REVIEW ARTICLE

A Systematic Literature Review of Autism Research on Caregiver Talk

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Describing how caregivers' talk to their autistic children, and how their talk may influence social and language outcomes, has important implications for developmental theory and intervention research. In this systematic literature review, we examine 294 caregiver talk variables extracted from 65 studies, provide a narrative overview of research findings, and link measurement approaches to various theories of language development. The majority of variables included only talk directed to children (90%), and specified the speech act being performed (57%). More than one-third of variables measured talk that was responsive to children's attention, activities, or communication (38%), and slightly less than a third measured variables that elicited children's communication or engagement. Semantic aspects of talk were specified in 41% of variables, structural features were measured in 20% of variables, and suprasegmental features were measured in only 1% of variables. Talk quantity (without reference to other aspects of talk) was measured in 8% of variables. We found strong support that talk related to children's attention is implicated in autistic children's language development, but this construct has been measured inconsistently in terms of semantic, structural, and functional features. There is also evidence for bi-directional relationships between caregiver's talk and autistic children's development on a variety of semantic and structural variables. ***Autism Res*** *2020, 00: 1–18.* © 2020 International Society for Autism Research, Wiley Periodicals LLC.

Lay Summary: In our review, we found many differences in how researchers measured caregiver's talk, but also some promising leads. Researchers should continue examining caregiver talk related to children's focus of attention to clarify how this type of language contributes to autistic children's development. We also found interesting research on how children influence caregiver's talk, and encourage researchers to continue to study how this occurs.

Keywords: autism; caregiver talk; child-directed speech; follow-in talk; language; social-communication

Introduction

How caregivers talk to their children has been of interest to child development researchers for several decades [e.g., Baumwell, Tamis-LeMonda, & Bornstein, 1997; Borenstein & Tamis-LeMonda, 1989; Goodwin & Cekaite, 2018; Hoff & Naigles, 2002; Nelson, 1973]. As such, autism researchers have extended considerable efforts on this topic, in the context of both developmental and intervention research [e.g., Green et al., 2010; McDuffie & Yoder, 2010; Siller & Sigman, 2002]. Caregiver talk is a primary influence on children's language acquisition, and may be a particularly important resource for autistic[1] children. Caregiver talk can also structure and maintain interactions that impact a variety of developmental milestones, including social-communication, one of two core domains of autism (Bottema-Beutel, Yoder, Hochman, & Watson, 2014; Bottema-Beutel, Lloyd, et al., 2018; Bottema-Beutel, Malloy, et al., 2018; Siller & Sigman, 2002, 2008; Yoder, Watson, & Lambert, 2015). Given that autistic children often exhibit language delays, and some do not go on to develop flexible language in any modality [Tager-Flusberg & Kasari, 2013], the features of caregiver talk that are most influential for autistic children's language and social-communication development are of interest to discern. Describing the features of caregiver talk, and how it may differ between caregivers of autistic children and other populations is also of interest, because autistic children's caregivers may modify their talk in particular ways as a response to their children's social and language profiles [Nadig & Bang, 2017].

As early as the 1980s, intervention researchers have sought to modify how caregivers speak to their autistic children in an effort to positively influence autistic children's development [e.g., Harris, Wolchik, & Milch, 1982]. Because caregivers spend more time with

[1]We use "identity-first" language (e.g., "autistic children") as it is the preference of many autistic community members, and conveys that autism is not incompatible with personhood. See Bottema-Beutel, Kapp, Lester, Sasson, & Hand [2020] for a fuller rationale for this choice.

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their children than clinicians, coaching caregivers to talk to their children in particular ways is a promising intervention strategy [Sandbank et al., 2020b]. Recently, these interventions have focused on increasing caregiver talk that is responsive to children's behavior, and elicits their participation in interactions of increasing duration and complexity. A recent meta-analysis synthesized effects of interventions that trained caregivers to increase parent verbal responsiveness (PVR), a subcategory of caregiver talk that is related to children's focus of attention or previous communication [Edmunds, Kover, & Stone, 2019]. This study found that while intervention effects on PVR were significant, there were no significant downstream effects on autistic children. Currently, there are two well-designed randomized controlled trials (RCTs) showing caregiver's responsive communication mediated intervention effects on child outcomes; one conducted with autistic children [Pickles et al., 2015] and one conducted with infant siblings of autistic children [Watson et al., 2017]. However, because this research is sparse and not supported by meta-analyses, it is not yet certain that altering caregivers' talk positively influences autistic children's growth in language or other domains. Researchers may not have identified the features of caregiver talk that, when modified in the context of caregiver-mediated interventions, are most likely to influence autistic children's development.

Approaches to the Study of Caregiver Talk

There are numerous theoretical and analytical inroads to examining talk. Below, we summarize four broad approaches commonly drawn upon by developmental researchers, and discuss how they correspond to different ways of conceptualizing and operationalizing caregiver talk variables. These include information processing, transactional, speech act, and interactional approaches. These approaches are not mutually exclusive; many researchers draw from several of these frameworks simultaneously.

Information processing. Information processing approaches conceptualize caregiver talk as "input," which is processed in by children and transformed into "output" as children begin to use language [Behrens, 2006]. This line of research posits that caregivers who talk more to their children, use more complex utterances with more words per utterance, and use a greater variety of words as compared to other caregivers, will have children who also talk more, formulate more complex utterances, and use a greater variety of words [e.g., Bang & Nadig, 2015; Dunn, Brown, & Beardsall, 1991; Fusaroli, Weed, Fein, & Naigles, 2019; Hart & Risley, 1995]. Research using this approach has operationalized variables in terms of lexical size, word tokens, mean length of utterance (MLU), or grammatical complexity. Some researchers have also focused on aspects of talk or the interactive environments that render language more "processable" by children. This could include talk that is semantically associated with children's focus of attention, or that occurs within reciprocal engagement formats [Bakeman & Adamson, 1984; Bottema-Beutel et al., 2014; Crandall, McDaniel, Watson, & Yoder, 2019; McDuffie & Yoder, 2010]. The assumption is that processible talk provides linguistic input to the child but does not overtax cognitive resources, so that word-meaning associations can be efficiently encoded [Adamson, Bakeman, Deckner, & Romski, 2009; Bloom, Tinker, & Scholnick, 2001].

Transactional theories. Transactional theories of language development emphasize the mutual, bidirectional influences between caregiver and child. Children not only learn from caregiver's talk, but caregivers learn from their children to adjust their talk so that it aligns with their children's developmental level and interactional proclivities. These adaptations occur within an interaction, as caregivers tailor their talk to be relevant to their child's ongoing activities and interactional overtures, and over time, as caregivers and children mutually influence their communicative repertoires. PVR is a prominent example of this framework [Edmunds et al., 2019], more specifically referred to as "follow-in" talk (or sometimes "synchronous" talk; Siller & Sigman, 2002, 2008). Follow-in talk involves more linguistically competent interaction partners (caregivers) talking to their children about their children's current focus of attention [Bloom, 1993; Moore & Dunham, 1995; Tamis-LeMonda, Bornstein, & Baumwell, 2001]. Caregivers may also talk more slowly and with exaggerated affect to secure their children's attention and provoke a communicative response. These caregiver adaptations are thought to facilitate children's development.

