

Research Article

The Relation Between Early Parent Verb Input and Later Expressive Verb Vocabulary in Children With Autism Spectrum Disorder

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Purpose: The purpose of this study was to evaluate if higher quantity, diversity, and grammatical informativeness of verb phrases in parent follow-in utterances (i.e., utterances that mapped onto child attentional leads) were significantly related to later expressive verb vocabulary in children with autism spectrum disorder (ASD).

Method: We examined these associations in a sample of 31 toddlers with ASD and their parents in a longitudinal correlational study. Key aspects of parents' verb input were measured in 2 video-recorded 15-min parent-child free-play sessions. Child expressive verb vocabulary was measured using parent report.

Results: An aggregate variable composed of the quantity, diversity, and grammatical informativeness of parent verb input in follow-in utterances across the 2 parent-child sessions strongly and positively predicted later child expressive verb vocabulary, total $R^2 = .25$, even when early child expressive verb vocabulary was controlled, R^2 change = .17. Parent follow-in utterances without verbs were not significantly related to later child expressive verb vocabulary, $R^2 = .001$.

Conclusions: These correlational findings are initial steps toward developing a knowledge base for how strong verb vocabulary skills might be facilitated in children with ASD.

The development of spoken language by the end of the preschool years has been repeatedly identified as an important predictor of long-term adaptive outcomes in individuals with autism spectrum disorder (ASD; Howlin, Goode, Hutton, & Rutter, 2004; Tager-Flusberg et al., 2009). Although much attention has been given to pragmatic language development in this population, less attention has been given to the development of grammatical structures (Eigsti, Bennetto, & Dadlani, 2007). Among other aspects of grammar, this domain of language development includes grammatical categories, such as verbs (Eigsti et al., 2007).

A strong verb vocabulary is central to building efficient, grammatical sentences. Verbs facilitate communication

about the relation between objects and event structures (Brandone, Pence, Golinkoff, & Hirsh-Pasek, 2007). Verbs also allow for the formation of early simple sentences (Brandone et al., 2007). At least in children with typical development, early verb lexical diversity has been found to be a better predictor of later grammatical outcomes than early noun diversity (Hadley, Rispoli, & Hsu, 2016). Furthermore, having a limited verb vocabulary at 2 years of age has been considered a sign of a potential language disorder (Hadley et al., 2016; Olswang, Rodriguez, & Timler, 1998; Paul & Norbury, 2012; Reed, 2012). Because developing generative, grammatically correct language is a critical goal for children with ASD and because verbs are central to grammatical development, devoting attention to how verb learning might be facilitated in those with ASD is clearly warranted.

Verb Acquisition in Children With ASD

Verbs in general may be inherently more difficult to learn than nouns, even for children with typical development. Verbs tend to emerge later in children's vocabularies than nouns and to comprise a smaller proportion of total vocabulary (Bates et al., 1994; Hsu, Hadley, & Rispoli, 2017; Nelson, 1973). Potentially challenging characteristics of verbs include the weight of grammatical information they

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carry (e.g., person, number, and argument structure) and their often transient or abstract referents (Golinkoff & Hirsh-Pasek, 2006; Johnson & De Villiers, 2009; Tomasello & Kruger, 1992).

For children with ASD, there might be further challenges associated with verb learning. Investigators have found significantly flatter individual growth curves of number and proportion of verb tokens produced for young children with ASD compared to children with typical development matched for expressive language (Tek, Mesite, Fein, & Naigles, 2014). One reason this may be the case is that children with ASD tend to demonstrate “sticky” attention (i.e., difficulties in shifting attention from one visual stimulus to another; Hood & Atkinson, 1993; Landry & Bryson, 2004). The relational quality of verbs, the transient nature of their referents, and the degree of inferencing that is often involved with identifying the meaning of a novel verb all potentially heighten the importance of interactional supports (Golinkoff & Hirsh-Pasek, 2008). For example, the speaker’s attentional focus and the apparent intent of the speaker might help narrow down the potential meaning of a novel verb (e.g., Brandone et al., 2007), but these important cues might be missed by a child with ASD due to sticky attention.

Facilitating Verb Acquisition

A natural starting place for informing verb instruction for children with ASD is identifying aspects of adult input that predict individual differences in verb vocabulary development. The extant literature suggests that the referent of adult input (i.e., *what* the adult talks about) and *how* adult input is crafted might be important factors to consider as predictors of children’s verb vocabulary development.

