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Sibling Involvement in Interventions for Individuals with Autism Spectrum Disorders: A Systematic Review

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Abstract Many researchers have studied various interventions for individuals with autism spectrum disorder (ASD). Occasionally, siblings will be included in intervention studies, participating in programs designed to address a number of challenges faced by individuals with ASD. Although sibling involvement in such interventions is not a new phenomenon, there is no consistent method for including siblings in treatment for individuals with ASD. The purpose of this article is to review the existing literature describing sibling involvement in interventions among families of children with ASD, describing patterns of research and targeted outcomes. The authors also identify gaps and areas for future consideration from researchers, clinicians, and families.

Keywords Siblings · Autism spectrum disorder · Intervention · Review

Introduction

Autism spectrum disorder (ASD) is one of the fastest growing medical concerns in the United States and is currently estimated to affect 1 in 68 school-aged children (Baio 2014). Based on the most recent update to the Diagnostic and Statistical Manual (DSM-5; American Psychological Association 2013), ASD is defined by persistent deficits in social communication (e.g., reciprocity, nonverbal communicative behavior, developing relationships) and restricted or repetitive patterns of behavior, interests, or activities (e.g., insistence on sameness, stereotyped motor movements). To help address these deficits among a growing number of families, researchers have identified numerous interventions for individuals with ASD.

Most of the interventions for individuals with ASD target the core characteristics of the disorder by attempting to teach social communication skills or reduce repetitive behavior (Hall 2009). Interventions derived from the principles of applied behavior analysis have the most empirical support for treating individuals with ASD (Wong et al. 2013) and generally involve a method for modeling or otherwise describing very specific target behaviors, prompting those behaviors at the appropriate time, and delivering reinforcement following the occurrence of the behavior (Odom et al. 2010). For example, many interventions involve a form of in vivo or video modeling wherein another person performs the targeted skill and the individual with ASD is instructed to watch the model. The individual with ASD is then given an opportunity to perform the same skill under similar conditions to those in the model. If the individual with ASD performs the skill the teacher delivers a preferred consequence (i.e., reinforcer). If the individual with ASD does not perform the skill, the teacher provides a prompt such as gentle physical guidance or a vocal reminder to ensure the behavior occurs, and then delivers reinforcement.

Although adults represent the intervention agent in the large majority of the extant literature, there is clear empirical support for peer mediated interventions wherein similarly aged typical peers are taught to actively perform one or more of the components described above (Sperry et al. 2010). Peer mediated interventions can include teacher-initiated activities as well as those initiated by the learner with ASD or the peer (Fettig 2013). Benefits of peer

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mediated interventions for individuals with ASD include increased opportunities to interact with social partners, improved social competence, and independence (Sperry et al. 2010). In addition, typical peers have been found to demonstrate academic gains, increased sensitivity to others, higher self-confidence, and expanded peer networks after participating as peer mediators for individuals with ASD (Carter et al. 2008).

Sibling Involvement in Interventions for Individuals with ASD

Typically-developing siblings of individuals with ASD make logical extensions as interventionists from the peer mediated intervention literature because the sibling essentially provides a readily available source of potential social interaction (Tsao and Odom 2006). Sibling relationships are often the longest lasting that people will have (Cicirelli 1994), making siblings a familiar partner for practicing social skills. Interactions with the sibling in the family home can also provide a frequent practice schedule for the individual with ASD, allowing them to develop skills that can potentially be generalized to peers at school and in the community (Ferraioli et al. 2012).

In addition to supporting the individual with ASD, researchers have hypothesized that participation in interventions can benefit siblings by strengthening the sibling relationship and providing the siblings with a sense of self-efficacy and involvement (Ferraioli et al. 2012). There is anecdotal support for this hypothesis, with siblings indicating they enjoy participating in interventions for a brother or sister with ASD and are more likely to play with their sibling after being involved in a sibling mediated intervention (Baker 2000; Rayner 2011b). In addition, parents report siblings spending more time with their brother or sister with ASD following involvement in a sibling mediated intervention (Baker 2000). These findings tentatively suggest potential gains for the sibling, similar to evidence from the peer-mediated intervention literature suggesting that peers experience gains in social and academic development when participating in interventions for individuals with ASD (Chan et al. 2009). However, such a conclusion specific to siblings requires additional empirical support.

Research in sibling-mediated interventions often examines the same interventions tested during peer-mediated intervention studies (Ferraioli et al. 2012). However, given important differences in the relationship and time spent together between siblings of and peers of individuals with ASD, sibling needs and safety (emotional and physical) should also be carefully considered. For example, siblings

of individuals with intellectual and developmental disabilities, including ASD, are often expected to help out more at home (e.g. Hannah and Midlarsky 2005), which could lead to distress on the part of the sibling (Barak-Levy et al. 2010), making the siblings less likely to willingly participate in future interventions. Sibling-mediated interventions must therefore balance the needs of the individual with ASD and the sibling in ways that may not be as important when a peer is involved as intervention agent.