Speech acts. A third approach comes from Speech Act theory, originated by J.L. Austin [1962] and later expanded by Searle [e.g., Searle & Vanderveken, 1985]. This work conceptualizes speech as having a performative dimension, in addition to a propositional dimension. That is, speech is not solely comprised of statements that are "true" or "false," it also performs various functions or "acts," such as directing, commenting, requesting, or protesting. While the initial theory was devised as a description of language and not of language development, researchers in developmental pragmatics adapted this work to describe how children develop communicative and linguistic competence [e.g., Bates, Camaioni, & Volterra, 1975; Bruner, 1975; Ochs & Schieffelin, 1979]. Children learn the performative/function-oriented nature

of talk both when caregivers direct speech acts toward them, and when caregivers interpret their communicative overtures (both speech and nonspeech) as imbued with functional ramifications. Some caregiver's speech acts, such as directives, are designed to elicit a response from an interaction partner. In contrast, comments offer descriptions of objects, people, events, and so forth.

Interactional approaches. In contrast to speech act theory, interactional approaches consider the interaction, and not the utterance, as the means through which social actions take shape. Interactional research traditions, such as linguistic anthropology, language socialization, and conversation analysis, analyze caregiver-child interactions in ways that extend beyond the word, clause, or utterance boundary [e.g., Goodwin & Cekaite, 2018; Schieffelin & Ochs, 1986]. They may focus on "stretches of talk," "encounters," and "speech events" to understand how caregivers and children collaborate through talk and other forms of communication to produce action trajectories embedded within culturally salient activities [see Ochs, Kremer-Sadlik, Sirota, and Solomon [2004], Sterponi, de Kirby, and Shankey [2015], and Solomon [2008] for notable examples of these approaches as applied to autism research]. Through interactions with caregivers, children learn not just meanings and functions of words and sentences, but the interactive potential of language, such as that questions entail answers [Forrester, 2013]. Further, children learn that interactional sequences can be expanded to collaboratively build action trajectories, such as persuading or constructing play narratives.

These approaches have offered important critiques to lines of inquiry such as "language gap" research, which purports the amount of talk children are exposed to is causally linked to a number of developmental milestones [see Avineri et al., 2015]. Language gap research uses blunt estimates of caregiver talk quantity [with some attention toward the quality and context talk, see Golinkoff, Hoff, Rowe, Tamis-Lemonda, & Hirsh-Pasek, 2019], without regard to what the talk is doing in the interaction in terms of the social actions it is designed to pursue, how it is sequentially organized around children's interactive moves, or the socio-cultural significance of a given interaction. Importantly, interactional research has shown that efforts to transform families' linguistic practices to be "optimal" for their children's language learning, without attending to the socio-cultural impacts of such transformations, may have counterproductive effects [Yu, 2016].

Purpose of this Review

The aims of this review are to expand on Edmunds et al.'[2019] important meta-analysis of PVR and Nadig and Bang's (2017) narrative review of caregiver talk by: (a) systematically reviewing findings related to all types of caregiver talk variables, (b) examining how caregiver talk variables are defined and measured, and (c) linking caregiver talk constructs to specific theoretical approaches to language and language development. In our "state of the science" review, we summarize research on caregiver talk employing a variety of study designs, including those examining across-group differences, within-group differences, concurrent and longitudinal associations with child outcomes, and intervention effects. This broad scope will allow us to identify areas of consensus, contradiction, and gaps in developmental and intervention literature, and ultimately suggest directions for future research.

Method

Search and Screening Procedures

Online databases including ERIC, Education Source, PsycINFO, Medline, Education Research Complete, and PubMed were initially searched in March of 2019 to identify relevant articles, using the following search terms: "Input*" OR "*Language respons**" OR "*Linguistic respons**" OR "*Verbal respons**" OR *Interact** OR *Talk** OR *Utterance** OR *Speech** OR "*Child-directed speech*" OR *Comment** OR *Directive** OR "*Follow-in*" OR *Motherese** OR *Synchron** AND *Parent** OR *Caregiver* OR *Mother* OR *Father* OR *Paternal* OR *Maternal* OR *Caretaker* AND *Autis**." We also reviewed references in Edmunds et al. [2019][2]. Finally, hand searches of *Autism* were conducted to locate online first articles, because the databases we used did not index these articles. After removing duplicates, Abstrackr was used to screen titles and abstracts of remaining articles. Inclusion criteria were that articles must: (a) be peer-reviewed, (b) be published between 1980–present, (c) be published in English, (d) measure some aspect of talk in caregivers of autistic children (using diagnostic criteria relevant to the time of publication), and (e) be group design studies quantitatively analyzing caregiver talk. Studies that included participants without autism diagnoses, did not separate parent talk from other communication modalities (e.g., gesture), utilized a single case design to measure changes in parent talk, or did not include direct measures of parent talk (e.g., if they included caregivers' reports about how they talked to their child) were excluded. We also excluded one intervention study that measured caregiver talk as a control variable, but did not hypothesize that it would change due to the intervention [Slaughter & Ong, 2014], and one study for which we were unable to locate a full text after multiple attempts

[2]Many studies that were included in Edmunds et al. [2019] did not meet our inclusion criteria, because the studies measured caregiver talk variables that did not clearly separate out caregiver talk from paralinguistic communication, and/or because they were conducted on infant sibling populations without restricting analyses to those later diagnosed with autism.

[Ramsay, Ghai, Kumareswaran, Edwards, & Bailey, 2019]. The search and selection process was repeated in August of 2020 to gather any articles published between our initial search and our submission of the study.

After initial screening, 250 full-text articles were reviewed and 65 were ultimately selected for inclusion. See Figure 1 for the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram documenting the search and screening process.

Coding Procedures

The second author extracted relevant information from each included study, including child and caregiver characteristics (sample size, mean age, gender, education level, and SES) and characteristics of the caregiver talk variables (variable names, definitions, measurement procedures, and quality indicators). Procedures were classified as either unstructured (no specific instructions given, and observations took place in the families' home), semistructured (observations with a standard set of toys, and caregivers instructed to play as the normally would), or structured (observed in a laboratory with a standardized set of toys, and caregivers are given "scripts" on how to engage the child), and as using either automated or human coding procedures. Information regarding reliability of coded data, and quality indicators for intervention studies was also collected [Higgins et al., 2011]. In