The Importance of Follow-In Utterances

Input presented in episodes of joint attention maps onto the child and adult’s shared attentional focus. These utterances are called *follow-in utterances*. At least in children with typical development, a relation between follow-in utterances and vocabulary learning has been found specifically for verbs. In a sample of 1-year-old children with typical development, adult verb input presented in follow-in utterances was positively related to later child verb vocabulary; verb input presented outside the follow-in utterances was negatively related to child verb vocabulary (Tomasello & Kruger, 1992).

Because children with ASD often have difficulties with shifting attention, follow-in utterances are probably important contexts for lexical input (e.g., Dube, MacDonald, Mansfield, Holcomb, & Ahearn, 2004; McDuffie, Lieberman, & Yoder, 2012; Siller & Sigman, 2002, 2008). In a sample of initially preverbal children with ASD, parents’ use of follow-in utterances was found to be predictive of later child language outcomes even after controlling for eight other known predictors of early language (Yoder, Watson, & Lambert, 2015). McDuffie and Yoder (2010) likewise found that parent follow-in utterances were more strongly associated

with child vocabulary size than other types of parent utterances. When adults use follow-in utterances, the burden to read the speaker’s attentional focus is lifted, reducing the difficulty associated with extrapolating the meaning of a new word.

Because of the importance of follow-in utterances for children with ASD and existing evidence that follow-in utterances are specifically important for verb learning in children with typical development, it is reasonable to assume follow-in utterances are a good place to begin when looking at additional components of input that might facilitate verb acquisition in children with ASD. However, even when considering verb input within follow-in utterances, we must decide which aspects of verb input to examine.

Potentially Important Facets of Verb Input in Follow-In Utterances

In the typical development literature, there is strong theory, but equivocal evidence, that *quantity* of parent verb input might predict later child verb vocabulary. It may seem obvious that quantity of verb input should relate to later child verb vocabulary because children who hear verbs frequently are exposed to a relatively large number of opportunities to process the input and associate the verbs with their referents. On one hand, Naigles and Hoff-Ginsberg (1998) found that early quantity of parent use of a specific set of tracked verbs significantly predicted later child use of those same verbs. However, on the other hand, Hsu et al. (2017) found that quantity of verb input was not related to later child verb vocabulary in children with typical development, suggesting that other aspects of verb input may influence child verb vocabulary development (see below). The relation between quantity of verb input and child verb vocabulary has not been evaluated in the ASD population.

In children with typical development, there is consistent evidence that *diversity* of verb input predicts later child verb vocabulary. For example, diversity of parent verb input has been shown to be a stronger predictor of later child verb vocabulary than quantity of linguistic input (Hsu et al., 2017). The motivating theory behind the diversity hypothesis is that providing many different examples of verbs affords children with many different opportunities to learn new verbs. Furthermore, child verb vocabulary size might be maximized by providing many different low-frequency but meaning-specific verbs, such as those that describe specific manners or paths of action, rather than a smaller set of all-purpose verbs (e.g., “play with the ball” vs. “bounce the ball”; Hsu et al., 2017). By providing diverse verb input, adults might also highlight how different verbs can be used to describe the same action event, spurring opportunities for increasing the diversity, and thus size of child verb vocabulary. Samples of parent–child interactions that yield estimates of diversity of parent verb input capture a parent’s generalized tendency to use many different verbs when talking to their child. Like quantity of verb input, the association between the diversity of verb input and later child verb vocabulary still needs to be examined in children with ASD.

In the extant literature for children with ASD and with typical development, there is reason to believe that *grammatically informative* verb input might be more strongly related to child verb acquisition than verb input presented without grammatical context. Grammatical information included in input might provide important clues to early language learners that unknown words are verbs and help to narrow down potential meanings of those verbs (Golinkoff & Hirsh-Pasek, 2008). Verb-related morphosyntactic elements that might be grammatically informative include tense markers and auxiliary verbs, as well as adverbs and prepositional phrases. A more extensive list of these elements that were of particular interest in this study can be found in the Appendix. Evidence suggests that verb-related morphosyntactic elements in grammatically complete adult input facilitate language learning in children with typical development (e.g., Arunachalam & Waxman, 2011; Fernald & Hurtado, 2006; Hoff & Naigles, 2002; Huttenlocher, Vasilyeva, Cymerman, & Levine, 2002; Kedar, Casasola, & Lust, 2006; Lany & Saffran, 2010; Mintz, 2003; Mintz, Newport, & Bever, 2002; Syrett, Arunachalam, & Waxman, 2014) and in at least some children with ASD (Mayo & Eigsti, 2012; Naigles, Kelty, Jaffery, & Fein, 2011; Shulman & Guberman, 2007; Venker et al., 2015). Indeed, one study specifically found that omission of grammatical information in adult input was associated with poorer language outcomes for children with ASD (Venker et al., 2015).

