRS-2; Constantino & Gruber, 2012) is a 65-item rating scale that measures social behavior associated with autism and distinguishes children with a pervasive developmental disorder from those with other psychiatric conditions (Constantino et al., 2006). The SRS-2 is used for children between the ages of 4–18 years with internal consistency of.88, inter-rater reliability of .75, and test-retest reliability of .88 (Constantino & Gruber, 2012). For each child participant, the general or special educator who spends the most time with the student will complete the SRS-2.

5.2. Children's disruptive behavior

The Aberrant Behavior Checklist-Irritability Scale (Aman & Singh, 2017) is a 15-item, teacher-rated subtest that is commonly used to measure behavioral change. Items include disruptive behavior, tantrums, self-injurious behavior, and aggression rated from 0 to 3 with higher scores indicating greater severity.

5.2.1. Data analysis

Exploratory data analysis will be performed to explore attrition, check for missing data and outliers, and examine the distribution of study variables. We also will explore the associations among all variables by role (e.g., general or special education teacher and paraeducator) using bivariate analysis and look at correlations among variables and explore relevant subscales of all measures to understand the nuances of each construct. If the data are missing at random, as found by comparisons of available and missing data (Collins, Schafer, & Kam, 2001), we will use multiple imputation with expectation maximization (EM; Dempster, Laird, & Rubin, 1977; Puma, Olsen, Bell, & Price, 2009) and conduct sensitivity tests.

5.3. General modeling strategy

To address Aim 2, we will use 2-level generalized mixed effects models (HLM) because teachers and students (level 1) are nested within schools (level 2). Fixed terms will be entered for all levels and random effects for schools. Prior to model building, the intraclass correlation coefficient (ICC; $ICC = \tau_{00}/\tau_{00} + \sigma^2$) and design effect ($DE = 1 + (n_c - 1)$*ICC, where n_c is the number of teachers (to include general education teachers, special education teachers, and paraeducators) in each cluster will be calculated. If random effects are not statistically significant, the ICC is low (ICC $< .02$), and the design effect is less than 2, the random effect term for schools will be removed and the model re-run to preserve model parsimony (Muthén, 1994; Peugh, 2010; Raudenbush & Bryk, 2002). Although there is a third level of nesting (i.e., schools within districts), we anticipate being underpowered to include district ($n = 8$) as a random effect and will use dummy coded variables for district instead. We expect that about 90 % of general education classrooms will only have one student with autism who is partially or fully included; if a classroom has multiple included children with autism, we will randomly choose only one child's data for analysis. A covariate for role (i.e., general education teacher, special education teacher, or paraeducator) will be included in the models; if it is found to be statistically significant, models will be run separately by role.

Model building will follow standard procedures (Peugh, 2010; Raudenbush & Bryk, 2002); an unconditional model will be fit first to establish total model variance and enable calculation of variance accounted for in later models. Iterative models will be built, beginning with level 1 variables for the predictors and other control covariates such as EBP. Estimations will be fit using restricted maximum likelihood in all models due to small sample size (Peugh, 2010). Models will be assessed for violations of assumptions. Fixed and random effect significance and model goodness-of-fit will be evaluated using standard procedures including Wald Z and model deviance statistics (Akaike Information Criterion, Bayesian Information Criterion, and -2 Log Likelihood; Peugh, 2010). To maximize statistical power and model parsimony, reduce the risk of overfitting the models, and ensure that the model includes important variables, covariates not contributing to the model ($p > 0.20$) will be removed, consistent with standard model building practices (Babyak, 2004). Level 2 variables will be added and excluded for the same reasons. To control for multiple comparisons within each outcome, we will use the Benjamini and Hochberg's (1995) False Discovery Rate Procedure, which is preferable to the overly conservative Bonferroni correction (Schochet, 2008). All statistical tests will be two-tailed and a p value<0.05 associated with our independent variables of interest will be considered significant. Exploratory analyses will be conducted using Stata 13.1 (StataCorp, 2013), and mixed effects models will be built using HLM7.0 (Raudenbush & Bryk, 2002).

5.4. Power analysis for primary outcome

This study is adequately powered to detect a small to moderate effect for our primary implementation outcome of fidelity (Aim 2 sample from 60 schools: $n = 160$ general educators, $n = 120$ paraeducators, and $n = 80$ special educators). However, to account for the nested structure of the data (teachers and students within schools), an effective sample size must be calculated that accounts for Intracluster Correlation Coefficient (ICC), σ, a measure of the magnitude of relatedness of observations within clusters (Gulliford, Ukoumunne, & Chinn, 1999). For each level of nesting, the sample size is divided by the sample deflation factor 1+(mean cluster size-1)*σ. Because we have no prior information about σ in studies of autism EBP implementation in schools, we rely on proposed guidelines that recommend small, medium, and large ICCs of σ = .05, 0.10, and, .15, respectively (Zyzanski, Flocke, & Dickinson, 2004). Using Monte Carlo simulation via R, estimates of statistical power are based on a Type 1 error rate of 0.05 and sample sizes ranging from 138-164 students and 206–288 teachers, paraeducators, and special education teachers (R Core Team, 2018). This study has 80 % power to detect minimal detectable effect sizes (Cohen's r^2) ranging from .22 to .24 for students with autism and .17–.20 for models including all general and special education teachers and paraeducators.

