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The Relation between Parent Verbal Responsiveness and Child Communication in Young Children with or at Risk for Autism Spectrum Disorder: A Systematic Review and Meta-Analysis

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Abstract

Among preschool-age children with autism spectrum disorder (ASD) and typically developing children, parents' verbal responsiveness (PVR) has long been shown to predict children's later language ability. However, before the age of three, when language develops most rapidly, the early social communication deficits associated with ASD may impact parents' opportunities to facilitate early language development. The aim of this review was to characterize the relation between PVR and the vocal communication ability of children with or at high risk for ASD early in development. Specifically, we examined whether the relation between PVR and child communication varied by type of PVR and by child diagnostic status, as well as whether interventions increased PVR. A systematic multi-database search yielded 25 empirical studies (804 parent–toddler dyads; 30 effect sizes) that met inclusion criteria and related a variable of PVR to a variable of child vocalization or language. Meta-regression analyses revealed that the relation between PVR and child communication was significant regardless of PVR type or child diagnostic status. To date, interventions targeting both PVR and child communication were found to significantly increase PVR, but not child communication, for these populations. Future research should examine parent–child communication in a transactional, longitudinal manner. In addition, these findings have implications for interventions designed to target parents' responsiveness and child communication.

Lay Summary:

For families with children under 3 years old who are at risk for or diagnosed with ASD, this study revealed empirical evidence of a robust relation between parents' verbal responsiveness to their children's play and communication and children's communication ability. This relation is similar to that reported in research on typically developing children. Interventions designed to improve parent–child interaction in children with or at risk for ASD may be effective in increasing parents' responsiveness.

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Conflict of Interest

The authors have no conflicts of interest to disclose.

Keywords

autism spectrum disorder; language development; parent–child relations; child; parents; communication

Introduction

Parents clearly play a large role in facilitating the language development of typically developing (TD) children [Tamis-LeMonda & Bornstein, 2002] and children with autism spectrum disorder [ASD; e.g., Tager-Flusberg, 2016]. Transactional theories of development emphasize the reciprocal, cumulative effect that behaviors—for example, children’s communication and parents’ responses—have on each other over time [e.g., Warlaumont, Richards, Gilkerson, & Oller, 2014; Wu & Gros-Louis, 2014]. It is particularly important to understand such relations through a transactional lens in families with a child with ASD, because these children may display fewer or different social communication behaviors, which in turn may lead to fewer learning opportunities with parents compared to children with typical development [Tager-Flusberg, 2016].

Using a transactional perspective, the current review focused on one type of parent-facilitated learning opportunity for young children: parents’ verbal responsiveness (PVR) to their children’s communication and focus of attention. PVR is a pivotal facilitator of child communication in the early years of life, when language develops rapidly [e.g., Baumwell, Tamis-LeMonda, & Bornstein, 1997]. More specifically, the mechanisms by which PVR impacts children’s later language ability may depend on whether parents are responding to children’s communication acts themselves or simply to their focus of attention. Importantly, because children with ASD display early deficits in social communication, the way and degree to which PVR impacts communication ability in this population may be different than for TD children. PVR may also impact communication ability differently for young toddlers at high familial risk for ASD (HR children), who may be prodromal for language delays or ASD. Yet, research on the relation between PVR and communication ability in young children at HR for ASD or diagnosed with ASD has yet to be systematically reviewed.

The purpose of this systematic review and meta-analysis was to assess the relation between PVR and child communication for young HR children and children with ASD and to determine whether certain types of PVR are more strongly linked than others to child communication ability. Given the emphasis on identifying early interventions that facilitate social communication development in young children with and at risk for ASD [e.g., Dawson et al., 2012], we also examined the extent to which interventions thus far have been found to improve PVR and child communication outcomes in this young population.

PVR and Child Communication in Typical Development

Beyond other parent behaviors, PVR has been found to powerfully influence TD children’s language ability in a transactional manner, beginning very early in development [Baumwell et al., 1997; Bornstein, Tamis-Lemonda, Hahn, & Haynes, 2008; Goldstein & Schwade,

2008; Goldstein, King, & West, 2003; Gros-Louis, West, Goldstein, & King, 2006; Gros-Louis, West, Goldstein, & King, 2014; Hirsh-Pasek et al., 2015; Leigh, Nievar, & Nathans, 2011; McGillion et al., 2013; Tamis-LeMonda, Bornstein, & Baumwell, 2001; Tamis-LeMonda, Kuchirko, & Song, 2014; Wu & Gros-Louis, 2014]. The first 3 years of life are a period of intense communication development and a crucial time to facilitate parents' responsiveness to children's communication and play.

Evidence suggests that PVR facilitates children's complex preverbal communication [e.g., Gros-Louis et al., 2014], early language comprehension [e.g., Baumwell et al., 1997], and the age at which toddlers say their first words [e.g., Tamis-LeMonda et al., 2001]. The developmental complexity of children's vocalizations may influence parents to, in turn, provide more rapid or more advanced verbal responses [Gros-Louis, West, Goldstein, & King, 2006]. That is, PVR to their children's communication may lead to advances in children's language, which then results in children's increasingly complex communication bids—in a transactional manner. The transactional literature on typical language development has addressed the relation between many types of PVR and child communication outcome.