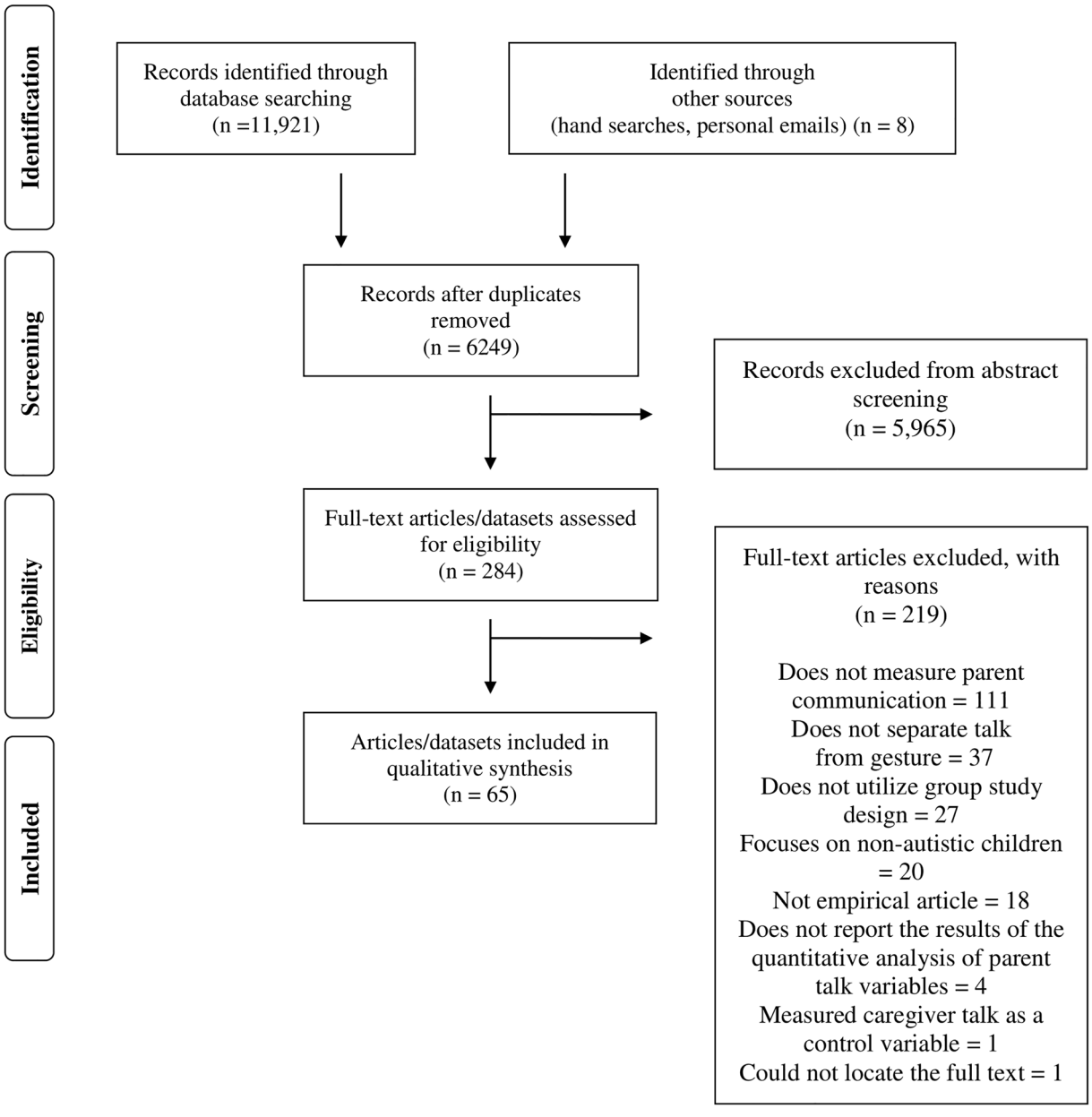

Figure 1. PRISMA (preferred reporting items for systematic reviews and meta-analyses).

instances where caregiver talk variables were associated with child outcomes, we recorded the child outcome and organized these by construct (e.g., expressive language, receptive language, vocabulary, etc.); we considered a detailed analysis of the child outcome measures to be beyond the scope of our review.

A final round of coding was conducted to capture the different ways caregiver talk variables were operationalized. To do this, a coding manual was developed inductively using a subset of the studies, which resulted in eight categories. Four characterized the talk itself, including: (a) suprasegmental, (b) structural/syntactic, (c) lexical/semantic, and (d) amount of talk, and four characterized the talk in relation to the child: (e) communicative function, (f) responsiveness, (g) elicitiveness, and (h) whether or not the talk was specifically addressed to the child (see Table 1 for definitions and examples). These categories were then coded as present or absent for each variable, and were not mutually exclusive. All coded data have been deposited in the Open Science Framework: https://osf.io/pcvw2/

Table 1. Definitions and Examples of Caregiver Talk Categories

Category	Definition	Examples
Structural/ syntactic	Measures of how words are put together to form an utterance, or the complexity of talk	Mean length of utterance (MLU), the presence of verb clauses
Supra-segmental	Measures of the features of talk that extend over syllables, words, or phrases, such as intonation, volume, stress, emphasis, and prosody	Parentese, affective talk
Semantic/ lexical	Measures of vocabulary or variables related to the meaning of words, phrases, or utterances	Vocabulary size, follow-in talk
Function	Classifications of what the utterance does in a social context, in terms of the purpose or effect it is meant to perform	Labels, questions, and comments, directives
Responsive	Measures of caregivers adjusting their talk to respond to the child's focus of attention, prior talk, or actions on toys	Follow-in talk, linguistic mapping, expansion, and repetition
Elicitiveness	Measures talk reflecting caregiver attempts to elicit children's engagement, which can be in the form of child talk, gestures, collaboration in play, and so on.	Directives, prompts for language
Amount of talk	Overall quantity of caregiver words, phrases, or utterances	Word tokens and number of utterances
Child-addressed	Indications of whether caregiver's talk is explicitly directed to the child (but not necessarily adapted in any specific way)	Follow-in talk and expansions

Results

In this section, we describe basic study features, demographic characteristics of participants, summarize features of the caregiver talk variables, and give an overview of study findings. In the discussion, we link our results to theories of language.

Eleven studies examined intervention effects, and the remaining 54 were combinations of correlational (concurrent and/or longitudinal), across-group difference, and within-group difference designs. Five of the 11 intervention studies were RCTs, and only one of these received "low" probability of bias ratings for all five scales relevant to intervention studies (i.e., sequence generation, allocation concealment, selective reporting, detection bias, and attrition bias). The median sample size for autistic participants was n = 24 (M = 31, range = 4–111). The grand mean age of autistic children and caregivers, weighted by sample size, was 48.1 months (range 6 months–11 years, 4 months) and 36.7 years (range 33–43 years), respectively. However, only 21 studies reported caregiver age, so this range is likely imprecise. The grand mean percentage of male participants (again weighted by sample size) was 83%. Of the 42 studies that provided information on caregiver education, 37 reported that half or more of the sample had attended at least some college.

We extracted 294 variables related to caregiver talk from the 65 included articles. Sixty-eight percent provided reliability information for coded caregiver talk variables, and reported acceptable ranges. One study coded variables from structured observation sessions, 56 from semistructured observation sessions (only one of these was conducted in the family's home), and eight from unstructured observation sessions conducted in families' homes. To derive variable scores, fifty-eight studies used human coders, and seven studies used automated software (e.g., LENA, CLAN, and CHAT). Three of the 58 studies that used human coders used automated software to derive transcripts, but human coders to apply the coding scheme to the transcripts.

The majority of variables considered only talk directed to children (90%), and specified the speech act being performed (57%). More than one third of variables measured talk that was responsive to children's attention, activities, or communication (38%), and just under one third measured talk that elicited children's communication or participation. Semantic aspects of talk were specified in 41%

of variables, structural features were coded in 20% of variables, and suprasegmental features were coded in only 1% of variables. Finally, the amount of talk was coded in 8% of variables. See Table 2 for total numbers of reports and variables coded for each category of caregiver talk.