5.5. Outcomes of Aim 2

We draw from the TPB and EPIS framework to identify potential factors to understand the relative contribution of individual (e.g., attitudes, norms, and self-efficacy) and organizational factors (e.g., implementation leadership and climate) that support EBP implementation and their effects on child outcomes. Aim 2 will allow us to understand the malleable factors that might facilitate the use of EBPs to support the inclusion of children with autism and identify potential factors to explore as mechanisms that facilitate EBP use in Aim 3.

For Aim 3, we will use a mixed methods approach to elucidate the mechanisms linking individual and organizational factors to the use of EBPs to answer the following research question: What are potential mechanisms through which individual and organizational factors facilitate or hinder teachers' and paraeducators' use of EBPs?

5.5.1. Sample

We anticipate a total of 80 participants (i.e., 40 general and special education teachers and 40 paraeducators) from 40 classrooms in approximately 40 schools who participated in Aim 2. The targeted enrollment for Aim 3 will be stratified on: 1) whether teachers and paraeducators practice partial or full inclusion; and 2) EBP implementation (penetration and fidelity data collected in Aim 2). We will conduct ten interviews per cell to achieve data saturation (Guest et al., 2006). We anticipate that there will be enough variability in time in inclusion and EBP implementation to populate each cell. We will use a purposive sampling strategy to identify individuals who will participate in the interviews (Palinkas et al., 2011). Teachers and paraeducators will be ranked by their implementation of EBPs (penetration and fidelity from Aim 2) and classified as high- and low or non-performing relative to the sample. Because participants with low or no implementation may be less likely to participate in additional data collection, should a participant decline, we will invite the next participant with the highest or lowest implementation fidelity following the procedures outlined in Beidas et al. (2013); Lyon et al. (2013), and Locke et al. (2016).

5.5.2. Procedures

We will use the penetration and fidelity data gathered in Aim 2 to identify participants in Aim 3 who will be recruited as described in Aim 1. Once informed consent is obtained, we will conduct individual, audio-recorded semi-structured interviews at a convenient time for the participant (via videoconference), lasting approximately 30−45 min. As an incentive for participation, participants will be offered $40.

To take advantage of general and special education teachers' and paraeducators' perspectives and develop a complete understanding of the mechanisms underlying the use of EBPs in inclusive settings, we will use the following mixed methods design (see Fig. 1), based on the framework articulated by Palinkas et al. (2011): the structure is *sequential* (we will have quantitative data from Aim 2 prior to gathering qualitative data (Aim 3); the function is of *sampling* (we will select interview participants in Aim 3 based on responses on quantitative data in Aim 2) and *complementarity* (we will use qualitative data to elaborate upon the quantitative findings to understand the underlying mechanisms that affect EBP use; quan→QUAL); and the process is *connecting* (the qualitative data set will build upon the quantitative data set).

5.5.3. Measures

5.5.3.1. Qualitative interview protocol. Using the EPIS framework to generate questions, we will develop a systematic, comprehensive semi-structured interview guide that examines mechanisms through which individual and organizational constructs identified in Aim 2 facilitate or hinder teachers' and paraeducators' use of EBPs to successfully include and retain children with autism in general education settings. We will generate a series of carefully crafted questions that will: 1) elicit examples of how each construct manifests in their schools; and 2) explore the mechanisms through which these constructs affect their ability to adopt and implement EBPs. Synthesis of this information will point to potential mechanisms through which individual and organizational factors affect EBP use.

5.5.4. Data analysis

Transcription and data analysis will follow those proposed in Aim 1. The analyses from Aim 3 will explore the nuances of the constructs identified in Aim 2 to understand potential mechanisms that affect the implementation of EBPs in general education settings. Qualitative data will provide a deeper understanding of what is truly happening in schools that may be driving the quantitative results as a means to identify critical implementation intervention targets.

5.5.5. Outcomes of Aim 3

Aim 3 will explore the individual- and organizational-level mechanisms that facilitate EBP use to support the inclusion of children with autism and point to the malleable factors to be targeted in a multilevel implementation intervention. Aim 3 will allow us to gain insight into how individual providers and the school context relates to EBP adoption and implementation, with implications for developing implementation theory and strategies.