Types of Parent Verbal Responsiveness

One challenge to characterizing the relationship between PVR and child communication is the lack of consensus on how to operationalize and measure PVR [e.g., Bornstein et al., 2008; Leigh et al., 2011; Warren & Brady, 2007]. Parent responses that are relevant and contingent facilitate children's later language development [Gros-Louis et al., 2014; Tamis-LeMonda et al., 2001]. Historically, responsiveness was rated globally [e.g., Ainsworth, Bell, & Stayton, 1974; Kim & Mahoney, 2005; Meins, Fernyhough, Fradley, & Tuckey, 2001]. PVR has also been operationalized more specifically by categorizing the content of parents' verbal responses [e.g., affirmations, imitations, descriptions of child actions, questions, and demonstrations; Tamis-LeMonda et al., 2001], to examine differences in the extent to which these categories predict language [e.g., Yu, Smith, & Pereira, 2008].

PVR has also been operationalized based on the child behavior to which parents are responding. McDuffie and Yoder [2010] measured PVR to two types of child behavior in children with ASD: (a) to children's communication acts, and (b) to children's focus of attention. Within these categories, they made a further distinction between three types of PVR to children's communication acts: (a) "linguistic mapping," or putting a child's initiation into words; (b) "repeating," or repeating a child's word approximation with an adult, fully pronounced word; and (c) "expansion," or adding words or meaning to expand a child's previous vocalization. They also distinguished between two types of PVR to children's focus of attention: (a) "follow-in commenting," or comments that are contingent, appropriate to the child's focus of attention and do not make any demands on the child to change their behavior, and (b) "follow-in directives," or comments that are contingent, appropriate, and do involve a request to change something about what the child is doing.

Types of Child Communication Outcomes

The literature on typical development has found relations between PVR and two primary types of child communication outcomes: preverbal vocalizations (e.g., canonical babbling) and verbal communication (e.g., vocabulary size or standardized measures of language ability). However, TD young children's preverbal babbling and lexical abilities are related phonologically and highly correlated across time [Jakobson, 1968; McCathren, Yoder, & Warren, 1999]. For example, the amount and timing of infants' babbling predict the amount and timing of their early speech [Kagan, 1971; Locke, 1989; McCathren et al., 1999; Stoel-Gammon, 2011]. Further, phonological aspects of toddlers' babble and early words are often similar [Locke, 1989; McCathren et al., 1999; Stoel-Gammon, 2011]. There is also a robust relation between early babbling and later language for children with ASD [Oller et al., 2010; Plumb & Wetherby, 2013; Yoder, Watson, & Lambert, 2015]. Therefore, in this review, we included both types of child communication outcomes, and did not distinguish among them.

PVR and Child Communication in ASD

Many children with ASD experience delays or impairment in communication development [Anderson et al., 2007; Paul, Fuerst, Ramsay, Chawarska, & Klin, 2011]. Up to a quarter of children with ASD do not develop functional language [Tager-Flusberg, Paul, & Lord, 2005]. This is important because greater language ability facilitates more meaningful social interaction and increased adaptive functioning [Anderson et al., 2007; Kasari et al., 2010; Luyster, Kadlec, Carter, & Tager-Flusberg, 2008; McDuffie, Yoder, & Stone, 2005]. Among older children with ASD (i.e., over 3 years), there is a consistent relation between PVR and child communication [Flippin & Watson, 2015; Fusaroli, Weed, Fein, & Naigles, 2018; Siller & Sigman, 2002, 2008; Walton & Ingersoll, 2014]. For example, Siller and Sigman [2002, 2008] found that parents' follow-in commenting was the best predictor of long-term language for children with ASD ages 3–5 years, controlling for cognitive abilities, joint attention, and initial levels of language. Mothers of children at HR or with ASD appear to be comparably responsive as parents of TD children [Baker, Messinger, Lyons, & Grantz, 2010; Leezenbaum, Campbell, Butler, & Iverson, 2014; Talbott, Nelson, & Tager-Flusberg, 2015; Tager-Flusberg, 2016]. However, children who are at familial risk for or diagnosed with ASD often have social communication deficits in joint attention and preverbal vocalizations, which could impact how effectively parents' responses facilitate communication development.

PVR may impact children's later communication ability via different mechanisms depending on whether parents are responding to children's attentional focus or to their vocal communication acts. Children with ASD vocalize less often during parent–child interactions and initiate vocal interactions less often than TD children [Paul et al., 2011; Warlaumont et al., 2014]. Transactional theories of language development may most directly explain the relation between PVR to these vocalizations and later child language ability [e.g., Sameroff & Fiese, 2000]; if parents have fewer vocalizations to which to respond, the paucity of parent–child vocal transactions may hinder children's communication development. In addition, children with ASD may have deficits in both initiating joint attention (IJA) and in responding to others' bids for attention (RJA; e.g., Mundy, Sullivan, & Mastergeorge, 2009; Stone & Yoder, 2001). In typical development, IJA and RJA facilitate vocal interactions with

parents and are associated with later language [Wu & Gros-Louis, 2014]. Thus, deficits in ASD and HR children's use of IJA and RJA could impact their communication development by offering fewer opportunities for sharing a focus of attention. Indeed, selective attention theories of language development posit that behaviors that affect children's "intake" from the input, such as joint attention, influence the degree to which they learn new words [e.g., Yu & Smith, 2011; Arunachalam & Luyster, 2016]. PVR to children's focus of attention puts the burden on the parent to wait until the child is attending to an object or event before providing a verbal response or comment. While PVR to children's focus of attention does not rely on an active child behavior such as a communication act, joint attention deficits in children with ASD may still preclude them from true "intake" of the parents' response. The current review distinguishes between findings for studies that utilized global ratings of PVR and those that coded specific types of PVR (i.e., to children's communication acts and to children's focus of attention) to determine whether these strategies differentially predict communication ability for HR or ASD children.

