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Amanda Binns
Western University, abinns3@uwo.ca

Rachael Smyth
Western University

Allison Andres
Western University

Joyce Lam
Western University

Janis Oram Cardy
Western University, janis.cardy@uwo.ca

Review Article

Looking back and moving forward: A scoping review of research on preschool autism interventions in the field of speech-language pathology

Amanda V Binns (iD)
Health and Rehabilitation Sciences, Western University, London, Ontario, Canada

Rachael Smyth (iD)
Health and Rehabilitation Sciences, Western University, London, Ontario, Canada;
Communication Sciences and Disorders, Western University, London, Ontario, Canada

Allison Andres, Joyce Lam and Janis Oram Cardy (iD)
Communication Sciences and Disorders, Western University, London, Ontario, Canada

Abstract

Background & Aims: Speech-language pathology services are frequently accessed by families of children who have suspected or diagnosed autism. This is expected given that social communication differences are a core feature of autism. This review looked broadly at the state of research in the field of speech-language pathology and preschool autism interventions in order to identify the types of studies that could be used to inform the practices of speech-language pathologists (SLPs), and to identify gaps in the field so they can be addressed in future research. Specifically, we examined the extent of research conducted on interventions delivered (at least in part) by SLPs to preschool children with suspected or diagnosed autism, identified the range of skill development areas targeted within the studies, and explored the characteristics of the interventions (i.e., theoretical models underlying the programs, service delivery models, treatment dosage).
Methods: A scoping review of articles published between 1980 and 2019 was conducted using the five phases outlined by the Arksey and O'Malley framework: (a) articulating the research question; (b) identifying relevant studies; (c) selecting studies; (d) charting the data; and (e) collating, summarizing, and reporting the results.
Main Contribution/Results: A total of 114 studies met inclusion criteria with most published since 2010 and conducted within North America. Case study or single-subject study designs were the most frequently used. Interventions delivered solely by SLPs and by multiprofessional teams that included SLPs were relatively equally represented. Across the included studies, nine skill development areas were targeted, but interventions targeting social communication, language, and augmentative communication skills made up the vast majority of studies. There was relatively even distribution of interventions informed by child-centered, clinician-directed, and hybrid models. Explicit information detailing intervention characteristics (e.g., treatment dosage, professional training of clinicians delivering the intervention) was poorly reported in many studies. For those studies providing details, there was a great deal of variability in the nature of interventions (e.g., service delivery models, SLPs' role, dosage).
Conclusions: This review revealed that research in the area of autism interventions delivered, at least in part, by SLPs has markedly increased over the past 10 years. Still, there remains a need for more research, and greater transparency detailing the nature of the interventions being investigated. The research conducted to date captures the versatility of the SLP's role within preschool autism intervention. Improved reporting and studies with strong methodological rigor focused on capturing the complex and individualized nature of interventions are needed, as are intervention studies aligned with real-world community practice.

Corresponding author:
Amanda V Binns, Health and Rehabilitation Sciences, Western University, London, Ontario, Canada N6G 1H1, Canada.
Email: abinns3@uwo.ca

Implications: This review provides a comprehensive examination of the status of research on preschool interventions delivered to children with suspected or diagnosed autism within the field of speech-language pathology. Several directions for future research are provided, as are suggestions for improving the clinical applicability of results to further the development of effective, evidence-informed policy and practice in speech-language pathology.

Keywords
Autism spectrum disorders, intervention/therapy, speech and language therapy, preschool children, health services

Introduction

Variations in social communication and social interactions are core behavioral features of autism spectrum disorder (ASD) or autism spectrum conditions, referred to here as autism (American Psychological Association, 2013; Fletcher & Watson, 2019). The extent and range of communication and social interaction challenges faced by autistic individuals varies from person to person, as does their impact on long-term outcomes and quality of life (Tidmarsh & Volkmar, 2003). Some autistic individuals achieve independent living, develop lasting relationships, obtain higher education degrees, and work in competitive jobs, but many do not. For these individuals, their social and communication challenges can negatively impact community involvement, health, and overall quality of life (Gentles et al., 2020; Marriage et al., 2009).

Evidence supports better outcomes for children with autism who receive early intervention (e.g., Beaudoin et al., 2014; Hampton & Kaiser, 2016), and one of the best predictors of long-term outcomes is functional use of language and social communication skills by 5–6 years of age (Szatmari et al., 1989; Taylor & Seltzer, 2011; Tidmarsh & Volkmar, 2003). Therefore, it is not surprising that services from speech-language pathologists (SLPs) are the most frequently accessed interventions after children receive an autism diagnosis (Al Jabery et al., 2014; Denne et al., 2018; Salomone et al., 2016; Volden et al., 2015) and that parents of autistic children have consistently identified communication and social domains as treatment priorities for their children (Pituch et al., 2011). Thus, from a public health and family well-being perspective, research focused on understanding the services provided by SLPs to support autistic children and their families is imperative.

The aim of this article is to look broadly at the state of research in the field of speech-language pathology and preschool autism interventions. Many reviews have evaluated the efficacy of interventions that aim to support autistic children's communication and language development (e.g., Hampton & Kaiser, 2016; Sandbank et al., 2020; Smith & Iadarola, 2015; Wetherby & Woods, 2008). However, isolating the studies that examined interventions delivered (at least in part) by SLPs was not the focus of these reviews. Identifying and examining research that represents the roles served by SLPs within preschool autism intervention

delivery can be used to identify research gaps in the field so they can be addressed in future research and, ultimately, be used to strengthen clinical practice and policy development related to the services provided by SLPs.

A note on SLP interventions and programs

Autism is thought of as both a "medical condition that gives rise to disability … and an example of human variation that is characterized by neurological and cognitive differences" (Lai et al., 2020, p. 4). Because the terms *treatment* or *intervention* can be interpreted to imply that autism itself is something that needs to be "treated" or "cured," the idea that autistic people require intervention or treatment has become controversial. SLPs do not aim to "cure" or "treat" autism. Instead, their intervention services focus on enhancing the wellbeing of both the autistic child and their family through supporting communication development and alleviating distress that a child or caregiver might be experiencing due to breakdowns in communication.