5.6. Inter-connectedness of outcomes from Aims 1–3

Identifying factors at the individual and organizational levels that are associated with EBP use for children with autism in schools has strong potential to improve the well-being of this population and to advance implementation theory but has yet to be articulated and thoroughly tested (Williams et al., 2019). Many studies assume (either implicitly or explicitly) that individual and organizational factors have independent and additive effects. If these assumptions are incorrect, then the models testing them are mis-specified and the field's understanding of how individual and organizational factors act as mechanisms for supporting EBP adoption and implementation is at best incomplete and at worst distorted. To date, the factors that create the necessary and sufficient conditions for successful EBP adoption and implementation in schools remain poorly specified. Deficits in implementation theory stifle the development of optimally effective and efficient implementation strategies.

6. Discussion

6.1. Innovation

The proposed study aligns with the needs and priorities of researchers, policymakers, and practitioners and has the strong potential to offer important findings regarding the EBP use in general education settings. If successful, stakeholders will understand the ways in which individual and organizational factors affect general and special education teachers' and paraeducators' use of EBPs, which will enable us to develop and tailor novel implementation strategies to promote the use of EBPs for children with autism in schools. This study will be the largest to date among included children with autism and point to ways to improve EBP use in order to promote the success of children with autism in their least restrictive environment. The diversity of schools in which this study will be conducted will ensure that the results will be generalizable across a number of settings and have critical policy and practice implications to improving the quality of care for children with autism in schools.

6.2. Limitations

This is one of the first studies to prospectively examine individual- and organizational-level predictors of implementation and sustainment of EBPs for included children with autism in public schools, though it is not without its limitations. Due to COVID-19 school closures, we replaced all observer-rated instruments (e.g., fidelity, classroom observations of disruptive behavior) with self-rated assessments, and the entire study will be completed remotely (e.g., online survey, videoconference interview, etc.). While both practical and necessary, self-report data may introduce bias. However, given the need to understand the educators who work with students in the contexts in which they are served, educators' perspectives will provide pivotal information for the field. We also note that there are additional challenges to educators' use of EBPs for children with autism via distance learning. To address this, we have anchored the survey items to pre-COVID instructional times in the past two years.

6.3. Impact

Research has shown that general and special education teachers and paraeducators often use EBPs for children with autism but with poor fidelity (Kretzmann, Shih, & Kasari, 2015; Mandell et al., 2013; Odom et al., 2013; Pellecchia et al., 2015; Stahmer et al., 2015; Suhrheinrich et al., 2013) resulting in an attenuation of effects and a substantial number of children with autism not receiving the support they need and deserve in public schools. The heterogeneity of presentation of autism characteristics is one of the greatest challenges in working with children with autism – no one EBP is guaranteed to work for all children (Cook & Odom, 2013). Thus, educators must be skilled in and knowledgeable about multiple practices. Given the extensive list of EBPs for children with autism, we must first understand: 1) which EBPs general and special education teachers and paraeducators have been trained to use and consistently use in inclusive settings; 2) the *individual and organizational factors* that predict EBP use; and 3) the *mechanisms* that influence EBP use. Successful completion of this study will identify a novel array of important malleable targets and mechanisms to increase EBP use and more meaningfully include and retain children with autism in general education settings.

Personnel

All authors are key study personnel affiliated with the primary institution.

Timeline

Timeline of quarterly research activities																	
Activity	Research Staff	2020-2021 Quarter				2021-2022 Quarter				2022-2023 Quarter				2023-2024 Quarter			
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Submit UW and school districts' IRBs	JL, JC	■				■				■				■			
Aim 1																	
Recruitment and data collection (n=15 schools)	JL, JC, IS		■	■													
Data entry, transcription, coding, and analysis	JL, MH, HC, EM, MJ			■	■	■											
Aim 2																	
Recruitment and data collection (n=60 schools)	JL, MH, JC, HC, EM, MJ, IS			■	■		■	■	■		■	■					
Data entry, cleaning, coding, and analysis	JL, MH, MP, HC, EM, MJ			■	■	■	■	■	■	■	■	■	■				
Aim 3																	
Recruitment and data collection: (n=40 schools)	JL, MH, JC, HC, EM, MJ, IS												■		■		
Data transcription, coding, and analysis	JL, MH, HC, EM, MJ												■	■	■	■	■
Dissemination	JC, AL, IS				■	■			■				■		■	■	■
Manuscript preparation	JL, MH, MP, AL, IS					■				■			■	■	■	■	■

Ethics

The University of Washington IRB (IRB ID: STUDY00010045) as well as each participating school district's Institutional Review Boards have approved the study procedures. The authors have no conflicts of interest.

Consent for publication

Not applicable.

Availability of data and material

The application described in this manuscript is freely available. Please contact the lead author for more information.

Funding and approval

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Authors' contributions

JL is the principal investigator for the study protocol, generated the idea and designed the study, was the primary writer of the manuscript, and approved all changes. Author MP is the study methodologist and drafted the data analysis sections. Authors MH, JC, HC, EM, MJ, ARL, and IS provided input into the design of the study. All authors were involved in developing, editing, reviewing, and providing feedback for this manuscript and have given approval of the final version to be published.

Declaration of Competing Interest

The authors report no declarations of interest.

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