Much of the research on grammatical informativeness conducted with children with ASD has been couched within the debate concerning whether grammaticality should be preserved in simplified input provided to children with ASD (i.e., if telegraphic or grammatical speech should be used; see van Kleeck et al., 2010, for a review of the debate). More attention to the importance of this debate and the relevance of this study to the debate will be given in the Discussion section.

Purpose

Our primary research question was “Does frequent use of diverse and grammatically informative verb phrases in follow-in utterances predict later child expressive verb vocabulary?” We restricted our analysis to parent follow-in utterances based on prior evidence that follow-in utterances are a strong predictor of language outcomes among children with ASD, as summarized in the introduction. A common, trivial explanation for results of studies evaluating relations between input and child language is that variation in early measures of the child’s language elicit variation in input and are stable over time (Yoder & Kaiser, 1989). To rule out this alternative explanation, we also asked, “Does frequent use of diverse and grammatically informative verb phrases in follow-in utterances predict later child expressive verb vocabulary even after controlling for early child expressive verb vocabulary?” We consider the analyses testing these predictions as exploratory because the data are from an extant data set and the study of verb input to children with ASD is in its beginning stages.

Rationale for Examining Key Aspects of Verb Input as an Aggregate

We chose to aggregate quantity, diversity, and grammatical informativeness of parent verb input into one parent input variable for these research questions. Four reasons for aggregating these components exist. First, the lack of extant evidence speaking to the relative benefits of these components for children in general suggests that the evidence base is not yet mature enough to test these components individually for children with ASD. Second, they may operate in a synergistic manner rather than having separable effects on verb acquisition. Third, they may be highly intercorrelated (i.e., parents who use many different verbs might also use verbs frequently and use those verbs in grammatically informative utterances). In at least one study measuring both diversity and quantity of parent verb input, these two variables were highly intercorrelated (Pearson’s r of .65; Hsu et al., 2017). High intercorrelation among the three verb input variables means that the relative contribution of each is not possible to untangle in nonexperimental research designs. Creating an aggregate represents this reality. A fourth argument for using an aggregate is that it minimizes the number of significance tests when testing the value-added prediction of later verb vocabulary controlling for early verb vocabulary, thereby reducing the probability of detecting sample-specific findings while retaining statistical power in relatively small samples.

Method

Participants

Participants were selected from a larger data set of children who had participated in a longitudinal study evaluating acquisition of useful speech in children with ASD ages 24–48 months at study entry (Yoder et al., 2015). Participants’ ASD diagnoses were based on criteria in the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision (American Psychiatric Association, 2000). These diagnoses were confirmed at study entry by licensed clinicians or research-reliable assessors using the Autism Diagnostic Observation Schedule (Lord et al., 2000; Gotham, Risi, Pickles, & Lord, 2007). To increase the probability that participants in our sample would have at least some verbs in their expressive vocabulary at the final measurement point, we selected participants with a parent report of at least 50 total words said on the MacArthur–Bates Communicative Development Inventories (MCDI; Fenson et al., 2007) Words and Gestures form at the final measurement point. To minimize missing data for the parent input variable, we further selected participants with existing data for at least one of two parent–child free-play observations used to extract input variables. As a result, 31 participants were identified for this study. Table 1 provides descriptive information for these participants and their parents.

Table 1. Means and standard deviations of descriptive variables at study entry.

Variable	<i>M</i>	<i>SD</i>
Chronological age (months)	38.83	7.34
MCDI Number of Words Understood	138.86	102.60
MCDI Number of Words Said	25.72	22.32
Parent formal education	Some college	-1 <i>SD</i> = high school graduate, +1 <i>SD</i> = college graduate

Note. MCDI = MacArthur–Bates Communicative Development Inventories Words and Gestures form.

Design

This study used a longitudinal correlational design. Four measurement points were taken from the larger study. Each time point was separated by 4 months, spanning 12 months in total. Participants were, on average, 38.83 months old (*SD* = 7.34 months) at Time 1, 42.55 months old (*SD* = 7.28 months) at Time 2, 46.71 months old (*SD* = 7.22 months) at Time 3, and 50.61 months old (*SD* = 7.37 months) at Time 4.