SLPs receive specialized training in how to support a range of skill development areas including augmentative communication, speech production, language comprehension, language use, social communication, play, and feeding and swallowing. This variety is echoed in reports of the intervention practices of SLPs working with autistic preschoolers in real-world settings (Gillon et al., 2017; Hsieh et al., 2018). The breadth of SLPs' scope of practice enhances their ability to tailor the selection of treatment goals and strategies to each individual child, which is imperative given the heterogeneity of autism. However, the wide range of treatment options available to SLPs and interest in providing flexible individualized intervention programs also poses challenges, making it difficult to select the single or combination of evidence-based early interventions(s) that are "just right" for a given individual with autism.

The current study

To gain a comprehensive understanding of the state of research on preschool autism interventions provided by SLPs, this review aimed to answer the broad question: What is the extent, range, and nature of the research conducted on preschool autism interventions delivered at

least in part by SLPs? Answering this question would generate a map of the extant literature on SLP interventions provided to preschoolers with autism, provide insight into the intervention characteristics across research studies, identify research gaps, highlight pathways for future research and policy development, and inform future funding initiatives and resource allocation.

We elected to focus on preschool aged children because of the important role that early intervention plays in autistic children's long-term outcomes (e.g., Hampton & Kaiser, 2016), the specific importance of achieving functional communication by the end of the preschool period for maximizing long-term outcomes (e.g., Tidmarsh & Volkmar, 2003), and the fact that families frequently seek out the services of SLPs following their preschooler's diagnosis (e.g., Volden et al., 2015). We used a scoping review because this method is particularly useful for mapping a specific area of research that has not been comprehensively reviewed before and examining "what" and "how" research has been conducted in a particular field (Arksey & O'Malley, 2005; Munn et al., 2018). A scoping review involves broadly searching the available literature and extracting relevant information, and is often a precursor to more detailed systematic reviews focused on examining the effectiveness and meaningfulness of particular practices (Munn et al., 2018). Five key phases are involved in conducting a scoping review: (1) articulating the research question; (2) identifying relevant studies; (3) selecting studies; (4) charting the data; and (5) collating, summarizing, and reporting results, and an optional sixth phase, consulting with stakeholders (Arksey & O'Malley, 2005; Levac et al., 2010). We did not formally conduct the optional sixth phase, but stakeholders (i.e., practicing SLPs, SLP researchers) were well represented on our team and thus could provide insight about the clinical relevance of the review.

Methods

Methodology for this scoping review was in accordance with the guidelines outlined by Arksey and O'Malley (2005). Our review included articles published since 1980, when autism was first included as a diagnosis in the Diagnostic and Statistical Manual of Mental Disorders (American Psychological Association, 2013).

Phase 1: articulating the research question

The central question guiding our scoping review was: What is the extent, range, and nature of published experimental literature on preschool autism interventions implemented, in part or in whole, by SLPs? To reflect the range of real-world SLP-delivered services, we included studies examining interventions both delivered solely by SLPs and where the SLP was one of the professionals within a group of non-SLPs delivering the intervention. Specifically, we were interested in identifying: (a) the extent of research conducted to date on interventions delivered to autistic preschool children by SLPs, including information about the progression of research over time, the study characteristics (i.e., study design, location, participant diagnostic information), and the role of SLPs in delivering intervention, (b) the range of intervention targets examined within the literature, and (c) the nature of these interventions including theoretical underpinnings of the interventions researched, service delivery models, and treatment dosage.

Phase 2: identifying relevant studies

In consultation with an expert health sciences librarian, we developed a concept map and search queries for seven electronic databases: Scopus, ERIC, PsycINFO, EMBASE, AMED, PubMed, and CINAHL using a combination of relevant keywords and controlled vocabularies such as MeSH terms. Search strategies were adjusted to each database to identify relevant articles published between January 1980 and December 2019. Our search strategy was intentionally designed to be comprehensive to include all relevant articles. All searches included at least one identifier for ASD (e.g., autism, PDD-NOS, etc.) linked to at least one identifier for intervention (e.g., therapy, treatment, intervention) and one identifier for SLP (e.g., clinician, therapist, speech-language therapist). Search results were imported into an Excel document and duplicates were identified and removed using the sorting feature. Search strategies and limits for all databases are provided within Supplemental Material A.

Phase 3: selecting studies

After removing duplicates, articles were reviewed in three steps: titles, abstracts, and full text review. Five reviewers (two SLPs, three graduate students training to become SLPs) participated in study selection. Prior to independently reviewing titles and abstracts, 25% of the articles were double coded to establish a minimum of 95% reliability between coders for kept articles. During full text review, two reviewers independently assessed the full text of all potentially relevant articles for eligibility. During both the abstract and full text review, at least one of the reviewers was a certified SLP. Discrepancies between reviewers were resolved through consensus with the first author. Reference lists of all included articles were also reviewed to identify additional studies to be assessed for eligibility. Interrater reliability was calculated for full text screening.

For articles to be included in this review, they had to meet the following predetermined criteria: (1) participants were between 1 month and 5–11 years old, or the mean age was below 6 years; (2) children were diagnosed with autism (inclusive of past diagnostic labels PDD-NOS or Asperger syndrome) or were suspected to have autism;

(3) the study evaluated a treatment provided or supervised by a SLP; (4) articles were written in English. We included children suspected to have autism but not yet diagnosed because many children do not receive an autism diagnosis until they are 4 years old (Christensen et al., 2016). For single-subject studies that included subjects outside of our predetermined age range, only data for subjects who fell below 6 years of age were included. Community-based studies that included over 90% of subjects with autism or suspected of having autism were also included. For the purposes of this article, *suspected of having autism* was defined as showing documented challenges in social communication skills and restricted or repetitive behaviors. Treatments *provided by a SLP* were defined as services directly provided by a SLP or SLP graduate student, supervised by a certified SLP, or provided in collaboration with a SLP. Services provided by graduate student SLPs were included in this group as they practice under the supervision of qualified professionals. Articles were accessed electronically or authors were contacted to obtain a reprint.

Phase 4: charting data

A table for extracting information from the included articles was developed a priori and interrater reliability between reviewers was calculated for data extracted. Information extracted from each article included: author names, year of publication, article title, study design, sample size, the SLP's role within the program (e.g., supervision, team, direct service), participant characteristics (i.e., age, autism diagnosis or suspected autism), type of speech-language intervention (i.e., skill development area[s] targeted), brand name of treatment program, theoretical approaches underlying intervention, service delivery model (i.e., group, 1:1 intervention, parent/caregiver training, remote therapy), intervention dosage (intensity, frequency, duration), location of service (e.g., home, clinic, daycare), country where intervention was delivered, and notes or questions for future reference.