Study Findings

Since most caregiver talk variables were coded for multiple categories, we grouped variables into five broad types that in some cases correspond to combinations of categories, rather than single categories, to avoid redundancy in summarizing study findings. These groups include variables specifying: caregivers' responses to children's attention, caregivers' responses to children's communication; speech acts; suprasegmental, structural/syntactic, and semantic features of talk; and amount of talk. We also provide a brief summary of relevant intervention research.

Responses to children's attention. The most frequently examined variable was follow-in talk, which accounted for 57 variables measured in 31 studies. There were several versions of this variable that varied in terms of semantic, grammatical, and speech act features, as well as the interactive context in which the talk occurred. For example, some coding procedures indicated that follow-in talk must contain semantic reference to the child's focus of attention (e.g., "thank you *for moving the truck*") while other procedures did not (e.g., "thank you"). Similarly, some coding procedures specified particular speech acts, such as comments or directives, while excluding speech acts such as affirmative tokens (e.g., "uh-huh") [McDuffie & Yoder, 2010]. Conversely, other researchers omitted directives from their conceptualization of synchronous utterances, with the assumption that directing the child to do something new is detrimental to children's engagement with caregivers [Siller & Sigman, 2002, 2008]. Two recent studies conducted by Crandall, Bottema-Beutel, McDaniel, and Watson [2019]; Crandall, McDaniel, et al. [2019] examined specific grammatical constructions (in this case verbs) within follow-in talk, and a few studies measured follow-in talk that occurred within a specific caregiver-child interaction format [e.g., Bottema-Beutel et al., 2019; Crandall, Bottema-Beutel, et al., 2019].

A handful of studies have examined group differences in the provision of follow-in talk. Parents of autistic children used fewer follow-in comments than parents of nonautistic children [Bottema-Beutel et al., 2018]. Parents of autistic children who were speaking used more follow-in comments than nonfollow-in comments, while parents of autistic children who were not speaking used follow-in and nonfollow-in comments with similar frequency [Strid, Heimann, & Tjus, 2013], and mothers used more follow-in talk than fathers [Flippin & Watson, 2015]. Finally, caregivers of autistic children were more likely to use follow-in talk after children's play with toys and after episodes of joint engagement than caregivers of nonautistic children [Bottema-Beutel, Lloyd, et al., 2018; Bottema-Beutel, Malloy, et al., 2018].

Longitudinal research has consistently shown that follow-in talk is predictive of autistic children's later language [Woynaroski et al., 2016; Yoder et al., 2015], and this has been shown for both directives [Haebig, McDuffie, & Weismer, 2013a, 2013b; McDuffie & Yoder, 2010] and comments (McDuffie & Yoder, 2010; Perryman et al., 2012; Rollins & Snow, 1998; Siller & Sigman, 2002, 2008). Importantly, Yoder et al. [2015] found follow-in talk predicted later language even when controlling for a variety of other empirically and theoretically motivated predictors. However, in two studies, follow-in comments were only significantly related to children's later receptive language for autistic children who were initially minimally verbal [Haebig et al., 2013a, 2013b]. Some studies have found that caregiver's follow-in talk provided when children reciprocally engage with toys, but do not look to the caregiver, is more predictive of autistic children's later language than follow-in talk provided during other forms of engagement [Bottema-Beutel et al., 2014; Bottema-Beutel et al., 2019; Crandall, Bottema-Beutel, et al., 2019]. Further, the importance of follow-in talk within reciprocal engagement appears more developmentally important for autistic as compared to nonautistic[3] children [Bottema-Beutel et al., 2019].

Findings from concurrent correlational research have been more mixed, but this may be because this research

Table 2. Number of Included Reports and Number of Variables Coded for Each Caregiver Talk Category

Caregiver Talk Variable Categories[a]	Number of Reports[b]	Number of Variables[c]
Structural/syntactic	18	60
Suprasegmental	3	4
Semantic/lexical	43	121
Function	48	169
Responsiveness	48	111
Elicitiveness	29	81
Amount of talk	17	23
Child-addressed	62	264

[a]Variable categories are not mutually exclusive.

[b]Reports refers to the number of published manuscripts that included each variable.

[c]Variables refers to the number of variables that operationalized caregiver talk; this number is larger than the number of reports because many reports included multiple variables.

[3]We use "nonautistic" instead of "typically developing" because the majority of comparison groups are not screened for all relevant neurodevelopmental conditions.

has examined associations between follow-in talk and a wider variety of variables in comparison to longitudinal research. Follow-in talk is concurrently correlated with cognitive constructs such as children's functional and symbolic play and visual reception, [Flippin & Watson, 2011, 2015], as well as measures of autism characteristics [Flippin & Watson, 2015; Hutman, Siller, & Sigman, 2009]. Similarly, some studies have found concurrent correlations between follow-in talk and child language variables, including expressive communication, auditory comprehension, and total language [Flippin & Watson, 2011, 2015]. Other studies, however, have found no concurrent correlations between follow-in talk and children's language [Hutman et al., 2009; Strid et al., 2013] or cognitive constructs such as nonverbal IQ and mental age [Strid et al., 2013].

Follow-in talk also appears to facilitate real-time engagement between caregivers and their autistic children. Walton and Ingersoll [2015] found that autistic children were more likely to speak after mothers used follow-in directives as compared to other types of follow in talk, and as compared to directives that did not follow-in to the child's focus of attention. In a series of studies using sequential analysis methods, Bottema-Beutel, Lloyd, et al. [2018]; Bottema-Beutel, Malloy, et al. [2018] found that caregivers' follow-in talk was more likely to be followed by joint engagement with their autistic children than talk that did not follow-in to the child's focus of attention. Further, follow-in directives were more likely to be followed by joint engagement than follow in comments [Bottema-Beutel, Lloyd, et al., 2018]. They also found that caregivers' follow-in talk was more likely to be followed by children's highest level of play than caregiver talk that did not follow-in to the child's focus of attention, and follow-in directives were more likely to be followed by children's play than follow-in comments [Bottema-Beutel, Malloy, et al., 2018].

Responses to children's communication. Twelve studies examined caregivers' responses to children's communicative overtures. One examined caregiver responses during dialogic book reading, and the remaining play-based studies included variables such as linguistic mapping (translating children's actions, gestures, or other communicative acts into words), expansions (repeating children's verbal communication with added words or clauses), repetition of children's talk, and responses that were temporally contingent with children's vocalizations.

Findings for these constructs have been mixed. One small study found that caregivers of autistic children with higher verbal abilities provided more language modeling (which included repetition, expansions, and corrections) than caregivers of autistic children with lower verbal abilities [Konstantareas, Zajdeman, Homatidis, & MeCabe, 1988], but a similar study failed to find group differences on this construct [Konstantareas, Mandel, & Homatidis, 1988]. In a reading context, caregivers of autistic children more often responded to children's errors than disfluencies [Arciuli et al., 2013]. Day-long recording technology was used by Warlaumont, Richards, Gilkerson, and Oller [2014] to examine caregivers' contingent responses to children's communication, and automated software was used to derive variable scores. They found that caregivers' responses to autistic children were less contingent on whether children's vocalizations were speech-like as compared to nonautistic children. Further, children's production of speech-like vocalizations was more likely to occur after their previous speech-like vocalizations received a response from caregivers, and this contingency was similar for autistic and nonautistic children.