ASD Risk Versus ASD Diagnosis

Factors unique to ASD risk versus diagnosis are also relevant to understanding the role of PVR in communication. A wide range of language abilities and trajectories are evidenced in the first few years of life among HR infants [e.g., Baker et al., 2010; Dereu, Roeyers, Raymaekers, & Warreyn, 2012]. Large-scale prospective research has revealed that 7–19% of HR children receive an ASD diagnosis themselves [Grønborg, Schendel, & Parner, 2013; Ozonoff et al., 2011], and an additional 20% demonstrate language or cognitive delays by 3 years of age [Messinger et al., 2013].

Although both children with ASD and HR children demonstrate communication deficits [Anderson et al., 2007; Edmunds, Ibañez, Warren, Messinger, & Stone, 2016; Iverson et al., 2017; Paul et al., 2011], assessing the difference in the relation between PVR and child communication for young HR children compared to children with ASD could provide a more complete picture of how parent–child vocal interactions develop, influence each other reciprocally over time, and respond to intervention. For example, one would expect more variability in communication outcomes of HR children because many have typical developmental outcomes. Ultimately, differences in the relation between PVR and child communication ability may be based on the language level of children with ASD. For example, PVR has been found to predict later expressive language in minimally verbal toddlers, but not in toddlers who can say more than a few words [Naigles, 2013]. Systematically examining the PVR-child communication relation in both those with ASD and those considered HR could provide insight into early variability and aid in generating hypotheses about familial risk from a transactional view. In addition, interventions are being developed for both children with ASD and those with HR status despite limited knowledge regarding the relation between and malleability of PVR and child communication in each population [e.g., Baranek et al., 2015; Kasari et al., 2014].

Interventions to Increase PVR and Communication in ASD

Early intervention occurring when communication ability is just developing could potentially improve long-term communication outcomes [e.g., Dawson et al., 2012].

Intervention research is relevant to understanding the relation between PVR and child communication, first, because it establishes that PVR is amenable to change, and, second, because it provides potentially stronger evidence that PVR affects child communication above and beyond other variables such as maturation [Venker, McDuffie, Ellis Weismer, & Abbeduto, 2011].

Some interventions for ASD are parent-implemented, and many of these attempts to increase parent responsiveness [e.g., Green et al., 2015; 2017; Kasari et al., 2014]. Parent-implemented interventions may be more effective than therapist-implemented interventions for children's communication because of the sheer number of hours that children spend with their parents compared to the hours they can spend with a therapist, and because intervention can occur in a child's everyday environment [Roberts & Kaiser, 2011]. However, the specific potential active components of parent-implemented interventions are not always clearly delineated. For example, studies rarely specify or justify a rationale for aiming to increase a specific type of PVR, and it may be the case that PVR to children's focus of attention is a more fruitful intervention target than PVR to children's communication acts for some children. A review of parent-implemented language interventions for children with language deficits found that fewer than half of the interventions reviewed provided information on which components of parents' involvement and parent-implemented interventions increased child language [Roberts & Kaiser, 2011]. To our knowledge, there has been no review of the efficacy of interventions for young children with or at risk for ASD that target PVR and child communication.

Research Questions

Research on TD children and older children with ASD strongly suggests that PVR and children's communication are related. However, for children in the early stages of communication development, several issues have yet to be systematically addressed, including differences between types of verbal responsiveness, high-risk status versus confirmed ASD diagnostic status, and the efficacy of intervention on these behaviors in these populations. This systematic review and meta-analysis address the following questions:

1. Does the relation between PVR and child communication differ for HR children and children with ASD in the first few years of life?
2. Are there differences in the relation between PVR and child communication depending on the type of PVR measured with respect to: (a) global versus specific measurement; and (b) PVR to children's focus of attention versus children's communication acts?
3. Are interventions effective at increasing PVR and child communication compared to control conditions for young children with or at risk for ASD?

Method

Summary of Research Strategy

A comprehensive search of peer-reviewed empirical articles from the following databases was conducted: PubMed, Embase, PsycINFO, Web of Science, and ASHA (American Speech-Language-Hearing Association) Journals Search. Key terms that were included in the search were ((responsiv* or sensitiv*) AND (parent* OR maternal OR caregiver)) AND ((vocaliz* OR babbl*) OR language) AND child* AND (ASD or autism). No publication date restrictions were used. Articles were limited to those published in English. Articles were also selected through an iterative process that involved examining reference lists of studies identified using the search terms above, the reference lists of review articles on related topics, and articles identified by contact with top experts in the field. The last search date was March 16, 2017.

Inclusion and Exclusion Criteria

This review included studies that examined the relation of PVR to their child's language and play, and children's vocalizations or language ability. The search included both observational studies that examined these two variables as they occur naturalistically as well as interventions designed to increase parents' responsiveness, children's language, or children's general social communication ability. To be included, studies needed to operationally define and measure both a variable of parent responsiveness that includes verbal responding and a variable of child communication (i.e., vocalization or language). Studies also needed to report some sort of relation between PVR and child communication (e.g., correlation), regardless of directionality (i.e., not limited to earlier PVR and later child communication). Intervention studies needed to operationally define and measure both the PVR and child communication variable, and these variables needed to be measured directly postintervention, at minimum. Both studies of parent-implemented interventions and therapist-implemented interventions were included, provided that parent responsiveness was purported to be affected by the intervention and was measured.

Further, this review only included articles that examined the variables of interest in children with or at risk for ASD between birth and 3 years old (i.e., a majority of their sample was under 3 years of age at the time points at which both PVR and child communication were measured). All studies included in this review were empirical articles that were either cross-sectional or longitudinal in nature.