Participant characteristics. For each participant meeting criteria for this review, we recorded the child's age and whether there was a formal diagnosis of autism or if the child was suspected of having autism.

Type(s) of speech-language intervention. For each included study, we identified primary skill area(s) that each intervention aimed to support. We predefined social communication interventions as programs that targeted foundational communication skills including engagement, synchronous communication, joint attention, reciprocal interaction, use of affect, and regulation (Binns et al., 2019; Binns & Oram Cardy, 2019). Language focused interventions were classified as targeting general language (including both language production and comprehension), language production, or

language comprehension. Studies where augmentative and alternative communication (AAC) systems were sometimes used by children, but use of the system was not the focus of the intervention, were not identified as AAC interventions. Instead, they were classified according to the distinct skill area(s) addressed by the intervention (e.g., social communication and targeted behavior; Smith et al., 2015). Interventions where clinicians supported children's use of AAC systems were identified separately. We defined speech-based interventions as those that targeted one of articulation, oral-motor production of speech sounds, voice, or fluency. Interventions that focused on skills such as imitation, flexibility, and adaptive behavior were identified as interventions for *targeted behaviors*. Feeding interventions were distinct from other behavior focused treatments. Finally, we predefined play interventions as those supporting children's development of play skills or use of social dialogue specific to play scenarios (e.g., peer play, use of social scripts).

Theoretical approaches underpinning interventions. Each intervention was classified using one of the three common approaches in which SLPs receive training: clinician-directed, child-centered, and hybrid (Paul et al., 2018). Theoretical models underpinning interventions were identified using information provided within the article (e.g., model identified by the authors, intervention descriptions), and searching supplemental material describing intervention approaches (i.e., therapy manuals, therapy brand websites). The following definitions guided our classification of theoretical model. Clinician-directed interventions were defined as using a high level of structure, drill, explicit prompting, error shaping, reinforcement of correct responses, clinician-directed modelling, or principles of applied behavior analysis to support communication and language. Child-centered interventions (also known as developmental social pragmatic or naturalistic approaches) were identified as treatment approaches that created communication and language learning opportunities within natural settings and used strategies such as following the child's lead, recasting, expanding, extending, modeling, and language mapping (Binns & Oram Cardy, 2019; Ingersoll, 2010). The classification of a hybrid approach was assigned where both clinician-directed and naturalistic elements were used to support communication and language development. When a single study examined two different interventions with different theoretical models underlying each intervention, we documented both of the theoretical models used (e.g., Paul et al., 2013).

Phase 5: collating, summarizing, and reporting results

Following data extraction, we used frequency analysis and narrative synthesis involving extraction of themes around treatment characteristics to summarize our findings.

Results

Extent of research

Our initial search of seven databases yielded 23,753 potentially relevant citations. After removing duplicates ($n = 3,442$) and completing title ($n = 19,796$) and abstract screening ($n = 4,506$), 1,026 citations remained for full text review. Following full text review, 108 articles reporting on 104 treatment studies met inclusion criteria and remained for data extraction. When study results were reported in more than one article, information from each article was collapsed into one entry (e.g., Casehniser et al., 2013, 2015). Ten additional studies were included after searching reference lists of the 108 articles, resulting in a final total of 114 studies included in this review (see Supplemental Materials B and C for references and data extracted from the 118 articles).

Interrater agreement during title and abstract screening was 97% based on double coding of 25% of the articles, and interrater reliability was $k = 0.90$. For full text review, agreement between reviewers double coding all articles was 96%, with interrater reliability $k = 0.88$. There was 94% interrater agreement for the data extraction phase after double coding of all articles meeting inclusion criteria.

Study characteristics, designs, and participants. Publication dates of the selected studies ranged from 1980 to 2019. There was a marked increase in SLP-delivered autism intervention publications since 2010, with 67% of the articles ($n = 76$) in this review having been published since 2010. Another 23% of the articles ($n = 26$) were published between 2000 and 2009. Studies were conducted across 6 continents within 21 unique countries, with the majority occurring within North America (see Figure 1).

Case study or single-subject study designs were the most frequently used (51%; $n = 58$), followed by pre-post single group designs (18%; $n = 21$), randomized control trials (RCTs; 18%; $n = 21$), and quasi-experimental group study designs (12%; $n = 14$). All RCTs were conducted within the last 10 years. Data analysis techniques varied greatly and included descriptive analysis, measures of central tendency (means, median, mode) and variation (standard deviations), changes in raw scores, percentage correct, and inferential analysis (paired *T*-test, analysis of variance/analysis of covariance, linear regression).

Sample sizes varied from 1 to 210. A total of 3095 children ranging in age from 7 months to 5–11 years participated across the included studies. Overwhelmingly, the treatment programs were provided to children who had received a diagnosis of autism (90%; $n = 103$).