In a second study using automated vocal analysis [Swanson et al., 2019], "conversational turn counts" (CTC) were measured by counting the number of times caregivers and children verbalized within 5 s of each other. CTC mediated the relationship between maternal education and children's later language development. However, this study combined infants later diagnosed with autism and infants who did not go on to receive a diagnosis. Some studies have shown longitudinal associations between linguistic mapping and autistic children's later language [Choi, Nelson, Rowe, & Tager-Flusgerg, 2020; Dimitrova, Özçalışkan, & Adamson, 2016; Haebig et al., 2013b], but these associations have not held up when potential confounding variables were taken into account [Haebig et al., 2013b], or when measured over a period shorter than 1 year [McDuffie & Yoder, 2010] or longer than 1 year [Haebig et al., 2013a]. However, Choi et al. [2020] found associations in the reverse direction. They coded instances where caregivers responded to semantic aspects of children's communication (e.g., after the child points to a toy, the caregiver says "you see the toy!"; a construct similar to linguistic mapping), and found that autistic children's language abilities predicted caregivers' later contingent responses in a model controlling for several parent and child factors.

Findings for expansions have been similarly mixed; associations with spoken vocabulary were evident over a 6 month time period and over 1 year [Haebig et al., 2013b; McDuffie & Yoder, 2010; Swensen, Naigles, & Fein, 2007], but not when controlling for other potential confounds or over a 3 year period [Haebig et al., 2013a, 2013b]. None of the included studies found that repeating children's words or word approximations were associated with children's later spoken language [Haebig et al., 2013a; McDuffie & Yoder, 2010].

Speech acts. As summarized above, follow-in literature shows both commenting and directive speech acts appear

to facilitate children's later language development, and follow-in directives facilitate real-time engagement and play with caregivers. In addition to this work, 20 studies examined variables related to the function of caregiver talk without specifying whether the talk followed-in to the child's focus of attention. The majority of these studies sought to identify group differences (e.g., between caregivers of autistic vs. nonautistic children) in the frequency of particular speech acts. The evidence in this literature is weaker in comparison to studies of follow-in talk, as it relies on much smaller sample sizes (as low as 6 participants per group, and a high of only 25 participants in an autism group). As such, many findings are contradictory. For example, several studies have found that caregivers of autistic children use more "elicitive" language (speech acts requiring a response, such as questions, prompts, directives, etc.) than caregivers of nonautistic children [Bottema-Beutel, Malloy, et al., 2018; Goldman & DeNigris, 2015; Pisula, 2008; Wolchik, 1983]. However, other studies have found the opposite pattern [Bentenuto, De Falco, & Venuti, 2016; Dossard-Roosevelt, Joe, Bazhenova, & Porges, 2003; Venuti, de Falco, Esposito, Zaninelli, & Bornstein, 2012], or that caregivers of autistic children with lower verbal abilities use fewer elicitive speech acts than caregivers of autistic children with higher verbal abilities [Adamson, Bakeman, & Brandon, 2015; Konstantareas, Zajdeman, & Homatidis, 1988].

Other types of speech acts designed to comment, demonstrate, reinforce, or respond to children's language have also been examined. Konstantareas, Zajdeman, et al. [1988] found mothers of speaking autistic children used more language modeling, language reinforcement, and answered more children's questions than caregivers of autistic children who were not using language. Caregivers of autistic children also labeled more objects, and gave more corrections as compared to caregivers of nonautistic children [Goldman & DeNigris, 2015], and gave more direct statements as compared to caregivers of nonautistic children and children with Down syndrome [Venuti et al., 2012]. However, other studies have found opposite trends. Caregivers of nonautistic children used more follow-in comments than caregivers of autistic children [Bottema-Beutel, Malloy, et al., 2018], and, in a storytelling context, caregivers of nonautistic children used more causal talk than caregivers of autistic children [Hutchins, Deraway, Prelock, & O'Neill, 2017]. Finally, in a small study comparing caregivers and siblings, caregivers provided more statements, questions, commands, play organizing, and attention getting language than siblings [El-Ghoroury & Romanczyk, 1999].

Other than follow-in talk literature, only a few studies examined correlations between caregivers' speech acts and child variables. In a book-reading context, caregivers' book related questions/prompts and explicit teaching were associated with children's concurrent language [Westerveld, Paynter, & Wicks, 2020], and questions/prompts were associated with children's visual attention within the session [Wicks, Paynter, & Westerveld, 2020]. Caregivers also used more clarification techniques if their autistic children had better social interaction skills, used more evocative strategies with children who had fewer behavior problems, and used more feedback strategies for children who scored lower on a pragmatic language assessment [Tipton, Blacher, & Eisenhower, 2017]. Similarly, in an experimental word learning study, caregiver prompting for a novel word increased odds the children would produce the novel word [Adamson et al., 2015]. However, Venuti et al. [2012] found no significant concurrent correlations between caregivers' functional language and children's MLU or total number of child utterances.

Suprasegmental, structural, and semantic features. Only three studies examined suprasegmental features of caregiver talk. In a study using automated analysis of home videos, Cohen et al. [2013] examined "parentese", characterized by heightened pitch, slowed tempo, and exaggerated intonation. They found that parentese facilitated autistic children's responses to the caregiver, was used more often by mothers than by fathers, and more often by caregivers of autistic children as compared to caregivers of nonautistic children. Similarly, in an experimental word learning context, caregivers of autistic children were more likely to draw attention to a novel word with prosody and pitch that expressed heightened affect than caregivers of nonautistic children [Adamson et al., 2015]. However, another study found no differences in talk with heightened affect between caregivers of autistic and nonautistic children [Venuti et al., 2012].

Fifteen studies have examined structural aspects of caregivers' talk (in addition to the three studies on expansions described above) including complexity, such as MLU and words per utterance, and syntactic features such as wh-question constructions, and the frequency of different syntactic categories. Caregivers' MLU was shown to be positively associated with autistic children's later MLUs [Choi et al., 2020; Fusaroli et al., 2019] and expressive vocabulary [Bang & Nadig, 2015; Fusaroli et al., 2019]. Further, children's earlier language abilities were correlated with caregivers' later MLUs, suggesting that these relationships are bidirectional [Fusaroli et al., 2019; Choi et al., 2019]. Caregiver's use of "telegraphic speech," characterized by short MLUs and the omission of noncontent words, was negatively correlated with autistic children's lexical diversity 1 year later, indicating that overly shortened MLUs could inhibit children's development (Venker et al., 2015; see also Sandbank & Yoder, 2016).

There is also evidence that syntactic elements of caregiver's talk are consequential for children's expressive and receptive language (albeit from studies with small sample sizes, ranging from $n = 10$ to $n = 38$). Barokova and Tager-Flusberg [2020] found concurrent, but not longitudinal correlations between caregivers' and children's personal pronoun use, and Crandall, McDaniel, et al.' [2019] found longitudinal correlations between the quantity, diversity, and grammatical informativeness of caregivers' follow-in verb constructions and children's later expressive verb vocabulary. Goodwin, Fein, and Naigles [2015] examined longitudinal associations between caregivers' wh- question constructions and autistic children's later question understanding. They found that caregivers' production of wh-question that masked wh-movement (which can be forms that are repeated often and subject to rote memorization such as "What's that?") was negatively correlated with autistic children's wh-question understanding 12 and 20 months later. Conversely, caregivers' use of wh-questions with verbs was positively correlated with autistic children's later question understanding. Similar to Crandall, McDaniel, et al. [2019] findings, this indicates more grammatically informative talk may facilitate autistic children's receptive language. Finally, Swensen et al. [2007] found positive longitudinal associations between caregivers' questions formatted as yes/no type questions and autistic children's later use of auxiliary verbs.