There are many potential benefits of teaching siblings to mediate effective intervention for individuals with ASD (Ferraioli et al. 2012). The long-term nature of the sibling relationship maximizes potential benefits through repeated interactions over a lifetime. As a result, teaching siblings to mediate interventions could have exponentially greater outcomes than peer mediated interventions that capitalize on the comparatively brief relationship between peers and individuals with ASD. Unfortunately, minimal literature exists to provide guidance about the long-term potential of sibling-mediated interventions. Questions exist pertaining to effective methods for the individual with ASD that are not overly burdensome for the sibling, durability of the intervention over time, outcomes for the sibling, and impact on the relationship. Generally speaking, researchers, families, and clinicians need to develop a comprehensive understanding of which methods are the most effective for the individual with ASD and the most beneficial for the sibling to conduct.

The Current Review

Many researchers have independently studied various types of sibling involvement in interventions, yet there have been no systematic reviews consolidating this body of research. As autism spectrum disorders affect a growing number of individuals, it becomes increasingly important to understand interventions that benefit not only the child with ASD, but the siblings and family, as well. The purpose of this systematic review is to summarize the existing research on sibling involvement in interventions for families of children with ASD and to identify future directions for research and practice.

The specific research questions this review seeks to answer are:

1. What is the nature of sibling involvement in interventions for individuals with ASD? What role do siblings play in the intervention and what methods are siblings taught to use?
2. What skills do individuals with ASD acquire as a result of sibling-mediated interventions?
3. What data are reported for siblings?

Methods

Eligibility Criteria

To be included in the review, articles were required to meet the following criteria: (a) describe quantitative results from empirical studies of interventions for individuals with ASD or their siblings (b) be published in peer-reviewed journals (c) be published in English (d) study population must include individuals with a confirmed diagnosis of ASD (autism, Aspergers, or PDD-NOS, per DSM criteria) OR siblings of such individuals (e) if the study includes individuals with disabilities other than ASD (or their siblings), separate analyses for individuals/siblings of individuals with ASD must be presented (f) if the intervention targets individuals with ASD, siblings must be active participants in the intervention itself (i.e., not simply confederates during testing or generalization). Studies were excluded if (a) the child with autism did not participate in the intervention (e.g. the intervention was meant to support siblings only), (b) if no quantitative results were reported, or if (c) the nature of sibling involvement was not specified.

Literature Search

An extensive literature search was conducted to identify published studies describing sibling involvement in interventions for families of individuals with ASD. The primary search utilized the online databases ProQuest, PubMed, and Web of Science and combined three sets of search terms: (1) sibling*, brother, or sister; (2) autis*, Asperger*, or PDD-NOS; and (3) interven*, "sibling involvement," treatment, protocol, procedure, "sibling support," practice, or therap*. While there were no restrictions placed on the date of publication, only works published in peer-reviewed, scholarly journals were considered. The initial online search yielded 547 peer-reviewed results. A secondary search was conducted using the online pre-publication sections of the following journals: *The Journal of Autism and Developmental Disorders, Autism, Research on Autism Spectrum Disorders,* and *Research in Developmental Disabilities.* Finally, the reference sections of identified studies were examined to ascertain any further relevant articles, but no additional eligible articles were found. Due to the small number of intervention studies involving siblings, the present review includes a wide range of methodologies, including single-subject designs, group comparisons, and uncontrolled outcome studies.

Article Coding Procedures

Following the initial search, abstracts were reviewed to confirm the study involved an intervention and that siblings were included as either participants or intervention agents. If this information could not be confirmed through review of the abstract, the participants and procedures sections were reviewed to confirm the inclusion of a study.

Studies that met the initial inclusion criteria underwent further systematic review to extract data pertaining to the research aims of this paper. To that end, studies were coded for participant demographics, sibling type of participation (e.g. intervention co-recipient or agent of intervention), sibling role in intervention (e.g. model or instructor), skills that siblings were meant to teach their brother or sister, and outcomes for both the sibling and the child with ASD, where reported. For quantitative codes (e.g. "How many siblings participated?" or "How many sessions were taught?"), agreement was calculated as number of matches between coders (e.g. both coders noted that 3 siblings participated in a given study) divided by total number of quantitative codes. There was 97 % agreement between coders, who discussed any disagreements until consensus was reached. For summary codes (e.g. "description of intervention"), coders independently reported descriptions, then met to discuss the content of the articles until it was agreed that all relevant information was included.