SLP involvement in intervention programs. Clinicians were identified as SLPs using a variety of terminology (e.g., speech-language clinician, speech-language therapist, speech therapist, specially trained language clinician, clinician with familiarity with developmental psycholinguistics, and communication interventionists). When not explicitly identified as SLPs (e.g., clinician with familiarity with developmental psycholinguistics), the professional background of the therapists was verified with the authors of the publications. Also prevalent were nonspecific references to professional background (e.g., clinician, therapist, the second author, the researcher). Of the 114 included studies, 21%
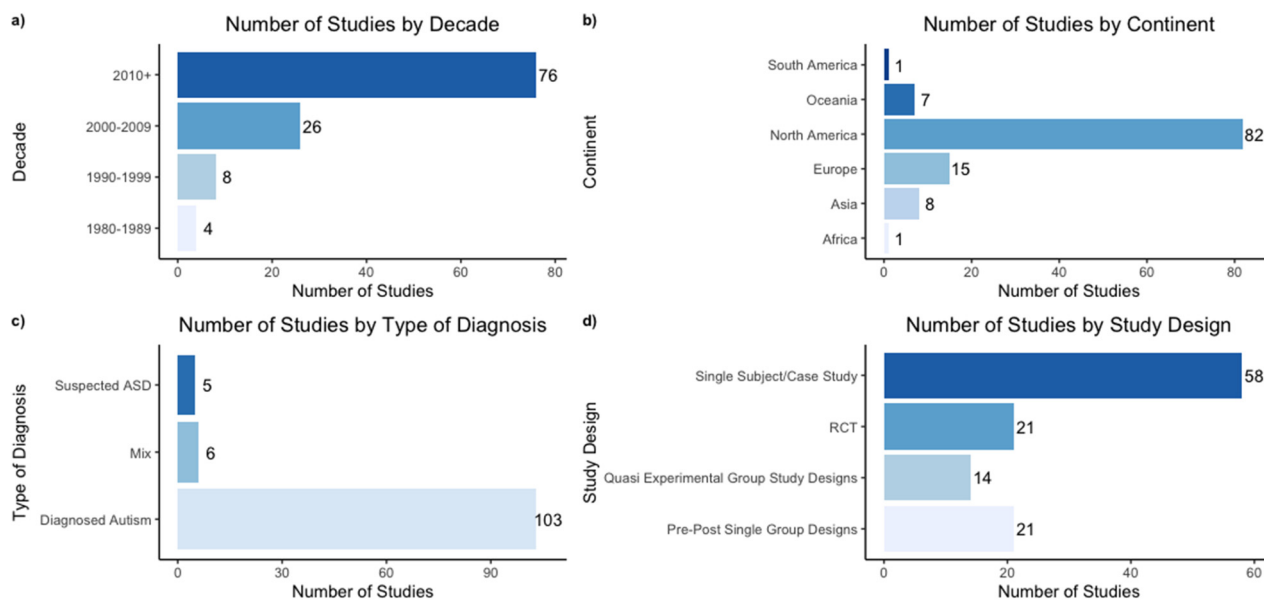
Figure 1. Number of publications by (a) decade published, (b) continent the study was conducted, (c) participant diagnostic information, and (d) study design.

($n = 24$) did not report the professional background of the therapists in the paper. When papers reported that "the authors" delivered interventions, we searched their professional background using Google to determine if the interventionists included SLPs. We also attempted to obtain information about interventionists from the authors via email. Notably, an additional 23 articles had missing information about the professional background of clinicians delivering the intervention in the article. We were not able to obtain information about the professional background of the clinicians for these articles therefore they were excluded. This resulted in a total of 47 of the articles reviewed during the full text inclusion/exclusion phase requiring reviewers to search for additional information about the professional background of clinicians.

Almost half of the treatment programs were provided by SLPs or SLP graduate students alone (45%; $n = 51$), while 63 programs (55%) were provided by a range of professionals (that in some way included SLPs), referred to here as *multiprofessional delivery*. Of the 76 articles published in the last 10 years, 63% involved multiprofessional delivery ($n = 48$). The SLP's role in multiprofessional delivered interventions varied greatly across studies. Some programs had SLPs providing direct 1:1 therapy to some of the participants, while the other participants received service from therapists with other professional backgrounds (e.g., Weatherby & Woods, 2006; Yu & Zhu, 2018). Other multiprofessional delivered interventions had each participant receiving 1:1 direct therapy both from SLPs and from other professionals on the team (e.g., occupational therapists; Casenhiser et al., 2013, 2015). In other programs,

SLPs supervised educators or behavior therapists providing 1:1 therapy (e.g., Dyer, 2008; Friedman & Woods, 2015; Muldoon & Cosbey, 2018). The extent of supervision by SLPs varied, ranging from supervision of each session (e.g., Koegel et al., 1996) to every 3 months (i.e., Dawson et al., 2010).

Range of skill development areas targeted. We identified nine skill development areas targeted within the 114 included studies: social communication, language, AAC, targeted behaviors, play, speech, feeding, auditory processing, and social emotional skills (see Table 1). Some programs targeted multiple areas (32%; $n = 36$). We identified interventions as *comprehensive* when they were delivered by multiple professionals and only measured broad outcomes using autism rating scales or diagnostic tools, rather than specific skill areas (4%; $n = 4$; e.g., Hojati, 2014; Papavasiliou et al., 2011).

The majority of programs targeted social communication ($n = 63$). Almost half of these interventions (48%; $n = 30$) also targeted other skill development areas within the program (e.g., language, play, AAC, targeted behaviors). Interventions targeting autistic preschoolers' language development were also prevalent within the studies in this review ($n = 39$). Language production skills were most frequently targeted ($n = 19$), followed by studies targeting both language comprehension and production ($n = 18$). Two studies (Grela & McLaughlin, 2006; Yorke et al., 2018) targeted language comprehension alone ($n = 2$).

AAC was another common skill targeted within the SLP-delivered interventions ($n = 20$). Both low ($n = 13$)

Table 1. Range of skill development areas targeted within the included studies.

Skill development area	Examples of specific skills targeted	Examples of articles
Social communication	Engagement, gestural communication, reciprocal interactions, use of affect, joint attention, synchronous communication, and initiation of communication	Green et al. (2010), Mcduffie et al. (2013), Rogers et al. (2012), Smith et al. (2015), Venker et al. (2012)
Language	*Production:* language use, question asking, expanding use of commenting, vocabulary use, verbal language *Comprehension:* response to question probes	Brown and Woods (2015), Casenhiser et al. (2015), Hampton et al. (2019), Salt et al. (2001), Summers et al. (2017)
AAC	Use of low or high tech devices, PECS, sign language	Tan et al. (2014), Thiemann-Bourque et al. (2016), Yoder & Stone (2006)
Targeted behavior	Imitation, escape behaviors, flexibility in routines, academic performance	Koegel et al. (2003), Dawson et al. (2010), Shire et al. (2017)
Play	Peer play behaviors, play dialogue, play steps, occurrence of novel play	Barber et al. (2016), Murdock et al. (2011), Shire et al. (2017)
Speech	Articulation, oral motor production	Chenausky et al. (2017), Dyer (2008), Rogers et al. (2006)
Feeding	Level of food acceptance, mealtime behaviors	Muldoon & Cosby (2018)
Auditory processing	Auditory perception (in children with cochlear implants and autism)	Mikic et al. (2016)
Social emotional	Regulation of emotions, social emotional functioning	Mahoney & Perales (2003), Yu & Zhu (2018)

Note: AAC = augmentative alternative communication; PECS = picture exchange communication system.

and high tech ($n = 7$) communication systems were included within this category. Three additional studies reported that participants receiving treatment were provided access to AAC supports when it was determined to be appropriate (i.e., Paynter et al., 2018; Reis et al., 2018; Smith et al., 2015). However, we did not classify these interventions as targeting AAC specifically as we could not identify how often this support was used across participants and supporting use of AAC was not the primary focus of the intervention.