In terms of group-differences, caregivers of autistic children appear to provide talk with fewer noun and verb types than caregivers of nonautistic children, even though noun and verb tokens were similar across groups [Tabul-Lavey, Jokel, Leon-Attia, & Gabis, 2020]. Caregivers of children later diagnosed with autism produced shorter MLUs than caregivers of nonautistic children [Choi et al., 2020], and caregivers of autistic children with lower verbal abilities produced shorter MLUs than caregivers of children with higher verbal abilities [Konstantareas, Mandel, et al., 1988; Konstantareas, Zajdeman, et al., 1988]. Along these lines, one study found that caregivers of older autistic children who were already speaking produced longer utterances in a storytelling context than caregivers of nonautistic children [Hutchins et al., 2017]. This could have been because the caregivers of autistic children extended their turns at talk to continue to prompt responses from their children, who may have less readily taken their own turns at talk. Some studies have found few or no differences in structural language (e.g., MLU, verb use, and pronoun use) between caregivers of nonautistic children and caregivers of language-matched autistic children [e.g., Bang & Nadig, 2015; Goodwin et al., 2015; Swensen et al., 2007]. These studies used small sample sizes however, so may have been underpowered to detect group differences. Finally, a small study suggests mothers had shorter MLUs than fathers (Konstantareas, Mandel, et al., 1988).

A handful of studies have focused on semantic aspects of caregiver's talk, beyond research previously reviewed on follow-in utterances. Caregivers of autistic children used less causal talk, and used fewer desire (e.g., want, wish, and need) or cognitive (e.g., know, think, and believe) terms than caregivers of nonautistic children during storytelling [Hutchins et al., 2017]. In their experimental word learning study, Adamson et al. [2015] found that caregivers of autistic and nonautistic children used novel words to refer to a novel object to a similar degree. Likewise, caregivers of autistic and developmentally delayed children used language that referred to toys to a similar degree [Siller & Sigman, 2002].

Findings from studies examining correlations between semantic aspects of caregiver's talk and child outcomes have been mixed. In a small study, the number of different words caregivers used was not significantly associated with children's concurrent gesture production [Talbott, Nelson, & Tager-Flusberg, 2015]. In a storytelling context, caregivers' desire terms were negatively correlated with children's concurrent scores on a "theory of mind" (ToM) assessment, while children's ToM scores were positively correlated with caregiver's emotion [Hutchins et al., 2017], explanatory, causal, and contrastive talk about cognition [Slaughter, Peterson, & Mackintosh, 2007]. Two studies found no associations between caregivers' word types or lexical diversity and children's later expressive vocabulary [Bang & Nadig, 2015; Fusaroli et al., 2019]. However, children's MLU did predict the number of word types caregivers used at a subsequent assessment, again bringing needed attention to the effects autistic children's language has on their caregivers [Fusaroli et al., 2019].

Amount of talk. Seventeen studies examined the overall quantity of caregiver talk, measured by summing the total number of words, utterances, vocalizations, or turns at talk. Studies testing group differences have shown consistently null results; no studies reported differences on talk quantity between caregivers of autistic as compared to nonautistic children (Bang & Nadig, 2015; Cohen et al., 2013; Goldman & DeNigris, 2015; Hutchins et al., 2017; Schwichtenberg, Kellerman, Young, Miller, & Ozonoff, 2019; Tabul-Lavey et al., 2020; Watson, 1998; Wolchik & Harris, 1982), or between caregivers of autistic children with higher vs. lower verbal abilities (Konstantareas, Mandel, et al., 1988; Konstantareas, Zajdeman, et al., 1988). Two small studies compared mothers and fathers of autistic children, with one finding that mothers talked more than fathers (Wolchik, 1983) and the other failing to find a difference (Konstantareas, Mandel, et al., 1988).

Findings for correlational studies are similar in showing null associations with children's concurrent [Rollins & Snow, 1998] or longitudinal language development [Bang & Nadig, 2015; Fusaroli et al., 2019], or children's gesture production [Talbott et al., 2015]. However, one study examined the rate of caregiver's child-directed talk, and found concurrent correlations with autistic children's rate of talk in a free-play session (Kaale et al., 2018).

Intervention research. Eleven studies examined interventions that aimed to improve child outcomes by first influencing how caregivers talked to their autistic children. Three randomized control trials showed increases in caregivers' follow-in talk following intervention. In one RCT, Rahman et al. [2016] showed concomitant increases in autistic children's communicative initiations. In a small pilot study that trained parents to increase expansions and follow-in talk, autistic children increased in prompted communication [Venker, McDuffie, & Weismer, 2011]. While these results are promising, child gains were restricted to those measured in caregiver-child interaction sessions. Caregivers' involvement in measurement sessions assessing caregiver-mediated interventions is problematic, as caregivers may have learned interactional strategies that better elicit children's existing capabilities, but do not reflect actual child growth (see Sandbank et al., 2020a for a more detailed discussion of this issue). The third study did not demonstrate any effects on children's language [Siller, Hutman, & Sigman, 2013]. This evidence, coupled with Edmunds et al.' [2019] meta-analysis of PVR interventions which did not find significant summary effects on child outcomes, indicates the effectiveness of these interventions on child outcomes is unclear.

Eight intervention studies focused on influencing the functions of caregiver talk. Two small studies showed increases in elicitive talk (e.g., prompts and questions) and responses to children's speech attempts (e.g., praise, answers, and imitation) [Harris et al., 1982; Howlin & Rutter, 1989]. Howin and Rutter's (1989) small, within-subjects design study associated these changes with autistic children's improvement in nonecholalic speech in an observational assessment. Parent–child interaction therapy has been examined in multiple studies, which purports that training can decrease caregivers' use of some speech functions, including questions, commands, and criticisms, while increasing praise, reflection, and commenting (Elder et al., 2011; Ginn, Clionsky, Eyberg, Warner-Metzger, & Abner, 2017; Parladé et al., 2020; Ros & Graziano, 2019; Zlomke, Jeter, & Murphy, 2017; Scudder et al., 2019). However, only two studies [Ginn et al., 2017; Scudder et al., 2019] were RCTs, and downstream child gains were restricted to measures subject to detection bias (e.g., parent reports, which are especially problematic for caregiver mediated interventions). Another issue with this research is that caregivers' speech functions are measured using a standardized protocol and coding system developed on nonautistic children (the *Dyadic Parent–Child Interaction Coding System-IV*, Eyberg, Nelson, Ginn, Bhuiyan, & Boggs, 2013), and the construct validity of this instrument is not yet clear for autistic child-caregiver dyads [Zlomke, Bauman, & Edwards, 2019]. Similar to follow-in talk interventions, function-based interventions also seem to have unclear evidence of effectiveness.