Studies were excluded if their operational definition of parent responsiveness did not explicitly include parents' verbal behaviors. Studies were also excluded if their samples comprised only children who were TD or included children with neurodevelopmental disorders other than ASD, such as fragile X syndrome. If study samples included children with or at risk for ASD, but results were not reported for those children as individuals or as subgroups group (i.e., separating HR from diagnosed), the studies were excluded. Dissertations, book reviews, review articles, conference proceedings, case studies, and other "gray literature" were not included in this review.

Using the results from the original search terms, 384 articles without duplicates were identified. Thirty-six additional articles were identified from the reference list of the articles identified using the original search terms, yielding 420 total nonduplicate articles. Eighty seven per- cent of the studies ($n = 364$) were excluded after a title and abstract review. Fifty five percent of the studies ($n = 31$) were excluded after a full text review. Overall, 25 studies from 19 different samples (804 parent–toddler dyads; 30 effect sizes) were included in this systematic review. Study selection was performed by the first author, and the second author independently con- ducted a title, abstract, and full text review on 20% of the identified nonduplicate studies; point-by-point agreement for study inclusion was 95%, and disagree- ments were resolved via consensus. A preferred reporting items for systematic reviews and meta-analyses diagram of the study selection process is shown in Figure 1 [Moher, Liberati, Tetzlaff, Altman, & PRIMSA Group, 2009]. A summary of included study characteristics can be found in Table 1.

Data Extraction from Included Studies

Included studies were coded according to a detailed man- ual. Report-level features of the manual included year of publication and whether or not the study reported that it shared a sample with another publication. Effect size-level features for studies included in Research Questions 1, 2, and/or 3 included: sample size; risk/diagnostic status (HR or ASD); average chronological age of participants in each group; procedural setting (naturalistic observation or inter- vention); temporal design (longitudinal or cross-sectional); PVR coding scheme (global vs. specific); type of PVR (PVR to children’s communication acts vs. PVR to children’s focus of attention); time points of PVR and child communication ability measurement (i.e., 18 months; note: postintervention measurements used for Research Question 3); type of child communication variable (standardized measure of language, intentional communication [both vocalization and words that are expressed with the intention of communicating], and vocalization only); and value of the effect size. Addi- tional effect size-level features for studies included in Research Question 3 included: name of intervention; aver- age chronological age of participants postintervention; whether or not the intervention purports to target PVR; and whether or not the intervention purports to target child communication.

See Table 1 for a list of the included studies categorized by selected demographic variables. Data extraction was performed by the first author. The second author indepen- dently coded a randomly selected 20% of the included studies. Point-by-point agreement was 97% across all variables. In cases of disagreement, the first author’s decisions were used after subsequent discussion and resolution of discrepancies.

Analytic Plan

All 25 studies were qualitatively reviewed. In addition, 18 studies were included quantitatively in the meta- regression to answer the three research questions. To be included in the meta-analytic components of this review, studies needed to report the statistics necessary to calculate an effect size appropriate to the research question.

Research questions 1 and 2: Differences by group and type of PVR. Zero-order or partial Pearson r-values were used as the effect size of interest for RQ1 and RQ2. Pearson r-values were Fisher z-transformed prior to analysis and back-transformed for reporting results [Borenstein, Hedges, Higgins, & Rothstein, 2009]. Multiple effect sizes reported within the same study (i.e., correlations between child communication and both PVR to children's communication acts and PVR to children's focus of attention) were included in the analyses. Meta-regression analyses with separate tau squared estimates and robust variance estimation were conducted using the "robumeta" package in R [Borenstein et al., 2009; Fisher & Tipton, 2015; Lipsey & Wilson, 2015]. Robust variance estimation corrects for dependent effect sizes [samples used across multiple studies; multiple effect sizes per study; Tanner-Smith & Tipton, 2014].

Research question 3: Intervention efficacy. Standardized mean differences (SMDs) between intervention and control groups for postintervention levels of PVR and child communication were calculated and used as the effect size of interest for RQ3. Simple meta-analysis was performed for PVR and child communication variables separately using the "meta" package in R [Schwarzer et al., 2007].

Results

Overview

Articles that met the review criteria were published between 2010 and 2016. A summary of relevant characteristics is presented in Table 2. The youngest infants studied were 5 months old, while half of the studies had at least some participants who were older than 3 years of age. Approximately 74% of the 804 participants included in the review sample were 36 months of age or younger, and the oldest participants ($n = 6$) were 60 months of age. Of note, none of the observational studies measured PVR and child communication each across multiple time points in a manner that would allow cross-lagged panel or transactional analysis. About two-thirds of the studies measured PVR in a specific manner, which therefore supported the coding of specific types of PVR.

Research Question 1: Does the Relation between PVR and Child Communication Differ for HR Children and Children with ASD?

Across all studies reviewed, there was a robust relation between PVR and child communication for both HR children and children with ASD. Of the 25 studies, 19 (76%) reported at least one significant relation between PVR (of some type) and child vocalization or language. Findings from the meta-analysis indicated that for both HR children and children with ASD, there was a significant, positive relation between PVR and child communication ($r_{HR} = 0.47$, 95% CI [0.16, 0.70]; $r_{ASD} = 0.35$, 95% CI [0.23, 0.46]). There was no significant difference in the strength of the relation by risk/diagnostic group, $Q = 0.58$, $P = 0.44$. However, descriptively, there was more variability in the relation between PVR and child communication in the studies that included only HR children ($\tau^2 = 0.11$) compared to children with ASD ($\tau^2 = 0.04$) (Fig. 2).