Targeted behaviors were also addressed in 13 interventions. These included programs supporting imitation skills (e.g., Cardon et al., 2012), noncontingent escape (e.g., Coleman et al., 1998), developing flexibility within routines (e.g., Ivey et al., 2004), reducing problem behaviors (Koegel et al., 2003), and adaptive functioning (e.g., Smith et al., 2015). Over half of the studies addressing targeted behaviors also supported other skill development areas (64%; $n = 9$; i.e., language, social communication, or play). The remaining targeted areas were play ($n = 9$), speech ($n = 3$), social emotional ($n = 2$), auditory processing ($n = 1$), and feeding ($n = 1$).

The nature of interventions delivered by SLPs

Theoretical models. The most frequently reported theoretical models underlying intervention programs were child-centered, developmental-naturalistic models (38%; $n = 45$), followed by clinician-directed interventions based on applied behavior principles (30%; $n = 36$) and hybrid approaches that combine aspects of both behavior and developmental-naturalistic models (22%; $n = 26$).

Five studies compared two different treatments aligned with different theoretical models (i.e., Hilton & Seal, 2007;

Koegel et al., 1992, 1996; Paul et al., 2013; Prelock et al., 2011). For these, we extracted information about both programs, thus we examined a total of 119 different programs. We were unable to determine the models underlying 12 interventions (10%).

We also examined the theoretical models underpinning interventions targeting specific skill development areas. For programs that targeted multiple skills, we accounted for each skill area separately. For the five studies that examined two different interventions aligning with different models, each intervention was counted separately. See Figure 2 for a summary.

Service delivery models. Across the included 114 studies, we identified nine unique service models used to deliver the interventions (see Figure 3). Most studies used a single service model (61%; $n = 70$), while 38% ($n = 43$) used a combination (e.g., parent coaching + direct therapy), and 1% ($n = 1$) was unknown.

Direct therapy, where a clinician worked 1:1 with a child, was the prominent model ($n = 63$) and was used in conjunction with other service delivery models in 24 interventions. Proportionally, interventions targeting speech (75%), AAC (52%), and play (50%) were most likely to use a direct service delivery model. Direct 1:1 therapy models were also frequently used when targeting behaviors (47%) and language skills (42%).

Delivering intervention programs using parent coaching was also prevalent ($n = 36$). We defined parent coaching as an intervention that involved clinicians providing direct 1:1 guidance and support to parents as they were interacting with their child. Some interventions exclusively used parent coaching ($n = 18$), while the others combined parent coaching with other service delivery models
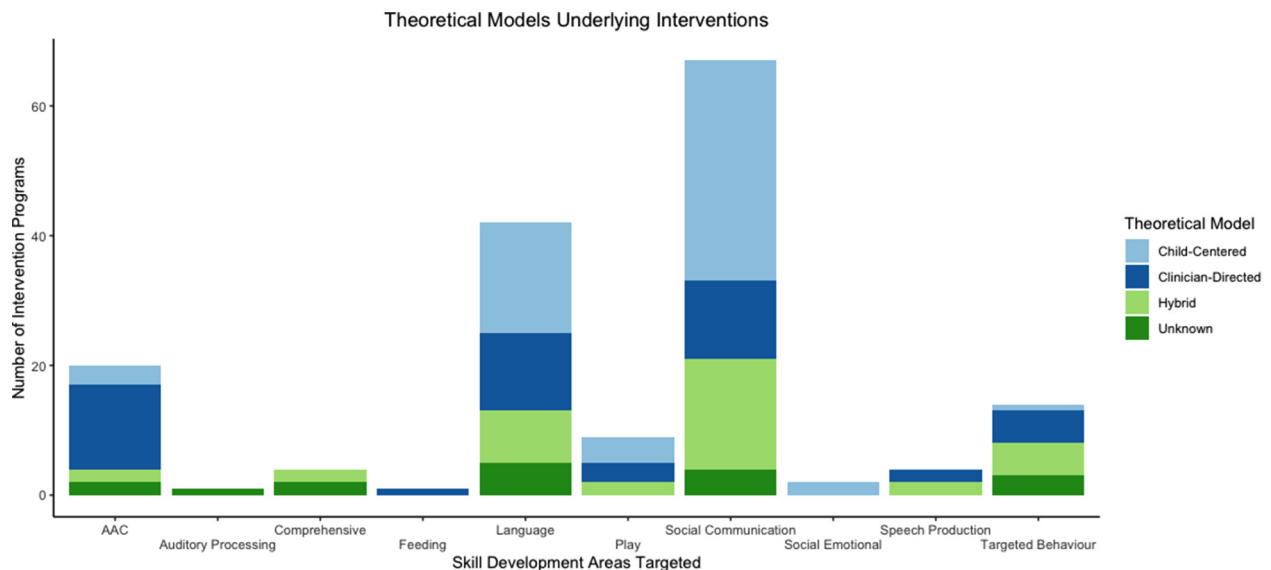
Figure 2. Theoretical models underpinning interventions targeting the nine skill development areas, and comprehensive interventions.