Results

Analysis of study components involved hierarchical categorization of the included studies. Studies were first split based on whether the sibling was (a) an active agent of the intervention of (b) a co-recipient of the intervention. Group (a) was further split into siblings as instructors and siblings as models. Studies were categorized as siblings-as-instructors if the siblings learned behavior-modification techniques or specific ways in which to interact with their brothers or sisters to improve the target skill sets. Studies were categorized as siblings-as-models if siblings learned the target behavior for the child with ASD to serve as an example of the correct actions. Finally, studies were categorized based on the nature of the targeted outcomes. A visual of the categorization hierarchy can be found in Fig. 1.

Seventeen studies describing sibling involvement in interventions for families of children with ASD were included in this systematic review. Of the initial 547 results, 26.1 % (n = 143) were duplicate listings, 63.8 % (n = 349) did not describe intervention studies, and 6.0 % (n = 33) did not include sibling involvement. Of the remaining 22 studies, three were excluded because they did not include quantitative results, and 2 were excluded because they described interventions that did not include the child with ASD (i.e. sibling support groups). Included articles were then hierarchically categorized by the primary
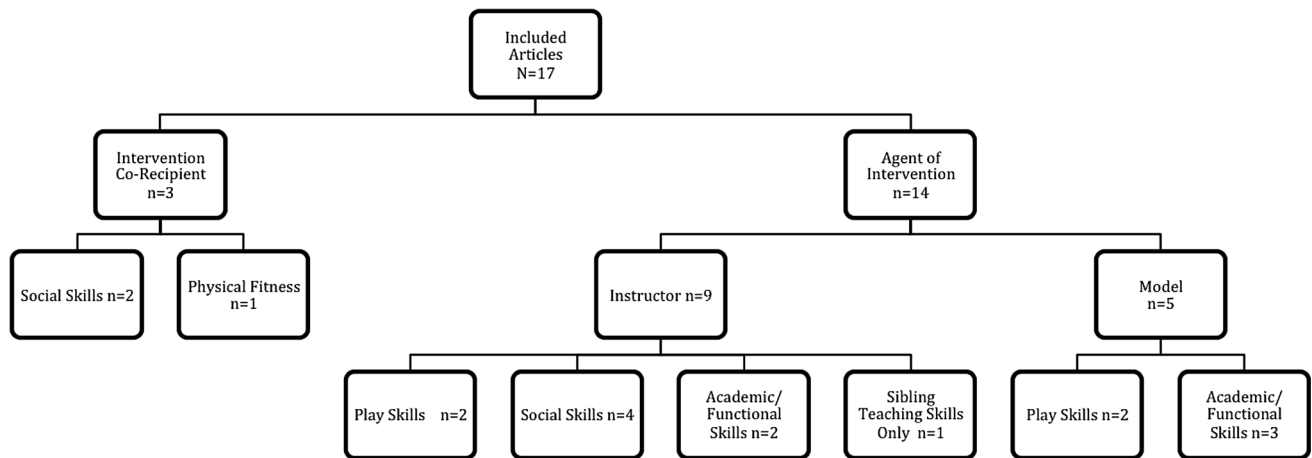
Fig. 1 Categorization hierarchy for reviewed articles

Table 1 Demographic characteristics of study participants

	Individuals with ASD				Siblings		
	N	Age range	Diagnosis	Gender (% Male)	N	Age range	Gender (% Male)
Baker (2000)	3	5.42–6.84	ASD = 3	67	3	7.58–8.67	0
Castorina and Negri (2011)	7	8.42–11.92	Asperger's = 7	100	7	NR (M = 12.71)	42.9
Celiberti and Harris (1993)	3	4.25–4.92	ASD = 3	67	3	7.75–10.25	0
Clark et al. (1989)	3	4.84–12.08	ASD = 3	33	3	8.25–9.84	0
Coe et al. (1991)	2	7	Autism = 2	100	2	9–11	100
Colletti and Harris (1977)	1	9	ASD = 1	0	1	10	0
Ferraioli and Harris (2011)	4	3.58–5.33	ASD = 4	75	4	6.00–8.33	100
Jones and Schwartz (2004)	3	3.75–5.17	ASD = 3	33	3	3.5–5.0	0
Oppenheim-Leaf et al. (2012)	3	4–7	Autism = 3	100	3	4–5	67
Pan (2011)	15	7–12	ASD = 15	100	15	7–12	33
Rayner (2011a)	1	15	Autism = 1	100	1	12	100
Rayner (2011b)	1	10	ASD = 1	100	1	10	100
Reagon et al. (2006)	13	4	ASD = 1	100	1	7	100
Schreibman et al. (1983)	3	5–8	ASD = 3	67	3	8–13	33
Taylor et al. (1999)	2	6–9	Autism = 2	100	2	6–8	50
Tsao and Odom (2006)	4	3.81–7.5	ASD = 1, Asperger's = 1, Autism = 1	100	4	4–11	50
Walton and Ingersoll (2012)	4	3.75–4.75	ASD = 4	100	6	8–13	33

sibling role (agent of intervention or co-recipient), sibling role, and targeted skills, respectively. Participant characteristics for each of the 17 studies can be found in Table 1.