This greater variability in the strength of the relation between PVR and child communication for HR children compared with children diagnosed with ASD may be related to the variability in age and heterogeneity of the corpus. Specifically the samples of HR infants were on average younger than the samples of children with ASD (i.e., about 18 months vs. 33 months), and there may be more variability in the amount and type of parent–child vocal interaction as these younger children learn to engage in vocal turn-taking and more advanced play sequences with their parents [Jaffe et al., 2001]. It is also possible that the variability is explained by the increased heterogeneity in outcomes for the HR children in these studies (i.e., ASD, language delay, and typical development).

Research Question 2: Are There Differences in the Relation between PVR and Child Communication Depending on the Type of PVR Measured, with Respect to: (a) Global Versus Specific Measurement; and (b) PVR to Children’s Focus of Attention Versus Children’s Communication Acts?

Studies that coded specific behaviors, rather than using a global rating, in their measurement of types of PVR were more likely to report a significant association between PVR and child communication. Twelve of the 13 studies (92%) that used specific coding for PVR found a relation with child communication, whereas 7 of the 12 studies (58%) that reported unclear or global coding of PVR found a significant relation. Findings from the meta-analysis indicate that for studies that measured PVR in a global manner and for studies that utilized a specific manner of coding, there was a significant, positive relation between PVR and child communication ($r_{\text{Global}} = 0.39$, 95% CI [0.05, 0.65]; $r_{\text{Specific}} = 0.37$, 95% CI [0.25, 0.48]). There was no significant difference in the strength of the relation by type of PVR coding scheme, $Q = 0.02$, $P = 0.89$. However, descriptively, there was more variability in the relation between PVR responsiveness and child communication in the studies that measured PVR globally ($\tau^2 = 0.11$) compared to specifically ($\tau^2 = 0.05$) (Fig. 3).

For both studies that measured PVR to children’s communication acts and for those that measured PVR to children’s focus of attention, there was a significant, positive relation between PVR and child communication ($r_{\text{CA}} = 0.38$, 95% CI [0.07, 0.62]; $r_{\text{FA}} = 0.37$, 95% CI [0.21, 0.51]). There was no significant difference in the strength of the relation by type of PVR, $Q = 0.00$, $P = 0.96$. However, descriptively, there was more variability in the relation between PVR and child communication in the studies that measured PVR to children’s communication acts ($\tau^2 = 0.14$) compared to PVR to children’s focus of attention ($\tau^2 = 0.03$) (Fig. 4).

Integrating meta-analytics with qualitative findings, both PVR to children’s focus of attention and communication acts are associated with children’s communication ability, but there is stronger evidence for PVR to children’s focus of attention as a unique predictor of children’s communication ability. When PVR to communication acts was the only type of PVR assessed within a study, it significantly predicted child communication [e.g., Leezenbaum et al., 2014]. However, when studies measured both types of PVR, they were more likely to find that PVR to children’s focus of attention was predictive of child communication [e.g., Haebig et al., 2013; McDuffie & Yoder, 2010]. Some studies measured these two types of PVR as an aggregate in order to provide a more stable and reliable

measure of the construct [e.g., Yoder et al., 2015; Woynaroski et al., 2016], and they also found a significant relation between PVR and child communication.

Research Question 3: Are Interventions Effective at Increasing PVR and Child Communication Compared to Control Conditions?

Five intervention studies, all randomized control trials, were included in the meta-analytic component of this review; studies included HR children and children with ASD; measured PVR globally and specifically, assessed a variety of types of interventions, and measured a variety of child communication variables. Overall, interventions were successful at increasing PVR in treatment compared to control groups, $SMD = 1.00$, 95% CI [0.52, 1.48]. However, intervention did not result in significantly better child communication in treatment groups compared to controls, $SMD = -0.05$, 95% CI [-0.28, 0.19] (Fig. 5).

One additional randomized control trial (RCT) and three small-N design studies were also identified as part of the systematic review. Of the nine total studies, all examined interventions that directly targeted PVR. Some interventions also included direct intervention on children's communication ability. Both RCTs and small-N designs yielded mixed results as to the efficacy of the interventions assessed at increasing PVR and child communication.

Overall, RCTs that targeted both PVR and child communication were more effective at improving PVR than child communication (Fig. 5). The interventions that did improve child verbal communication either included direct therapist intervention on language [Baranek et al., 2015], conducted in-home parent coaching [McDuffie et al., 2013], or examined moderators of intervention efficacy [Carter et al., 2011]. Carter and colleagues found that children who had lower levels of interest in objects pretreatment demonstrated a significant increase in their communication, suggesting that the intervention may affect children's communication abilities by increasing their interest in objects, rather than by increasing PVR. RCTs were more likely to measure PVR to children's focus of attention than PVR to children's communication acts. Finally, the two RCTs that examined the efficacy of intervention in HR children yielded mixed results. Adaptive responsive teaching [Baranek et al., 2015] improved child communication but not PVR, while focused playtime intervention [Kasari et al., 2014] improved PVR but not child communication. See Table 3 for more details about each RCT.

Discussion

This review describes the findings of research that examined the relation between PVR to child communication for young children with or at HR for ASD. The toddler-to-preschool period is a time of rapid and divergent communication development for HR children and children with ASD compared to TD children. Results indicate that, overall, there is substantial empirical evidence that PVR is associated with communication ability in these young children, although there appears to be more variability for HR children than children with ASD. There seems to be more evidence for the association of PVR to children's focus of attention, compared to their communication acts, with child communication. Interventions

for these populations that sought to increase PVR and child communication were effective at increasing PVR but not child communication.