Skill Development Area by Service Delivery Model
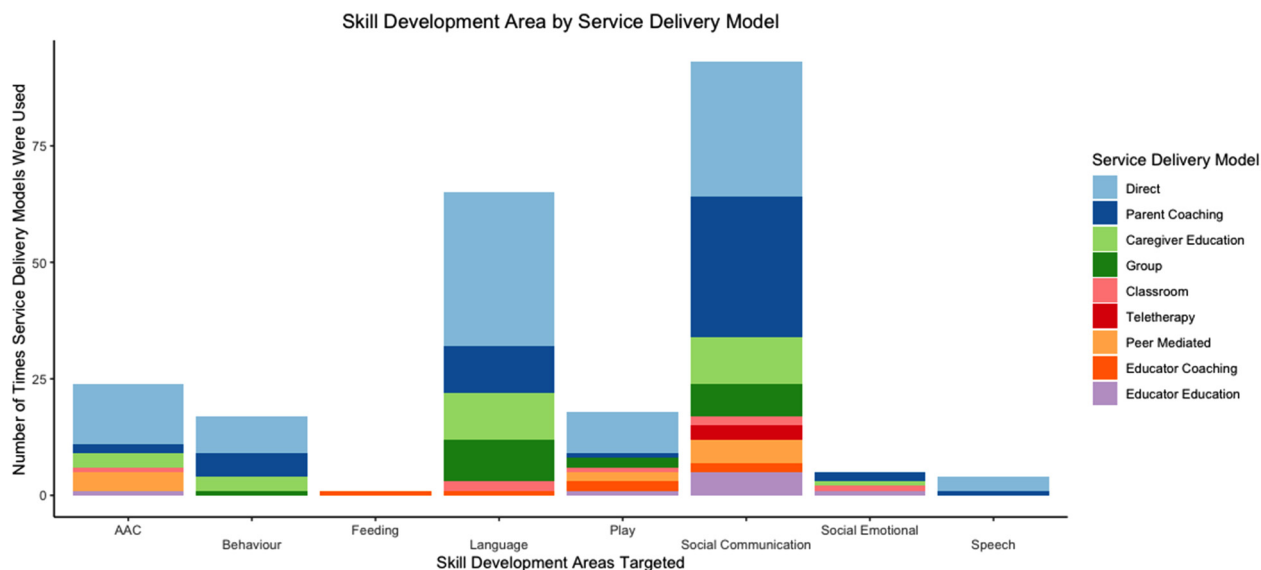
Figure 3. Number of times service delivery models were used across interventions targeting specific skill development areas. *Note.* No service delivery model was identified for the single intervention targeting auditory processing skills.

(e.g., direct therapy, group therapy). Social communication was the most common skill area targeted using parent coaching.

We differentiated treatment programs that used parent coaching from those that provided caregiver education (*n* = 22; i.e., workshops, webinars, clinician parent review meetings not in the presence of the child). Exclusive use of caregiver education was rare (*n* = 2). Most programs used caregiver education alongside other service delivery models (e.g., direct 1:1, parent coaching).

Other service delivery models identified included educator coaching (*n* = 6); educator training (*n* = 4); classroom delivered interventions (*n* = 4); small group therapy (*n* = 13); peer mediated interventions (*n* = 7); and remote (virtual) services (*n* = 3).

Dosage. Treatment dosage varied greatly across the included studies. Session length ranged from 10 min to 3 hr. Frequency of sessions ranged from 1 session monthly to 7 times/week and the duration of the intervention programs ranged from 3 weeks to 2 years. Generally, articles published since 2000 provided more information about treatment dosage than those published before 2000, with some even sharing the number of trials with which a child was presented during treatment (e.g., Al-dawaideh & Al-Amayreh, 2013; Reichle et al., 2018).

It is expected that the treatment dosage of interventions delivered by SLPs independently would differ from multi-professional delivery, and that different service delivery models would also differ in treatment dosage (e.g., caregiver education vs. direct 1:1 services). Furthermore, with many of the multiprofessional studies not specifying the breakdown of treatment dosage across service providers,

we decided to examine patterns in treatment dosage only for interventions delivered solely by SLPs. We were able to examine these patterns in the two most frequent service delivery models delivered by SLPs alone (direct 1:1 and parent coaching), but there were insufficient studies using any other service delivery models.

For direct 1:1 SLP interventions, session length (intensity) ranged from 15 to 60 min, with 30 to 45 min most frequently reported. Session frequency ranged from 1/week to 7/week, with 3/week being most common. Program duration ranged from 3 weeks to 10 months. For parent coaching delivered solely by SLPs, session intensity ranged from 30 to 120 min, session frequency from daily to monthly, and program duration from 10 weeks to 12 months.

Discussion

This scoping review provided important insights into the literature on interventions delivered to autistic children via SLPs. We identified a total of 114 studies examining interventions delivered, at least in part, by SLPs to autistic children under the age of 6 years. Single subject designs were most prevalent research design, followed by pre-post single group designs, RCTs, and quasi-experimental group designs. Most studies involved children who had already received a diagnosis of autism and were conducted within North America. Given that 78% of SLPs in the United States report servicing autistic children (Plumb & Plexico, 2013), the frequent use of SLP services by families of young children diagnosed with autism (e.g., Volden et al., 2015), and the range of skill development areas that fall within SLPs' scope of practice, the quantity of studies examining SLP-delivered preschool interventions is

relatively small. However, it is consistent with the general need for more intervention studies in the field of speech-language pathology (Justice et al., 2008).

There has been an upsurge in research in this area over the past 10 years. Over half of the studies and all of the RCTs included in this review were conducted between 2010 and 2019. This increase in publications and investment in larger scale RCT studies mirrors the continued increase in the number of children diagnosed with autism and progressively earlier age of diagnosis (Baio et al., 2018). Nonetheless, the extent of research examining interventions provided by SLPs to autistic preschool children continues to lag behind that conducted on other approaches for autism intervention (e.g., behavioral interventions; see Sandbank et al., 2020).

Notably, two-thirds of the studies conducted since 2010 were delivered by multiprofessionals (inclusive of at least one SLP) working either alongside or in collaboration with one another. Timing of the shift toward research into interventions delivered by a variety of professionals aligns with clinical practice recommendations for more holistic, comprehensive service provision within early interventions (ASHA, 2008; Wallace & Rogers, 2010). This shift also mirrors common real-world practices reported by SLPs (in the United States) and family reports of multidisciplinary care (Green et al., 2006; Plumb & Plexico, 2013).

Potential factors impacting the extent of research

The relatively small number of studies on SLP-delivered preschool autism interventions, and the smaller proportion examining interventions delivered solely by SLPs, could be due to a variety of factors. First, there may be less opportunity to conduct research within our field in general. Training in research foundations and participation in research during SLP clinical training occurs proportionally less often than in other fields (e.g., psychology, audiology, medicine; Roberts et al., 2020). This is an important consideration for future curriculum and course development in SLP academic programs. Additionally, a subset of the articles we examined did not mention the professional background of those delivering the interventions. For these articles, we only learned that SLPs had a role in delivering the intervention after a significant amount of investigating (e.g., via email, Google, university department websites). We were unable to determine the role of the therapists delivering the interventions for an additional 23 articles, thus prohibiting their inclusion in this review. This lack of clear reporting of the professional designation of the professionals delivering the interventions within the autism intervention literature may have contributed to the relatively small literature base we identified.