Discussion

Research focusing on how caregivers talk to their autistic children has accumulated to a somewhat sizable body of literature. Before discussing the implications of our review, we mention three caveats. First, we focused on variables that exclusively measured caregiver talk, resulting in the exclusion of variables that combine caregiver talk with paralinguistic communication. Second, we conducted a narrative synthesis without statistically aggregating effect sizes, since one of our goals was to disaggregate nuances in the ways caregiver talk has been conceptualized and measured. This means we cannot offer definitive conclusions about this literature, in terms of significant associations with child variables, group differences, or intervention effects. Third, we restricted our studies to those published in English, resulting in the majority of included studies conducted on English-speaking participants. Below, we discuss issues pertaining to how caregiver talk constructs have been measured and operationalized, and how findings align with different theoretical orientations to language and language development.

Measurement Procedures

Caregiver talk has primarily been examined in the context of semistructured, caregiver-child play sessions paired with human coding procedures. Semistructured formats allow for stable estimation of variables (see Bottema-Beutel et al., 2019) while still enabling interaction formats that are at least correlated with how families might interact outside the lab. Human coders can capture a wide range of talk features, including the function, activity context, and specific grammatical or semantic aspects. However, these procedures can be time consuming and costly to implement for studies with large sample sizes.

Newer technologies permit day-long, prospective audio recordings in families' homes, allowing for data collection across a range of family activities. This could lead to improved ecological validity in conceptualizing and

measuring caregiver talk. However, these high-volume data collection methods are usually restricted to audio recordings, and are paired with automated analyses techniques (e.g., LENA and Computerized Language Analysis). This software can quickly and accurately measure constructs such as grammatical complexity, latency between utterances, and total word tokens (although some of these indices require costly software). While there have been attempts to use automated analyses to analyze conversational aspects of talk (e.g., conversational turns), computing temporal contingencies between speaker's vocalizations has not yet been validated as an adequate measure of this construct. For example, one issue with this work is the between-turn latencies used to classify caregivers' talk as a response to children's vocalizations; one study used 5-s [Swanson et al., 2019], and another study used 1-s [Warlaumont et al., 2014]. These latencies are not based on empirical observations of caregiver-child interactions, and are likely much too long. For both adult-adult and adult-child interactions, between-turn latencies are on the order of milliseconds, not seconds [Casillas, Bobb, & Clark, 2016; Stivers et al., 2009]. Further, these procedures leave many aspects of talk unanalyzed, including meaning-, activity-, and action-oriented (i.e., what speakers are doing with their talk) dimensions. Given these limitations, automated audio analyses should supplement rather than replace human coding procedures for many aspects of caregiver talk that are critical to understanding autistic children's development.

Variations in Operationalizing Variables

We found some variation in the extent to which researchers relied on an empirical and/or theoretical tradition in operationalizing caregiver talk variables. Some researchers were very explicit about theory-variable connections [e.g., Rollins & Snow, 1998], while other groups relied less on prior empirical or theoretical work, which led to "clunky" variables that combined seemingly disparate categories that we found difficult to disentangle.

For follow-in talk, there is disagreement as to which speech acts should be considered follow-in talk; comments only, or comments and directives (sometimes referred to as "demanding" talk). We did not find any empirical justification for excluding directives from this construct, as there is evidence of longitudinal associations between follow-in directives and autistic children's later language, and no evidence that follow-in comments are more strongly associated with later language than follow-in directives. Additionally, follow-in directives appear to better facilitate children's play and engagement with the caregiver than follow-in comments. According to speech act taxonomy, directives commit the interaction partner to some course of action [Searle & Vanderveken, 1985]. While young children may not yet fully understand the referential content of directives, they may understand the "force" of the utterance (i.e., the intended effects on the listener), which can be conveyed through suprasegmental aspects such as prosody and intonation. Indeed, 3 year-old nonautistic children use prosody to understand turn-taking aspects of conversation [Keitel, Prinz, Friderici, Hofsten, & Daum, 2013]. Follow-in directives may therefore encourage autistic children's participation in interactions with their caregivers, and enable longer and more complex engagement even if they are still in early phases of language learning [Bottema-Beutel, Lloyd, et al., 2018].

Likewise, none of the studies we reviewed provided empirical support for the requirement that caregiver talk be *semantically* related to children's attention or communication in order to support autistic children's language development. Theoretically, follow-in talk that is semantically related with children's focus of attention or communication would support the child in making word-meaning connections, which could be necessary for vocabulary growth. However, follow-in talk may be important for other dimensions of language learning as well, such as supporting children's engagement in reciprocal interactions, and socializing children into the back-and-forth nature of conversational turn taking. For these latter two functions, semantic connections between caregiver's words and the immediate environment may not be necessary.

Apart from follow-in research, which tended to focus only on comments and directives, taxonomies for speech acts varied considerably across studies, with no two research groups using the same categories. Broadly speaking, most studies coded a combination of functions including responding to children's communication (e.g., answers), commenting on the interaction or environment, and prompting children's communication or engagement in interaction (e.g., "elicitive" functions). Nearly one third of variables were defined as caregiver talk designed to be elicitive. However, it is important to note that only three studies, two of which shared a participant sample, examined whether caregiver talk designed to elicit children's engagement actually resulted in children's participation in the interaction. All three found that follow-in directives were more likely to be followed by children's engagement, play, or communication with caregivers than other speech acts.

Structural and semantic aspects of caregivers' talk have been measured more consistently than follow-in talk or speech acts, likely due to availability of automated software and standardized instruments used to generate scores for these variables. While consistency in the ways that language structure and semantics have been conceptualized is a strength of this literature, there are a variety of structural and semantic aspects of language

that have not yet been addressed in this research (e.g., syntactic variation for constructions other than questions). Suprasegmental features are currently underexplored, but there are software technologies available for automated analyses of talk features such as prosody and pitch.

Relationships to Theories of Language

Information processing. We now have replicated evidence of positive correlations between various features of caregiver talk, and features of autistic children's developing communicative competence. Interestingly, research has consistently shown that raw amounts of caregiver talk (that does not account for features such as complexity or the extent to which it is related to what the child is doing) is not associated with autistic children's language. An interpretation of this finding is that caregiver talk should not be construed as de-contextualized input that children simply take in and transform into their own language abilities. Rather, caregiver talk that is directed to children, appropriate to their developmental level, relevant to their attentional focus, and provided within a reciprocal interaction format, may be most "proccessible" and therefore more facilitative of development [Adamson et al., 2009; Bottema-Beutel et al., 2014; Golinkoff et al., 2019; Naigles, 2017; Tamis-LeMonda, Custode, Kuchirko, Escobar, & Lo, 2019; Yoder et al., 2015]. In our view, the aspects of language this theory is able to explain extends to semantic and structural elements of language; there is no explanation for what children *do* with the vocabulary and language syntax skills they develop, in terms of the social interactions or activities in which they engage (see Avineri et al., 2015 for a similar viewpoint).

Transactional theories. Several studies have shown bidirectional effects between features of caregivers' talk (e.g., MLU, responsivity) and children's communication, both over time [Choi et al., 2020; Fusaroli et al., 2019], and within interactions [Bottema-Beutel, Lloyd, et al., 2018; Warlaumont et al., 2014]. This supports transactional theories of language development positing mutual influences between child and caregiver, and suggests that transactional effects operate on multiple timescales. To be sure, there is more evidence for associations between early caregiver talk and later child variables as compared to the reverse direction. Additional research delineating the influence autistic children have on their caregivers' talk would help clarify the boundaries of transactional effects. Given available evidence however, it does seem that caregivers of autistic children make a variety of adjustments to their talk so that it matches their children's developmental level and interaction style.