Measures

Overview of Measures

Fifteen-minute parent–child free-play sessions were recorded at Times 1 and 3 and used to extract parent input variables. MCDI reports taken at Times 2 and 4 were used to estimate child expressive verb vocabulary (Fenson et al., 2007). See Table 2 for descriptive statistics for the variables at these periods.

Child Expressive Verb Vocabulary

Measures of expressive verb vocabulary were obtained from the participants' MCDIs (Fenson et al., 2007). The MCDI is a parent report vocabulary checklist. These reports were taken at Times 2 and 4. The total number of words said as reported in the action word section of the MCDI was used to estimate total expressive verb vocabulary size.

Parent Verb Input Variables

Fifteen-minute parent–child free-play sessions were video-recorded and later coded to estimate parent verb input variables. A standard set of toys was provided. Parents were instructed to play with their children as they normally would at home. These sessions were obtained at Times 1 and 3.

During the larger study's primary data collection period, videos were coded for parent follow-in utterances with a 5-s partial interval behavior sampling method using ProCoder Software (Tapp & Walden, 1993). An interval was considered codable if the child and adult were both visible and the child was not engaging in behavior that required redirection or behavior modification (e.g., opening a mother's diaper bag) or soothing (e.g., crying uncontrollably). A follow-in utterance for this coding scheme was defined as a parent utterance that named the object the child was attending to or the action the child was doing immediately prior to the parent utterance.

Quantity. Each interval with a follow-in utterance was transcribed and coded for the presence of a verb. The rate of parent follow-in utterances with verbs (number of follow-in utterances with a verb/number of codable intervals) was used as the measure of quantity of verb input.

Diversity. Each follow-in utterance with a verb was then reviewed and the verb(s) used were recorded. The

Table 2. Construct, procedure, metric, analysis role, and descriptive statistics of analyzed variables.

Construct	Procedure (times)	Variable metric	Role (aim)	<i>M</i> (<i>SD</i>)
Child verb expressive vocabulary	MCDI (Times 2 & 4)	Total action words reported as said	Time 2: Independent variable Time 4: Dependent variable	Time 2: 5.03 (5.49) Time 4: 18.42 (14.172)
Parent verb input	Parent–child free-play (Times 1 & 3)	Average rate of codable intervals in the session that included a follow-in utterance with a verb (rate)	Independent variable	.237 (.108)
	Parent–child free-play (Times 1 & 3)	Average of the weighted sum of verb-related morphosyntactic elements divided by the total number of codable intervals (grammatical informativeness)	Independent variable	.230 (.153)
	Parent–child free-play (Times 1 & 3)	Average number of different verbs used in the free-play session (diversity)	Independent variable	29.08 (11.746)

Note. MCDI = MacArthur–Bates Communicative Development Inventory Words and Gestures form.

number of different verbs was summed as the estimate of diversity of verb input.

Grammatical informativeness. Intervals with a follow-in utterance with a verb were coded for the total number of different verb-related morphosyntactic elements (see the Appendix for the list of elements included in the coding scheme). A weighted frequency of grammatical informativeness was then calculated. That is, the number of intervals was multiplied by the number of verb-related morphosyntactic elements in those intervals (up to three) and then summed. For example, the number of intervals with three or more types of verb-related elements was multiplied by 3. These “weighted” counts were then summed and divided by the number of codable intervals to obtain the estimate of grammatical informativeness.

A weighting procedure may be used when the behaviors given larger weights are considered more suggestive of the general tendency of interest (e.g., Greenwood, Carta, Walker, Hughes, & Weathers, 2006; Yoder, Lloyd, & Symons, 2018; Yoder, Stone, Walden, & Malesa, 2009). We assumed that utterances with more verb-related morphosyntactic elements were more grammatically informative than utterances with fewer elements. They also might be more indicative of a parent’s tendency to use grammatically informative utterances. See Table 2 for a summary of input variable measurement and descriptive statistics on the component variables.

Reliability

A second trained coder independently coded 20% of the parent–child free-play sessions. These sessions were chosen at random, and the primary coder was blind to which sessions were chosen for reliability checks. An intraclass correlation coefficient (ICC) value was calculated for each of the component variables derived from the video sessions (quantity, diversity, and grammatical informativeness of verb input in follow-in utterances). ICC estimates were calculated using SPSS statistical software using the absolute agreement option and the observer as a random factor. The ICC values for each of the three component variables were all above .97 ($M = .99$, $SD = .006$).