The absence of explicit information about the professional training of clinicians delivering the interventions is problematic for a number of reasons. First, this is

considered to be a key quality indicator when evaluating the methodological rigor of interventions studies (Reichow, 2011). Second, not mentioning speech-language pathology or speech-language therapy within the publication hinders the ability of researchers, policy makers, clinicians, and families to search for and meaningfully use the published information. Finally, studies that generically referred to the people delivering the interventions as clinicians or therapists fail to acknowledge that practitioners with different educational backgrounds likely approach service delivery differently. Therefore, the unique skillset SLPs bring to their clients' communication challenges are not recognized. Moving forward, researchers must make a concerted effort to clearly document the professional designation of clinicians delivering the interventions.

Study designs

Another important finding was the predominance of single-subject designs. These designs are widely used in speech-language pathology and communication sciences and disorders. Historically, single-subject designs have not been considered methodologically rigorous or generalizable to the larger population due to the small sample size. They are often excluded from reviews evaluating treatment effectiveness and study quality and are frequently overlooked in health systems when considering evidence-based practice (Byiers et al., 2012). However, well-designed, single-subject study designs can produce valuable information for clinicians, families, and policy makers. They allow for systematic evaluation of the effects of a treatment at an individual level rather than examining the average impact of an intervention across patients, which is important when considering the heterogeneity of autism. Single-subject designs also allow researchers and clinicians to ask complex questions that may not be feasible to answer using traditional group or RCT designs (Byiers et al., 2012), and are usually more accessible because they are not as expensive to conduct. Within the field of autism intervention, there is precedent for using outcomes from single case experiments to inform policy development. For example, the widespread global adoption of ABA intervention programs and public policy changes including state level mandated insurance coverage for ABA treatment (e.g., Steven's Law, Arizona House Bill 2487), were predominantly supported by several hundred single case experiments (Matson et al., 1996).

Although single-subject designs were most common, the designs used to examine preschool autism interventions have diversified over the past 10 years. Nonetheless, there remains a need for additional research using both differentiated designs and methodologically strong single-subject designs. Of particular interest would be exploratory and pragmatic RCT studies. RCTs are considered gold standard for treatment effectiveness research. They allow

examination of active therapeutic ingredients and subgroup variation in treatment response (e.g., comparative efficacy trials, adaptive treatment designs, mediation and moderation analysis), and would generate evidence that could be used to guide selection of intervention(s) or combining of supports to tailor SLP services to children and families' needs. Pragmatic RCT designs are especially desirable as the interventions are administered by qualified SLPs in a way that captures real-world service delivery. Thus, there is a strong focus on external validity (i.e. generalizability of the results to real-world clinical practice).

SLP roles in delivering intervention

Interventions delivered solely by SLPs versus in part by SLPs (working either alongside or in collaboration with other professionals) were relatively equally represented in this review. The heterogeneity and complexity inherit in autism make multiprofessional delivered collaborative services a logical choice, but also pose problems for research.

When intervention programs are delivered by multiprofessionals, each therapist comes to the team with their own educational background and professional views, potentially adding to the complexity of the intervention. As interventions become increasingly complex, the risk for variation in intervention delivery increases (Santacroce et al., 2004) and the need for examination of the potential impact of intervention components is underscored. Within the multiprofessional interventions reviewed here, we found variability in the professional background of team members, access to services from members of the team (i.e., each participant did not always receive treatment from each professional on the team), the service delivery models used, and treatment dosage. Even the SLPs' roles within teams differed across studies (i.e., supervision of non-SLPs vs. direct 1:1 service provided by SLPs).

With autism intervention research shifting toward use of multiprofessional interventions that are susceptible to variability, there is the opportunity to use these studies to inform development of evidence-informed care pathways for preschool children with autism. To do so, future research focused on improving our understanding of processes, structures, and components used in multiprofessional interventions is essential (e.g., embedding process evaluations within RCTs), as are more studies using adaptive treatment designs and examining mediators and moderators of effective multiprofessional interventions (e.g., dosage, service delivery models, child's language level, caregiver stress). This work would also provide guidance for SLPs aspiring to provide flexible individualized intervention programs.

Range of skill development areas targeted

This scoping review revealed that the range of skill development areas targeted in the extant research reflects the breadth of SLPs' scope of practice. However, this research was not evenly distributed. Although nine different skill development areas were targeted, interventions supporting three skill development areas made up the vast majority of studies.

Most widely studied were interventions that supported autistic children's social communication, language, or use of AAC. This is not surprising given that autism affects how a person communicates with and socially relates to other people, and SLPs report frequently targeting these skill development areas with young autistic children (Gillion et al., 2017). Further research efforts are needed to examine the impact of SLP interventions covering a wider range of skill development areas (i.e., play, motor-speech production, feeding, social emotional).

Studies on interventions targeting play were few, despite play being a common skill development area targeted by SLPs working with autistic preschool children (Gillion et al., 2017). Thus, research exploring best practices for supporting autistic children's play is needed. Another focus to future research could be interventions targeting skill development areas that SLPs are uniquely trained to support (e.g., motor-speech production), since it is less likely that research from other disciplines are contributing to the advancement of these types of interventions. Further, conducting practice-based research that examines interventions used in the delivery of real-world SLP services, with qualified SLPs would provide opportunity to capture information about, and generate more research aligned with, the range of skill development areas targeted by SLPs.