Interpretation of Results

Confound of age and ASD risk.—Studies of children at risk for ASD will naturally have participants that are younger on average than studies of children who are diagnosed with ASD because children at risk can be identified before birth (i.e., based on family history rather than specific behavioral symptoms). The relation between PVR and child communication outcome may be more variable for HR children compared to children diagnosed with ASD because of the lower average age of HR children across the reviewed studies (HR: 18 months; ASD: 33 months). However, there is strong evidence that the language of TD children seems to benefit from parents' verbal responding in the first year of life [e.g., Wu & Gros-Louis, 2014; Tamis-LeMonda et al., 2001], so it is possible that the observed variability is not wholly due to the young age of HR children, but also that some aspects of their parent–child interactions that typically relate to language outcomes are altered.

Another consideration is that only a small subset of HR children will later be diagnosed with ASD. None of the studies included in this review with HR children reported whether or not these children were ultimately diagnosed with ASD. Findings with HR children may be more similar to findings with TD children compared to findings with children with ASD due to the variability in expected language outcomes for HR children. Indeed, we found that there was more variability in the relation between PVR and child communication for HR children compared to children with ASD.

Behavioral specificity of PVR.—Studies that coded PVR to children's focus of attention and studies that coded PVR to children's communication acts both found relations with later child communication. However, greater variability was found in the strength of the relation between PVR to children's communication acts and child communication. Studies that coded specific responsiveness behaviors in an interval or discrete fashion were more likely to find a significant relation between PVR and child communication than were studies that used a global scale (e.g., Hudry et al., 2014). These results suggest: (a) that PVR be coded using a behaviorally specific discrete or interval metric rather than using a global rating scale, and (b) that researchers specify the type of PVR they are utilizing, as each type may be differentially facilitative of child outcomes for children with or at risk for ASD.

PVR to children's focus of attention, which is not contingent on a child's communication act or other overt behavior, may be particularly effective for children with ASD. For example, Haebig et al. [2013] examined the specific types of PVR that may contribute most to the later language of children with ASD. Only parents' PVR to their children's focus of attention predicted children's receptive and expressive language, after controlling for parent education, child engagement, and initial language ability. PVR to communication acts did not significantly predict later language ability. Overall, there is evidence that PVR to children's focus of attention and children's communication acts both relate to children's

language ability. However, PVR to children's focus of attention appears to more frequently relate to language ability than PVR to child communication acts.

Intervening on PVR and child communication.—At this point in time, research on interventions for PVR and child communication at young ages seems inconclusive. RCTs of interventions that measured PVR to both children's focus of attention and communication acts [Carter et al., 2011; McDuffie et al., 2013; Venker et al., 2011] did also find improvements in child communication outcomes for at least some children. However, there were too few RCTs to make conclusions about whether the type of PVR targeted in the intervention affected child communication outcomes. Further, no studies examined whether the effect of the intervention on child communication was mediated by PVR (or vice versa), which would have provided stronger evidence for the mechanisms by which these interventions work.

Limitations

There were several limitations of this review. There were a relatively small number of studies that fit the review criteria, which limited meta-analytic power. Publication bias of the studies identified for this review was not assessed and is a limitation of this study [Higgins & Thompson, 2004]. Further, studies differed broadly in terms of the types of PVR and child communication that were measured, which limited the generalizability of this review's conclusions. The fact that a quarter of the participants in this study were older than 36 months weakened the ability of this review to draw conclusions about how PVR and child communication relate specifically in children who are under 3 years of age.

Published findings assessing interventions for ASD that purport to affect PVR and child communication often did not include an operational definition and measurement of the intervention's components or content. This might be a common problem in the field; a review of all parent-implemented language interventions for all children with language deficits noted that about half of all of the studies did not delineate and measure active components of their intervention [Roberts & Kaiser, 2011]. Describing intervention components in accessible terms would allow researchers to assess the relative efficacy of various components in improving outcomes. This review identified a unique set of early interventions for children with or at risk for ASD: interventions that purported to increase PVR and/or child communication. As such, our findings should not be generalized to all early intervention for ASD.

Future Directions

Systematic measurement of types of PVR will be important for determining the mechanism by which PVR affects child communication outcome. It could be that different types of PVR are more conducive to improving language at different developmental stages. For example, PVR to children's focus of attention could be most effective in improving child language when children are looking around in their environment and actively learning words, while PVR to children's communication acts could be most helpful when children are learning to produce complex nonword speech sounds (i.e., canonical syllables) and receive immediate parental models [Harbison, Yoder, Wade, & Warlaumont, 2018]. The role of children's

behaviors during responsive parent interactions should be further examined. For example, would children's vocalizations while they initiate joint attention predict their later communication ability over and above the amount of time that parents are verbally responsive?

The interaction style of parents of HR children should continue to be studied in more detail. Parents of HR children already have an older child with ASD, which may have shaped their parenting. For example, it may be that parents of HR children are even more responsive to their younger child's communication acts because of how relatively rare those communication acts might have been for their older child with ASD. On the other hand, it may be that because parents' older child with ASD was less vocal, parents had less opportunity to be responsive and may be slightly less likely to respond to their younger HR child's vocalizations [Wan et al., 2012; Warlaumont et al., 2014]. It may also be that both responsive and directive styles of parental interaction may facilitate social communication development in children with ASD. Decades of research has suggested that children's learning is best facilitated by input that scaffolds, or appropriately stretches, their experiences [e.g., Vygotsky, 1978]. While some research suggests that directive parental comments that redirect children from their focus of attention may impede language development, "follow-in directives" may increase language-learning opportunities of children with ASD because they are responsive to their focus of attention but expand their play [McCathren, Yoder, & Warren, 1995]. For example, parents of 12-month-old HR children have been found to provide verbal responses that are both more sensitive and also more demanding (i.e., requesting the child engage in an action) compared to parents of TD children [Steiner, Gengoux, Smith, & Chawarska, 2018]. In addition, Haebig et al. [2013] found that parents' follow-in directives for language (i.e., directing children to use language) predicted gains in receptive language for children with ASD.