Rationale for Averaging Across Periods for Input Component Variables

For parent input variables to be predictive of future verb vocabulary, the estimates of input should be stable across valid ways to measure it. Averaging scores across more than one estimate can improve the stability and thus validity of generalized behavioral tendencies (Yoder & Symons, 2010). Thus, we made an a priori decision to aggregate these variables across the two time points (Times 1 and 3) if they significantly correlated with each other at levels above $r = .6$. As is the case for creating any aggregate variable made up of several components, this threshold was chosen arbitrarily (DiStefano, Zhu, & Mîndrilă, 2009; Yoder et al., 2018). The parent verb input variables all met this threshold. For participants with data at both measurement points, variables were averaged across measurement points. For participants

with missing data at one of the measurement points ($n = 4$), the data from the existing measurement point was used. To equally weight scores for each component (i.e., quantity, diversity, grammatical informativeness), estimates of each component variable were z -transformed prior to averaging.

Results

Preparatory Analyses

To further support our decision to aggregate the three component parent input variables (quantity, diversity, and grammatical informativeness), we first checked each component variable’s unconditional relation with later child expressive verb vocabulary. We also checked the associations among these component variables.

Separate simple regression analyses for each component parent input variable and later child expressive verb vocabulary were thus conducted. The coefficients for each of the three verb input component variables were statistically significant and large in effect size (see Table 3). The three component parent input variables were also highly intercorrelated (i.e., Pearson’s r of .89 and above). These values exceeded the aggregation threshold of a Pearson’s r of .6 selected for this study.

Computation of the Parent Verb Input Aggregate

Z score–transformed scores for each of the component variables were averaged to create one aggregate parent verb input variable. The parent verb input aggregate was conceptualized as representing parents’ general tendency to frequently use diverse and grammatically informative verb input in follow-in utterances.

Primary Analyses

Does Frequent Use of Diverse and Grammatically Informative Verb Phrases in Follow-In Utterances Predict Later Child Expressive Verb Vocabulary?

The relation between the aggregate parent verb input variable and later child expressive verb vocabulary was evaluated using a simple regression. The relation was statistically significant with a large effect size, $F(1, 29) = 9.82$, $p < .005$, $R^2 = .25$ (see Table 4).

Does Frequent Use of Diverse and Grammatically Informative Verb Phrases in Follow-In Utterances Predict Later Child Expressive Verb Vocabulary After Controlling for Early Child Expressive Verb Vocabulary?

A multiple regression model including the aggregate parent verb input variable and earlier child expressive verb vocabulary as predictors resulted in a large amount of variance accounted for in later child expressive verb vocabulary, $F(2, 28) = 12.83$, $p < .001$, $R^2 = .48$. The change in R^2 for the association of aggregate parent verb input with later child expressive verb vocabulary after controlling for early child expressive verb vocabulary was .17, $p = .005$,

Table 3. Associations between component input variables and later child expressive verb vocabulary.

Variable	<i>b</i>	<i>SE b</i>	β	95% CI	<i>R</i> ²	<i>F</i>	<i>p</i>
Rate	61.05*	21.55	0.46	[16.98, 105.12]	.22	8.03	.008*
Diversity	0.47*	0.21	0.39	[0.05, 0.90]	.15	5.27	.029*
Grammatical informativeness	51.17**	14.31	0.55	[21.91, 80.43]	.31	12.79	.001**

Note. CI = confidence interval.

p* < .05. *p* < .005.

accounting for a large and statistically significant amount of variance (see Table 4).

Secondary Analysis

To rule out the alternative explanation that verb input is merely a proxy for all input and to increase confidence in the specificity of the observed relation between verb input and verb vocabulary, we tested whether parent follow-in utterances without verbs predicted later child expressive verb vocabulary. Rate of parent follow-in utterances without verbs was calculated by (a) subtracting parent follow-in utterances with verbs from total parent follow-in utterances and (b) dividing that number by the number of codable intervals in each parent-child free-play session. Rate of parent follow-in utterances without verbs at Time 1 and Time 3 were correlated ($r = .62$) above the chosen aggregation threshold. Thus, these scores were *z* score-transformed and averaged across the two sessions to improve stability and thus validity of the measure. The aggregate rate of follow-in utterances without verbs was not significantly related to later child expressive verb vocabulary, $F(1, 29) = 0.02$, *ns* (see Table 5 for further results). This finding demonstrates that the specific type of parent input matters. For child expressive verb vocabulary, verb input specifically (as opposed to input in general) is key.