Nature of SLP-delivered interventions

Theoretical models underpinning interventions. Interventions underpinned by child-centered, clinician-directed, and hybrid models were relatively evenly represented. Child-centered models were most prevalent and were predominantly used to target social communication and language skills. Child-centered models align with recommended early intervention practice (American Speech-Language-Hearing Association, 2008; Division for Early Childhood, 2014) and there is accumulating evidence supporting the use of these (and hybrid) models for targeting social communication outcomes (Binns & Oram Cardy, 2019; Sandbank et al., 2020). Interventions targeting AAC were likely to use clinician-directed models. Because many of the AAC interventions used the picture exchange communication system (PECS; e.g., Lerna et al., 2012; Reichle et al., 2018) and PECS is a program rooted in applied behavior analysis, it is logical that most AAC interventions were classified as being clinician-directed. Only a few studies delivered AAC interventions guided by child-centered or hybrid models of intervention (i.e., Barton-Hulsey et al., 2017; Min & Wah, 2011; Tan et al., 2014). More research examining

SLP-delivered AAC interventions using child-led and hybrid models to guide treatment is needed.

Despite theoretical differences between child-centered, hybrid, and clinician-directed intervention programs, there are likely common elements shared across these programs. Therefore, working toward a clearer understanding of the unique and shared elements of interventions guided by child-centered, hybrid, and clinician-directed theoretical models is an important direction for future research. This work could improve the consistency of assigning theoretical categories to interventions, identify which ingredients from child-centered and clinician-directed models are being combined in hybrid interventions, and guide analysis of how different intervention features mediate children's response to treatment. This information would support clinical decision making and development of evidence-informed policies.

Service delivery models and treatment dosage

Variability across treatment dosage and the service delivery models used was pervasive. Given the range of skill development areas targeted by SLPs, the varying roles of SLPs in intervention delivery, and SLPs' focus on individualizing intervention programs to fit each child's unique needs, a certain degree of variability was to be expected. Variability is not inherently bad. Variability means that we have access to information about a variety of interventions, targeting different skill development areas, in different ways. This is meaningful given the heterogeneity of autism and the intent of SLPs to provide flexible, individualized supports. Nonetheless, we need research examining the impact of different service delivery models or treatment dosages on child outcomes, parent acceptability and stress levels, and the accessibility and feasibility of implementation in community programs.

Related to accessibility and feasibility, the predominant service delivery model used across the research was a direct 1:1 therapy model, and almost half of these programs used direct 1:1 therapy in combination with other models. Few studies used group-based service delivery, which has been reported to be a cost-effective model within other speech-language services (e.g., Gibbard et al., 2004). Even fewer examined the use of remote (virtual) services. Given the high prevalence of autism globally, and the limited resources of many countries and health systems, a focus on research on more accessible and scalable service delivery models (e.g., peer, group, classroom, remote) in a range of real-world, community contexts, is also warranted.

Future directions

As previously discussed, several gaps and needs for future research were identified while conducting this scoping review. Beyond these, quality appraisal, examination of intervention effectiveness, and attention to broad methodological improvements are also warranted.

Quality appraisal of research and examination of treatment effectiveness falls outside the purview of scoping reviews (Arksey & O'Malley, 2005), but such examination is needed of studies of interventions delivered to preschool autistic children by SLPs (e.g., AAC interventions, play interventions, parent-coaching studies). Given the high proportion of single-subject studies in this area and the impact that well-designed single-subject designs can have on clinical decision making and policy development, inclusion of the appraisal of single-subject studies when examining treatment effectiveness is especially warranted. The Oxford Centre for evidence-based medicine ranks single-subject designs as Level 1 evidence, meaning that such studies can be used to inform decisions about treatment for individual clients when used alongside systematic reviews of RCTs (http://www.cebm.net/).

Many studies included in this review failed to provide comprehensive and systematic information about the professional background of clinicians, service delivery, treatment dosage, or implementation of interventions. The scarcity of such information does not allow for study replication. It also makes it difficult to gain a clear understanding of the unique and shared theoretical underpinnings across interventions (e.g., child-led vs. directive models) and does not cultivate examination of treatment mechanisms underlying change in children's outcomes. Furthermore, without this information, clinicians are unable to use the information to guide implementation of the interventions in real-world practice. As such, improving the reporting of intervention characteristics through systematic presentation of the processes, structures, and components used within interventions is necessary within future research studies.

One tool that could be useful for improving reporting quality is the Template for Intervention Description and Replication (Hoffmann et al., 2014), a 12-item checklist developed to address widespread poor reporting of clinical interventions in research articles (Hoffmann et al., 2014) that has been recommended for use within the field of speech-language pathology (Ludemann et al., 2017). The first two items provide background information about the intervention (Brief name & Why—Rationale/Theory). Procedural elements of the intervention are also accounted for within items 3–9 (What—materials; What—procedures; Who provided—drawing on what knowledge/training, how, where, when, and how much; and Tailoring—what, when, why how). The final three items examine issues relevant to treatment fidelity (Modifications—what, when, why, how; How well—planned; and How well—actual). The checklist and further details can be found at https://doi.org/10.1136/bmj.g1687.

Strengths and limitations

This review offers a comprehensive picture of the state of research on interventions delivered by SLPs to autistic preschoolers and clearly demonstrates existing gaps. Findings can guide future research and support advocacy for the versatile role of the SLP in preschool autism services and for the need for more research. Although an important first step, this review has certain limitations. First, some relevant studies may not have been identified. Despite our best efforts to contact authors when clinical training of the interventionists was not reported, we were unable to identify the interventionist role for some studies and thus could not include them in the review. Another limitation is that only citations that provided full texts in English were included (because of limited financial resources to translate). Additionally, only peer-reviewed articles were included, leaving the possibility that publication bias might have impacted our dataset. We decided to only include peer-reviewed articles because we wanted to capture the literature base that was most likely to be accessible to clinicians and policy makers when developing plans. Finally, we did not preregister the protocol for the scoping review, which would have added transparency and more rigor to the review process (Munn et al., 2018).

Conclusion

The current study sheds light on the status of research within the field of speech-language pathology and preschool autism interventions. Our findings captured the versatility of the SLP's role within preschool intervention and revealed that research in the area of autism interventions delivered, at least in part, by SLPs has markedly increased over the past 10 years. Future efforts focused on capturing the complex and individualized nature of interventions through improving reporting, increasing the sophistication of intervention study methodology, and aligning research and real-world SLP services through community-practice research would further the development of effective, evidence-informed policy and practice in speech-language pathology.

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ORCID iDs

Amanda V Binns   https://orcid.org/0000-0003-1510-020X
Rachael Smyth   https://orcid.org/0000-0001-6673-1824
Janis Oram Cardy   https://orcid.org/0000-0002-7170-6145

Supplemental material

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