Siblings as Agents of Intervention

Summary of study design, intervention, and outcomes for all included articles can be found in Table 2. The majority of included studies (n = 14) described interventions in which the sibling was used as a model or instructor for the

child with ASD. In these studies, the siblings were either taught various intervention strategies, which they were then instructed to use with their brother or sister, or siblings were video-taped carrying out the actions, which the individual with autism was then meant to imitate.

Siblings as Instructors

Most studies (n = 9) in which siblings were agents of intervention involved teaching siblings direct, face-to-face

Table 2 Description of methodology, intervention, and findings from included studies

	Methodology	Intervention description	Measurement	Individuals with ASD		Siblings	
				Target outcomes	Findings	Target outcomes	Findings
Sibling as instructor							
Celiberti and Harris (1993)	Multiple-baseline design across individuals	One-on-one play skills instruction	Coded observations	Play skills	Increased number of desired play responses, interest in play, and cooperation	Intervention implementation, sibling relationship	Increased use of teaching skills, confidence, interest in brother/sister, pleasure in interaction, decreased frustration
Clark et al. (1989)	Multiple-baseline design across individuals	One-on-one play skills instruction	Coded observations	Not quantitatively measure	–	Intervention implementation	Moderate increase in use of attending and sign language, decreases in controlling behavior
Coe et al. (1991)	Multiple-baseline design across individuals	One-on-one play skills instruction	Coded observations	Play skills	Increased verbal play behavior	Intervention implementation	Increased use of verbal prompts & reinforcements, decreased use of physical prompts
Colletti and Harris (1977)	ABAB design	One-on-one fine motor skill instruction	Number of beads strung/coded observations	Fine motor skills (bead stringing)	Increased number of beads strung	Intervention implementation	Increased reinforcement given
Ferraioli and Harris (2011)	Multiple-baseline design across individuals	One-on-one social skills instruction	Coded observations	Social skills	Increased social responses, sporadic improvement joint attention and behavior requests	–	–
Oppenheim-Leaf et al. (2012)	Multiple-baseline design across individuals	One-on-one social skills instruction	Coded observations	Social skills	Increases in social behaviors, though not at independent levels	Intervention implementation	Increased use of invitations to play, asking to share, and instructions
Schreibman et al. (1983)	Multiple-baseline design across individuals	One-on-one academic skills instruction	Sum of correct responses	Academic skills	Increases in correct responses	–	–
Tsao and Odom (2006)	Multiple-baseline design across individuals	One-on-one social skills instruction	Coded observations	Social skills, sibling relationship	Increases in social behavior, joint attention, fun, and quality of sibling interaction for 3 out of 4 participants	Intervention implementation	3 out of 4 siblings showed increased social behavior toward brother/sister

Table 2 continued

	Methodology	Intervention description	Measurement	Individuals with ASD		Siblings	
				Target outcomes	Findings	Target outcomes	Findings
Walton and Ingersoll (2012)	Multiple-baseline design across individuals	One-on-one social skills instruction	Coded observations	Social skills	Improvements in joint engagement and imitation for some participants with ASD	Intervention implementation	Improvements in modeling, prompting, linguistic mapping, imitation, and praise for some siblings
Sibling as model							
Jones and Schwartz (2004)	Parallel treatment	One-on-one live modeling	Sum of correct verbal responses	Academic skills	Increases in correct response, regardless of model	–	–
Rayner (2011a)	Multiple-baseline design across skills	One-on-one video modeling	Number of correct steps completed	Functional skills	No improvement in skill imitation; sib model = adult model	–	–
Rayner (2011b)	Multiple-baseline design across individuals	One-on-one video modeling	Number of correct steps completed	Functional skills (shoe tying)	Slight increase in number of shoe-tying steps completed; sib model < peer models	–	–
Reagon et al. (2006)	Multiple-baseline design across skills	One-on-one video modeling and live play	Coded observations	Play skills	Increase in scripted statements and actions, no increase in spontaneous speech	–	–
Taylor et al. (1999)	Multiple-baseline design across individuals	One-on-one video modeling and live play	Coded observations	Play skills	Increases in play-related statements	–	–
Sibling as co-recipient							
Baker (2000)	Multiple-baseline design across individuals	Incorporation of ritualistic behavior into games	Coded observations	Social skills, problem behavior, sibling relationship	Increased time spent in social play, joint attention, decreased ritualistic behavior, increased positive affect with sibling	Sibling relationship	Increased positive affect with brother/sister with ASD
Castorina and Negri (2011)	Controlled pre-post design	Scripted social-skills instruction groups	Rating scales, video assessments	Social skills	Improved ability to identify social cues; treatment > control	–	–
Pan (2011)	Pre-post design	Group and pair instruction	Physical tests	Functional skills (swimming)	Increases in strength, flexibility, balance, and aquatic readiness	Aquatic skills	Increases in strength, flexibility, endurance, and aquatic readiness