Additional research on the transactional development of PVR and child communication ability in ASD is needed. Warlaumont et al. [2014] found that parents of both children with ASD and TD children were significantly more likely to respond to speech compared to a nonspeech child vocalization, but the strength of this relation was weaker (although still significant) for parents of children with ASD than for those of TD children. This suggests that it may be more difficult for parents of children with ASD to respond discriminatively between speech and nonspeech sounds compared to parents of TD children. In contrast, early in development, mothers' responsiveness may not yet be affected by the different vocal trajectory of children with ASD; at 9 months, mothers of both HR and TD infants are more likely to provide language-promoting responses to infants' more complex speech vocalizations [Talbot et al., 2015]. Importantly, no research has yet examined transactional, bidirectional effects of PVR and child communication in HR toddlers [Wan, Green, & Scott, 2018], and these longitudinal investigations are needed to assess whether parents' interaction style could potentially ameliorate ASD symptomatology and language impairment within the context of intervention.

Intervention studies should measure types of PVR so that, if only some types relate to children's communication, future iterations of the intervention could pare down the elements that parents are asked to learn. Examining moderators and mediators of treatment effect on

PVR and child communication may also be a useful direction for future research. Why might the evidence on intervention efficacy be mixed for young children with ASD? Is it that the deficits in social communication that children with ASD display prevent parents from being the most effective intervention access point? One study reviewed here [Carter et al., 2011] found that children's object interest was a moderator of treatment efficacy on later language ability. Other researchers have posited that interventions that purport to teach children social communication skills through increasing PVR alone (i.e., conceptualizing PVR as a mediator of treatment effect) may not be sufficiently powerful, and that directly targeting social communication skills such as joint attention may in turn have a greater impact on children's vocal communication development [e.g., Kasari et al., 2014]. Indeed, the lack of compelling evidence thus far that PVR and child communication can be simultaneously increased via early intervention suggests that intervention researchers aiming to improve child communication may want to continue including other intervention strategies in addition to strategies designed to increase parents' responsiveness. However, for all young children with or at risk for ASD, there is increased consensus that parents are an important part of any naturalistic developmental behavioral intervention [Schreibman et al., 2015].

Overall, future research should examine PVR in a behaviorally specific manner, study both parent and child variables in a transactional manner, further examine HR children, and most importantly, design studies and analyze data such that clear conclusions as to the effect of interventions on PVR and child communication can be obtained. Identifying the mechanisms by which interventions are effective may lead to streamlining them for eventual implementation in the community and will provide a much clearer understanding of why and how parents' vocal input to their children with or at high risk for ASD helps them acquire language.

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Figure 1.

Preferred reporting items for systematic reviews and meta-analyses (PRISMA) diagram of study selection based on systematic review.

Figure 2.

Forest plot of the correlation between PVR and child communication, displayed separately by group. Note. Squares indicate mean study effect size; lines indicate 95% confidence interval. Diamonds indicate across-study summary effect size; fullest height of diamond indicates mean effect size; edges of diamond indicate 95% confidence interval.

Figure 3.

Forest plot of the correlation between PVR and child communication, displayed separately by PVR coding scheme. Note. Squares indicate mean study effect size; lines indicate 95% confidence interval. Diamonds indicate across-study summary effect size; fullest height of diamond indicates mean effect size; edges of diamond indicate 95% confidence interval.

Figure 4.

Forest plot of the correlation between PVR and child communication, displayed separately by type of PVR. Note. Squares indicate mean study effect size; lines indicate 95% confidence interval. Diamonds indicate across-study summary effect size; fullest height of diamond indicates mean effect size; edges of diamond indicate 95% confidence interval.

A Post-Intervention PVR: **B Post-Intervention Child Communication:** **Figure 5.**

Forest plots of postintervention differences in PVR (A) and child communication (B) between intervention and control groups. Note. Squares indicate mean study effect size; lines indicate 95% confidence interval. Diamonds indicate across-study summary effect size; fullest height of diamond indicates mean effect size; edges of diamond indicate 95% confidence interval

Table 1.