Initially, transactional theories highlighted the "situatedness" of language and language development, noting that the context in which language is used is crucial for children's developing abilities to make meaning from talk [Bruner, 1983; Vygotsky, 1978]. Because the majority of the data we reviewed was collected in the context of caregiver-child play sessions (e.g., snack time or story time, with day-long recordings being exceptions), the influence of context has essentially been controlled for. That is, the extent to which social context influences how caregivers and children co-construct linguistic interactions, and the meanings these interactions entail, is not readily apparent if the study of talk is constrained to a single activity context. Observational work (both qualitative and quantitative) across a range of activity and discourse contexts could offer new directions for understanding the mutual influences between caregivers and children (see Goodwin & Cekaite, 2018 and Tamis-LeMonda et al., 2019 for examples).

Speech acts. Findings from research on caregiver's talk functions have been too inconsistent to draw useful conclusions. A lack of consistent taxonomies, definitions, and coding procedures likely accounts for some of this variation. Another issue could be that coding communicative functions at the utterance level is simply not feasible beyond a few broad categories (e.g., comments and directives), that are restricted to specific contexts (e.g., caregiver-child play). In our own work, we have found that as children become more involved in communicative interactions with caregivers, demarcating utterance boundaries and assigning single functions to each utterance becomes more difficult. Additionally, similarly categorized speech acts at the utterance level can perform actions with subtle but important differences depending on the activity context. For example, when caregivers use directives during play, they tend to function as suggestions for what the child might do with the toys. Caregivers do not generally insist the child follow through on the directive, or sanction the child for doing something other than what the caregiver suggested. The ensuing play interactions are therefore collaborative, and not really "directed" by the caregiver. In contrast, during family routines such as dressing or bed time, caregivers give directives with the expectation that they will be fulfilled, and will provide continued prompts or even negative consequences until the requested action is completed [Goodwin & Cekaite, 2018]. Similarly, caregivers' use of known-answer questions (a common form of talk used by caregivers of children with communication impairments) can result in interactions that range from playful and creative, to constraining and pedagogical [Bottema-Beutel, Oliveira, et al., 2020; Sterponi & Fasulo, 2010].

We should note that initial uses of speech act coding in developmental research included the "interchange" level, which referred to speakers' orientations to the interactive project underway across stretches of talk (e.g., negotiations and social rituals), in addition to the utterance level [Ninio, Snow, Pan, & Rollins, 1994; Rollins & Snow, 1998]. This follows from updated theories of language-as-action, which reject initial claims from speech act proponents that language functions are ascribable to single utterances; actions implemented through talk are distributed across speakers and extend over multiple turns at talk [Schegloff, 1982]. However, none of the studies we examined included this level of coding.

Interactional theories. Because the vast majority of quantitative research on caregiver talk has operationalized talk at the word, clause, or utterance level, there is little information about the specific social actions (e.g., negotiating, collaborating, resisting) that are organized through caregivers' talk, and the specific ways that caregiver talk is implicated in the manifestation of different social actions. While there are observational coding procedures that capture some global features of caregiver-child interactions [e.g., Adamson et al., 2009; Bottema-Beutel et al., 2014] many of these procedures do not specifically focus on caregiver's talk, do not provide a micro-analytic accounting of each interaction partner's role in formulating an interactional trajectory, and are not designed to describe how caregivers and children collaborate to produce a variety of social actions. In order to incorporate interactional theories into research on caregivers' talk to their autistic children, procedures will need to be developed that are both micro-analytic (to examine how caregivers' talk influences the unfolding of an interaction), and able to characterize interactions across multiple turns at talk (to understand the larger social actions underway). Further, additional observational work with families in everyday scenarios will be needed to understand how activity contexts influence how talk is used and understood by caregivers and children within interactions.

Conclusion

Research on caregiver talk has yielded valuable insights into how autistic children learn from their linguistic interactions with caregivers, and suggests that many caregivers adapt their talk to reflect their children's developmental level and interactional preferences. We do not yet have robust experimental evidence (i.e., beyond a single well-designed RCT) that changing caregiver's talk will positively influence autistic children's development. Because of the cultural and interpersonal significance of families' linguistic routines, practitioners should exercise caution when giving caregivers advice about how to alter their language practices. This is especially important given that recent research suggests caregiver talk linked to previous clinical advice is negatively associated with autistic children's development (e.g., using telegraphic speech, Sandbank & Yoder, 2016; Venker et al., 2015], and can be detrimental to children's participation when incorporated into family routines (e.g., speaking only English in bilingual households, Yu, 2013, 2016]. Given the findings of our review, we close with the following eight suggestions for future research:

a. Improve the quality of both foundational and intervention research, such as by increasing sample sizes, utilizing RCTs, and clearly indicating how caregiver talk constructs are linked to linguistic theories.
b. Build consensus around what constitutes follow-in talk, and the features of this talk that facilitate children's development. This could mean comparing different forms of follow-in talk (e.g., semantically related vs. not semantically related) to determine which forms are associated with which aspects of children's language and social-communication outcomes.
c. Conduct additional research to understand the kinds of caregiver talk that encourages autistic children to engage in complex, reciprocal interactions with caregivers. This will be especially important for improving intervention research aiming to support autistic children via adjustments in caregiver talk.
d. Develop measurement approaches so that the social actions (beyond the utterance) implemented through caregivers' talk can be analyzed quantitatively. This could mean working with researchers who traditionally conduct this research using qualitative methods, to design construct-valid quantitative measurement procedures. Additionally, rating scales could be developed and validated to analyze qualitative features of caregiver talk [e.g., Adamson, Bakeman, Deckner, & Nelson, 2012].
e. Pair automated methods with micro-analytic human coding, to understand how structural, suprasegmental, and semantic features of caregivers' talk are recruited by autistic children, how they influence interactions, and ultimately how they influence autistic children's development.
f. Devote resources to understanding how caregivers' syntactic diversity, complexity, and use of specific syntactic structures influence autistic children's expressive and receptive language. This should include conducting hypothesis driven analyses, in the context of sufficiently powered studies.
g. Consider the role of contextual, child, and caregiver characteristics on the features of caregiver talk, and associations between caregiver talk and autistic children's outcomes. This means that researchers will need to apply these methods to a wider range of family

activity contexts, and with participants with more diverse demographics, including those from a variety of socio-economic and linguistic backgrounds (including non-English speaking, bilingual, and multilingual families). Additionally, researchers should distinguish between fathers' and mothers' talk. Child characteristics such as gender, cognitive abilities, sensory characteristics, and initial expressive and receptive language levels could be further examined as potential moderators of associations between caregiver talk variables and child outcomes, and as moderators of intervention effects (see Haebig et al., 2013a, 2013b; Kinard et al., 2017).

h. Conduct research that systematically explores which aspects of caregiver talk are associated with specific domains of autistic children's development. This line of research should also systematically explore the extent to which caregiver talk constructs are associated with specific measures of child outcomes (e.g., standardized tests vs. spontaneous speech samples).

Conflict of Interest

Kristen Bottema-Beutel has received grant funding for research on follow-in talk, one of the types of caregiver talk examined in this review.

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