instruction methods. In these studies, siblings used various interventions to teach their brother or sister academic or functional skills, play skills, and social skills. One such study (Clark et al. 1989) focused only on sibling teaching ability, without any focus on skill development for the child with ASD.

Academic/Functional Skills Involving siblings as interventionists is not a new concept, and the earliest sibling-led interventions focused mainly on simple functional and/or academic skills. Colletti and Harris (1977) were the first to document a case of a child with autism being taught by her sister. In this study, researchers taught a young girl with ASD to string beads by instructing her sibling to offer verbal praise and tangible reinforcement (i.e. food) after each successfully strung bead. During the bead-stringing exercise, only the sibling interacted with the child with autism. Schreibman et al. (1983) employed a more rigorous training method, using video and direct instruction to teach three siblings methods for instructing their brother/sister with ASD, including reinforcement, shaping, chaining, and discrete trial training. Siblings then chose a given skill to teach the child with autism, using the newly-learned instruction techniques; the chosen skills were different for each dyad.

These early sibling-led training findings were generally positive. Colletti and Harris (1977) found that both bead-stringing and sibling reinforcement behaviors increased during training, with increases in bead-stringing maintained at a 5-week follow-up measurement. Sibling reinforcement was not measured at follow-up. Schreibman et al. (1983) found that all three siblings showed increases in all teaching skills—instructions, prompts, consequences, and discrete trials—and the children with ASD each showed improvements in the chosen lesson (grammar, money counting, and spelling).

Play Skills Two studies used siblings as instructors for play skills. Coe et al. (1991) used role-play to instruct two siblings on the use of verbal and non-verbal prompts and reinforcements. The siblings then implemented these skills to increase the use of appropriate play behaviors in their respective brothers. Celiberti and Harris (1993) demonstrated ways to evoke play and play-related responses to three siblings, including praise, prompting, and enthusiasm. The siblings would then practice using each of these intervention techniques to evoke play responses and cooperation from their respective brother or sister (n = 3).

Coe et al. (1991) reported that both children with ASD exhibited increases in verbal behavior that were maintained at a 1-month follow-up visit. Both siblings demonstrated increased levels of verbal prompts and reinforcement, which gradually replaced the use of physical prompts.

Sibling behavioral changes were also maintained at follow-up (Coe et al. 1991). In the Celiberti and Harris study (1993), all three siblings displayed increases in evocative responses, praise, and prompts, and all three children with autism showed increases in appropriate play responses. Behavioral gains by both siblings and children with ASD declined slightly at 6-week and 16-week follow-up measures, but remained higher than baseline levels (Celiberti and Harris 1993). Siblings also exhibited high levels of skill generalization when presented with a novel toy to use with the child with ASD. Importantly, researchers reported improvements in all measures of social validity; interest in play, cooperation, and overall play skills, and sibling enthusiasm, effectiveness of implementation, confidence, interest in their brother or sister, and pleasure in the interaction increased for all three dyads. Sibling frustration decreased for two out of the three siblings, as well. Social validity was not measured at follow-up (Celiberti and Harris 1993).

Social Skills Other studies (n = 4) taught more broad social skills. Tsao and Odom (2006) engaged siblings in 10-min social skills lessons, teaching them behavioral strategies meant to encourage the use of joint attention and social behaviors in their brothers. Ferraioli and Harris (2011) used direct instruction, modeling, and role play to teach siblings pivotal response training and discrete trial training strategies. Siblings would then use these strategies to instruct the child with autism on responding to and initiating joint attention. Walton and Ingersoll (2012) taught six siblings of four individuals with ASD various strategies including imitation, simplified language, praise, and physical guidance. Siblings would implement these strategies during playtime with the child with autism to increase joint engagement and imitation behaviors. Finally, Oppenheim-Leaf et al. (2012) taught siblings to use invitations to play and requests to share to increase social behavior for their brother or sister. Siblings were instructed with a combination of didactic teaching, modeling, and role-plays.