Selected Descriptive Characteristics of Included Studies

Study	Sample type	Sample age (months) M (range) ^a	Temporal design	PVR coding scheme	Type of PVR	Child comm. variable	Included in meta-analysis
Naturalistic Observational Studies							
Baker et al. [2010]	ASD	18, 24, 36	Longitudinal	Global	N/A	Language	RQ1-2
Bottena-Beutel, Yoder, Hochman, and Watson [2014]	ASD	38 (27–51)	Longitudinal	Interval	Focus of attention	Language	RQ1-2
Dimitrova, Özçalı kan, and Adamson [2015]	ASD	31 (21–37), 34	Longitudinal	Discrete	Communication act	Int. Comm.	–
Haebig, McDuffie, and Weismer [2013]	ASD	31 (24–39), 43	Longitudinal	Interval	Both	Language	RQ1-2
Hudry et al. [2014]	ASD	45 (24–60)	Cross-sectional	Global	N/A	Language	RQ1-2
Kinard et al. [2016]	HR	13	Longitudinal	Interval	Focus of Attention	Int. Comm.	RQ1-2
Leezenbaum et al. [2014]	HR	13, 18	Longitudinal	Discrete	Communication Act	Int. Comm.	RQ1-2
McDuffie and Yoder [2010]	ASD	40 (27–60), 46	Longitudinal	Interval	Both	Language	RQ1-2
Min-Venditti, Harker, Ibañez, and Stone [2014]	HR	9, 12, 18	Longitudinal	Global	N/A	Language	RQ1-2
Northrup and Iverson [2015]	HR	9, 24, 36	Longitudinal	Discrete	N/A	Language	RQ1-2
Perryman et al. [2013]	ASD	26, 30	Longitudinal	Interval	Focus of attention	Language	RQ1-2
Quigley and McNally [2013]	HR	5–12, 18	Longitudinal	Discrete	N/A	Language	RQ1-2
Talbot et al. [2015]	HR/ASD	9	Cross-sectional	Discrete	Focus of attention	Vocalization	–
Warlaumont et al. [2014]	ASD	36 (16–48)	Cross-sectional	Discrete	N/A	Int. Comm.	–
Woynaroski et al. [2016]	ASD	35 (20–48)	Longitudinal	Interval	Aggregate	Voc/language	RQ1-2
Yoder et al. [2015]	ASD	35 (20–48)	Longitudinal	Interval	Aggregate	Language	RQ1-2
Intervention Studies							
Baranek et al. [2015]	HR	15, 22, 32	Longitudinal	Global	Focus of attention	Language	RQ3
Brown and Woods [2015]	ASD	25, 31	Longitudinal	Discrete	Communication act	Int. Comm.	–
Brown and Woods [2016]	ASD	25, 31	Longitudinal	Discrete	Communication act	Int. Comm.	–
Carter et al. [2011]	ASD	21, 26, 30	Longitudinal	Interval	Both	Int. Comm.	RQ3
Green et al. [2010]	ASD	45 (24–60), 57	Longitudinal	Global	N/A	Language	RQ3
McDuffie et al. [2013]	ASD	42 (27–69), 45	Longitudinal	Interval	Both	Int. Comm.	–
Kasari et al. [2014]	HR	22, 25, 37	Longitudinal	Discrete	Focus of attention	Language	RQ3
Nunes, Araújo, Walter, Soares, and Mendonça [2016]	ASD	34, 40	Longitudinal	Global	N/A	Int. Comm.	–
Venker et al. [2011]	ASD	41 (28–68), 43	Longitudinal	Discrete	Both	Int. Comm.	RQ3

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The range is only presented if the mean is close to or greater than 36 months in order to demonstrate that at least some of the sample was younger than 36 months. Commas are used to separate measurement time points, if applicable. "N/A" is used in the "Type of PVR" column to denote studies with operationalization of PVR that do not fit the definitions of PVR to focus of attention or communication acts (i.e., are either coded globally or use another specific operational definition). Int. Comm., intentional communication.

Table 2.

Summary of Study Characteristics

	Number of included studies (%)	Number of included studies (%)
Risk/diagnostic status	HR children: 8 (32%)	Children with ASD: 17 (68%)
Procedural setting	Observational: 16 (64%)	Intervention: 9 (36%)
Temporal design	Longitudinal: 22 (88%)	Cross-sectional: 3 (12%)
Child communication variable type	Language: 13 (52%)	Language and vocalization: 11 (44%) [Vocalization: 1 (4%)]
Time of variable measurement	Concurrent: 8 (32%)	Predictive: 17 (68%) PVR █ CC: 13; CC █ PVR: 4
PVR coding scheme	Global: 6 (24%)	Specific: 19 (76%)
Type of PVR	To children's focus of attention: 6 (35%) Measured PVR to children's focus of attention and communication acts: 7 (41%)	To children's comm. acts: 4 (24%)

Notes. Global coding scheme: a single responsiveness rating was made after observing a several-minute interaction. Specific coding scheme: interval or discrete (interval: splitting an interaction into intervals and then judging the presence or absence of a responsiveness-related behavior within each interval; discrete: individually marking each instance within the interaction that a parent made a comment judged to be responsive to the child). Specific (but not global) coding schemes supported the coding of types of PVR. Two studies conducted specific coding of PVR but did not further describe the type of PVR used. CC, child communication.

Table 3.

Summary Characteristics for RCTs Identified by Systematic Review

Study	ASD diagnostic status	Intervention name	Intervention goals relevant to the review	Length of intervention	Effect on PVR?	Effect on child communication?
Baranek et al. [2015]	HR	Adapted responsive teaching (ART)	<ul style="list-style-type: none"> • Coach parents to Increase PVR • Included direct therapist intervention on child communication (among other pivotal skills) 	6 months	No	Yes
Kasari et al. [2014]	HR	Focused playtime intervention (FPI)	<ul style="list-style-type: none"> • Coach parents to Increase PVR and facilitate child communication (among other pivotal skills) 	3 months	Yes	No
Carter et al. [2011]	ASD	Hanen's more than words (MTW)	<ul style="list-style-type: none"> • Coach parents to Increase PVR and facilitate child communication (as well as social interaction) 	3.5 months	No	Yes (moderated by object interest at preintervention)
Venker et al. [2011]	ASD	Modified MTW	<ul style="list-style-type: none"> • Coach parents to Increase PVR and facilitate child communication (as well as social interaction) 	2.5 months	Yes: PVR-FA Marginal: PVR-CC	Yes: Vocalizations Marginal: Verbal communication
Green et al. [2010]	ASD	Preschool autism communication trial (PACT)	<ul style="list-style-type: none"> • Coach parents to increase child communication through PVR and other strategies 	12 months	Yes	No
McDuffie et al. [2013]	ASD	Naturalistic language intervention via desktop video conferencing (VTC)	<ul style="list-style-type: none"> • Coach parents to Increase PVR and facilitate child communication (among other pivotal skills) • Majority of sessions conducted In-home via VTC 	4 months	Yes	Yes

PVR-CC, parent verbal responsiveness to children's communication acts; PVR-FA, parent verbal responsiveness to children's focus of attention.