Outcomes in social skills interventions were somewhat mixed. Tsao and Odom (2006) found that 75 % of siblings and children with ASD displayed increases in social behaviors, and the same proportion of siblings also showed increases in experimenter-rated fun, involvement, and quality of sibling interaction. Ferraioli and Harris (2011) found more mixed results, with all children with ASD exhibiting increases in social responses to tapping and pointing, but only one showing moderate improvement in initiating joint attention, and one showing a small increase in initiating behavior requests. In the Oppenheim-Leaf et al. study (2012), all siblings displayed increases in the use of teaching skills. The children with autism generally

exhibited more social behaviors, but did not necessarily achieve independence in the use of these behaviors. Walton and Ingersoll (2012) found that only half of the sibling interventionists achieved "effective" or "delayed effective" ratings for all intervention skills. Two siblings were rated as "ineffective" for modeling, two were ineffective for prompting, and one was ineffective for linguistic mapping and praise. Outcomes were similarly mixed for the children with ASD: two exhibited effective use of joint engagement during the intervention, one exhibited effective joint engagement with one sibling teacher, but delayed use of joint engagement with the other, and the final child showed a decrease in joint engagement followed by an increase with one sibling, but did not exhibit effective use of joint engagement with the other sibling trainer.

Two of the articles reported information on maintenance and generalization of social skills, with behaviors varying across participants and studies. Three of the four children in the Ferraioli and Harris (2011) study demonstrating an increase in social responding at a 3-month follow-up, while social responding decreased for the fourth child. Additionally, siblings reported moderate satisfaction with the intervention (3.4 on a 5-point Likert scale). Walton and Ingersoll (2012) included measurements from a 1-month follow-up session and assessed skill generalization by observing sibling pairs in a different setting and with different toys, with results differing by skill. Four of the six siblings achieved generalization of contingent imitation, three showed generalization of linguistic mapping, three generalized modeling skills, four generalized their use of praise, and three showed generalization of prompting. For sibling follow-up measurements, three siblings maintained increases in contingent imitation, two maintained increases in linguistic mapping, two maintained gains in prompting, and four continued increased use of praise. No siblings continued to use modeling at follow-up. Among the children with ASD, all three participants who increased their use of imitation maintained those gains at follow-up measurement, though only one participant maintained increases in joint engagement. Finally, siblings and parents were given brief rating scales on treatment acceptability, which indicated high levels of enjoyment of the intervention, as well as increased quality of play between the siblings and their brother or sister with ASD.

Sibling Intervention Implementation Of the studies that included siblings as instructors, one (Clark et al. 1989) focused entirely on how well siblings could be taught to teach; that is, can siblings attain procedural fidelity as interventionists for the child with ASD? The study only included qualitative report of behavior among the children with ASD as "a probe of the extent to which sibling treatment influenced social responsiveness." (Clark et al.

1989). Through discussion and role-play, three siblings were taught to increase their use of attending behavior and sign language, and decrease their use of controlling behavior with their brother or sister. The authors report that siblings showed moderate increases in the use of attending behavior and sign language, and moderate decreases in the use of controlling behavior, though only the latter change was observed at 3- and 6-month follow-up observations. Aggregate parent reports indicated an increase in sibling positive interaction and sibling teaching behaviors and a decrease in sibling conflict.

Siblings as Models

The remaining studies that examined siblings as agents of interventions examined siblings as models of desired behavior, either on video or in vivo. Two such studies (Reagon et al. 2006; Taylor et al. 1999) also included siblings as interaction partners to test the modeled skills, though video modeling was the core instructional component of the interventions.

Play Skills Taylor et al. (1999) used siblings as behavior models, video-taping the siblings making play-related statements in three settings. These videos were then shown to the children with ASD, who would imitate the play behaviors. Similarly, Reagon et al. (2006) taught siblings a series of play scripts. Siblings and peers were video-taped carrying out these play scenarios, and siblings would watch the videos with their brother or sister. Sibling pairs were then provided with the play materials shown in the video, and siblings would re-enact their role in the scenario, with the child with autism meant to fill in the appropriate scripted statements.

Both children with ASD in the Taylor et al. study (1999) showed increases in play-related statements in all three settings compared to baseline. The child with the sibling model in the Reagon et al. study (2006) exhibited improvements in actions and scripted statements, but not spontaneous speech. These gains were maintained and generalized with different play partners at a follow-up after an unspecified period of time.

Academic/Functional Skills The remaining studies used siblings to teach academic and/or functional skills to the child with autism. Jones and Schwartz (2004) used siblings as live models to show the correct responses in an academic matching game. Siblings were then compared to unrelated peers and teachers to determine the effectiveness of different models. Rayner (2011a, b) conducted two different studies using siblings as models in videos teaching individuals with ASD functional skills including appropriate behavior during school, preparing simple food

(2011a), and tying their shoes (2011b). In both studies, both sibling-as-model and adult-as-model videos were used to compare outcomes.

Studies teaching functional skills using modeling had the lowest overall rates of success. While Jones and Schwartz (2004) showed increases in the percentage of correct responses in a matching game, none of the children with ASD involved in either of Rayner's studies showed meaningful improvement in imitating school routines or simple cooking skills (Rayner 2011a) or shoe tying (Rayner 2011b). All three studies compared sibling models/teachers to peers and adults, but results showed no differences in outcomes based on the different interventionists.

Siblings as Intervention Co-Recipients

The remaining three studies involved siblings as recipients of intervention (n = 3). That is, siblings received the exact same treatment alongside their brother or sister with ASD.

Two studies including siblings as participants (Baker 2000; Castorina and Negri 2011) aimed to teach social skills to individuals with ASD. The third (Pan 2011) included siblings in an aquatic fitness program for children with ASD. In the Baker (2000) study, interventionists developed games that incorporated thematic rituals for each child with ASD. The child and the sibling were then taught these new games and instructed to play together. Siblings were not given any instruction on behavior modification or other intervention responses. Castorina and Negri (2011) compared seven sibling dyads to eight individuals with autism, all of whom received social skills training through weekly group sessions. Siblings attended the sessions with their brother or sister and were expected to participate, but were given no explicit instructions on how to use the learned skills. Finally, Pan (2011) organized an aquatic skills intervention for children with ASD and their siblings, all of whom participated in the same lessons.

All three children with autism in the Baker study (2000) showed increases in time spent engaged in social play and joint attention, and decreases in thematic ritualistic behaviors. All participants, including siblings, showed increases in positive affect compared to baseline, and these changes were maintained at two follow-up measurements at 1 and 3 months post-intervention. Parents reported decreased severity of "obsessional activity" for two of the three children with ASD (Baker 2000). Both intervention groups in the Castorina and Negri study (2011) showed increases in perception of social cues, but the sibling-inclusion group did not show any significant benefits compared to the non-sibling intervention group. Pan (2011) showed improvements in various measures of physical fitness as well as measures of water-readiness for all participants.

The results of these studies show that the inclusion of siblings as participants in interventions can be beneficial, or at least does not negatively impact outcomes. While Castorina and Negri (2011) did not find any benefits of sibling inclusion beyond the intervention protocol itself, the other two studies did not compare sibling-inclusive interventions to non-sibling interventions. Importantly, Baker (2000) found that positive affect increased for both the child with ASD and the sibling after sibling participation in an intervention, suggesting that sibling inclusion can be beneficial for the sibling relationship, as well as helping improve skills.

Discussion

Summary of Findings

Overall, this review found evidence of several decades of sibling involvement in interventions for individuals with ASD. Though siblings have participated in interventions for many years, there have been no reviews of sibling involvement, consolidating the results from different studies. The results of this review find that sibling-mediated interventions are similar to results of peer mediated interventions (Chan et al. 2009); sibling involvement seems to lead to positive outcomes for children with ASD across a variety of skills and methods. Overall, the siblings learned the intervention procedures, and their brothers and sisters with ASD showed increases in skill acquisition and/or decreases in problematic behavior.

In response to our first research question as to the nature of sibling involvement in interventions, we found that siblings in the reviewed studies were most often agents of intervention. As agents of the intervention, the majority of studies described teaching the siblings various behavioral techniques to use with the individual with ASD, while others had the sibling act as a model to demonstrate desired behavior or skills, either in videos or in vivo. In a few studies, siblings were co-recipients of the intervention, meaning they participated alongside their brother or sister with ASD, but were not given instruction on how to interact with or change the behavior of the child with ASD.

Although siblings successfully performed intervention procedures during the brief period of time that behavior was overtly measured, just under half of the studies (n = 8) included follow-up measurements, with the longest period of time between intervention and follow-up being 6 months. Siblings as interventionists deviate from the research on peers as interventionists in that the individual delivering the intervention is involved in the life of the child with ASD on a more regular and sustained basis. Peers in a classroom setting may not consistently interact

with children with ASD as they change grades or leave school for the summer. In contrast, siblings offer a long-term opportunity for social learning. Future research evaluating long-term behavioral changes in both siblings and children with ASD would be beneficial to evaluate the full potential of sibling-mediated interventions. For example, interventions may change how sibling pairs interact in the home over time and whether or not intervention skills generalize to other settings.

Our second research question asked what skills children with ASD acquired as part of sibling-mediated interventions. In terms of targeted outcomes, the studies covered a variety of skills for the participants with ASD including play skills, social skills, academic knowledge, functional skills (e.g. cooking, shoe-tying), and aquatic fitness. The most common skills taught were social skills (addressed in six studies) and play skills (addressed in four studies). Children with ASD, when taught by or learning alongside siblings, successfully demonstrated gains across a variety of target behaviors. There were two cases (i.e., participants) where the child with ASD did not learn skills when a sibling participated as a video model, though the researcher attributed poor outcomes to a mismatch between video modeling and the participants or target skill as opposed to an issue with the sibling as an intervention agent (Rayner 2011a, b).

Our final question sought to identify data collected for the siblings involved in the reviewed interventions. Although 10 of the 17 articles included sibling data, eight reported only procedural information: how well the siblings were able to implement the given intervention, with Clark et al. (1989) measuring only sibling implementation (i.e. no outcomes were reported for the child with ASD). In addition to their reports of sibling implementation, Celiberti and Harris (1993) measured sibling confidence, pleasure in interacting with the child with autism, and frustration toward the child with autism in addition to how well the siblings were able to implement the intervention. Of the two remaining studies that reported sibling data, Baker (2000) measured sibling affect during the intervention, and Pan (2011) measured sibling aquatic fitness.

Data reported on siblings supports the positive findings for the individual with ASD. Nearly all participating siblings demonstrated acceptable levels of implementing the intervention methods. The reported fidelity data suggest siblings can be taught many different types of intervention procedures. Of the studies that reported on the sibling relationship or affect, most reported positive changes in their selected measures. Such a phenomenon is consistent with outcomes for peers participating in peer mediated interventions (Carter et al. 2008), though there is insufficient research to draw conclusions about improvement in the sibling relationship.

Additionally, three studies included quantitative measures of treatment acceptability, or how much siblings and/or parents enjoyed the intervention, all of which indicated moderate to strong satisfaction. Six of the included articles reported qualitative results from parents or siblings that also show positive opinions of the interventions. Though these results are promising, more systematic evidence is needed. As mentioned above, siblings have the potential to teach many different skills to their brothers or sisters with ASD over time. However, lengthy interactions call for additional considerations, such as prevention of burnout for the sibling interventionists and awareness of developmental changes in the siblings' abilities and desires to participate in interventions. Therefore, it is important to qualitatively measure sibling outcomes as well as procedural data in regards to sibling participation in interventions.

Further Considerations for Researchers

There are several additional factors salient to ASD research that researchers should consider in future intervention studies with siblings. First, studies included in the present review did not consistently report on measures of functioning, such as IQ, behavior problems, and severity of autistic symptoms. Despite several positive examples of siblings effectively serving as interventionists for their brothers or sisters with ASD, it is important to understand whether nor not such positive effects are likely if the interventions were to be implemented for children with lower IQ, more behavior problems, or more autistic symptoms. These data are needed to better guide practitioners regarding the type sibling involvement most appropriate for the wide range of individuals on the autism spectrum.

In addition to accounting for functioning when studying the efficacy of interventions, it is also important to determine which siblings may be best suited as interventionists. Factors such as sibling age, gender, and closeness with the target brother or sister could all play a role, both in how well a sibling can implement the intervention and how much the target child learns from the sibling. If a family has multiple typically-developing siblings, researchers should consider the possibility of different types of involvement for each child. One sibling may be an ideal instructor for academic interventions, while another may function better in play settings. Future research is needed to determine which sibling factors are important in maximizing positive outcomes.

Conclusion

Although the prospect of siblings implementing successful interventions for individuals with ASD is exciting,

additional research is needed to fully understand the challenges and benefits of incorporating siblings as interventionists. Until additional research is available to guide practice for sibling-mediated interventions, families and clinicians should proceed with caution when deciding how to involve siblings in treatment for individuals with ASD. For example, when choosing whether or not to include siblings in interventions, parents should carefully consider the siblings' opinions and abilities as well as potential outcomes. If siblings are already expected to help out more at home (e.g. D'Arcy et al. 2005), participation in interventions could lead to frustration or resentment. However, if parents are careful to take into account sibling desires and skills, sibling involvement in interventions can lead to an increased sense of efficacy and independence, as well as increased skills for the child with ASD (Ferraioli et al. 2012).

Many researchers have hypothesized the benefits of involving siblings in interventions for children with ASD. Although empirical support for some of these claims is limited, studies do show that siblings can be effective teachers in a variety of interventions. Nearly all of the target children in studies in this review gained new skills or made improvements in their existing abilities. However, a narrow emphasis on short-term skill gains for individuals with ASD may be limited. Future researchers can build on the existing literature by measuring the impact of these interventions on the sibling interventionists, studying long-term outcomes of interventions, and including additional measures of individual differences for both siblings and children with ASD that may affect intervention outcomes. As research identifies the methods that provide optimal benefits for everyone involved, clinicians and families can start to implement procedures that will improve outcomes for both children with ASD and their siblings.

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