Discussion

This exploratory study revealed a significant relation between (a) early quantity, diversity, and grammatical informativeness of verb input in follow-in utterances and (b) later child expressive verb vocabulary, even when controlling for earlier child expressive verb vocabulary. This relation was specific to verb input. Quantity of parents'

nonverb input in follow-in utterances was unrelated to later child verb vocabulary.

These findings replicate relations between certain qualities of verb input and child verb vocabulary found in typical development samples in a sample of young children with ASD and clarify other aspects of the input-output literature. Quantity, diversity, and grammatical informativeness of verb input tend to be highly intercorrelated. Thus, it is likely difficult to investigate one of these aspects separate from the others, at least in nonexperimental studies. That said, our findings do speak to the relevance of these qualities for children with ASD.

First, our findings replicate the identified relation between quantity of verb input and later child verb vocabulary that has been found in children with typical development (e.g., Naigles & Hoff-Ginsberg, 1998). The specificity of the relation between quantity of verb input with verb vocabulary size also parallels a finding that children with ASD are sensitive to effects of quantity of parent noun input on later child vocabulary development (Naigles, 2013).

Second, our findings also support the relation between diversity of verb input and later child verb vocabulary (e.g., Hsu et al., 2017). However, these findings diverge somewhat from what has been found in some typical development samples. The positive relation found between both quantity and diversity of parent verb input and child expressive verb vocabulary is in contrast with findings in at least one sample of children with typical development. Hsu et al. (2017) found that quantity of parent verb input was not significantly related to later child expressive verb vocabulary. However, as in our sample, Hsu et al. found that diversity and quantity of parent verb input were intercorrelated (i.e., parents who used verbs often also used many different verbs). Furthermore, as in our sample, diversity of parent verb

Table 4. Regression analyses.

Independent variables	Model 1				Model 2			
	<i>b</i>	<i>SE b</i>	β	95% CI	<i>b</i>	<i>SE b</i>	β	95% CI
Parent verb input	8.04**	2.57	0.50	[2.79, 13.29]	6.73**	2.21	0.42	[2.20, 11.27]
Early child verb vocabulary					1.24**	.36	0.48	[0.41, 1.98]

Note. CI = confidence interval.

***p* < .005.

Table 5. Associations between nonverb input and later child expressive verb vocabulary.

Variable	<i>b</i>	<i>SE b</i>	β	95% CI	<i>R</i> ²	<i>F</i>	<i>p</i>
Rate of nonverb parent input	7.25	47.97	0.03	[-90.86, 105.35]	.001	0.02	.88

Note. CI = confidence interval.

input positively predicted later child expressive verb vocabulary. Given the conflicting evidence in research on children with typical development about the associations of quantity of verbs in input with child verb acquisition (Hsu et al., 2017; Naigles & Hoff-Ginsberg, 1998), we do not consider the findings of this initial study to offer definitive evidence that quantity of verb input has differential importance for verb acquisition in children with ASD versus those with typical development but rather suggest a potential difference that warrants further examination.

One possible explanation for this difference is that different populations (ASD and typical development) may need different numbers of exposures per verb prior to acquisition. Children with ASD might require more exposures to the same verbs than children with typical development before acquisition is observed.

Another possible explanation stems from our definition of quantity of verb input. Although Hsu et al.'s (2017) measure of quantity of verb input included the total number of all verbs parents used, our measure of quantity of verb input only included verbs used in follow-in utterances. When all verbs are included, some of those verbs are likely to be used outside the follow-in utterances. This distinction is relevant. In at least one sample of children with typical development, whereas verb input in follow-in utterances was positively related to later child verb vocabulary, verb input outside the follow-in utterances was negatively related to later child verb vocabulary (Tomasello & Kruger, 1992). It is possible that when all verb input is included in a quantity of verb input measure, the association between quantity of verb input and verb vocabulary becomes nonsignificant.

Third, the current study's findings regarding grammatical informativeness further support the important role morphosyntactic elements play in supporting verb acquisition for both children with typical development and ASD. Specifically considering children with ASD, our findings are relevant to the ongoing clinical debate regarding telegraphic versus grammatical input. Some language-focused interventions for individuals with ASD promote the use of input that is simplified by stripping out grammatical elements, function words, and other words that are deemed nonessential (e.g., Lovaas, 2003). Some language experts have called this type of input *telegraphic speech* (van Kleeck et al., 2010; Venker et al., 2015). In telegraphic speech, the grammatical rules of English are broken. For example, instead of "Put the cup in the bucket," an adult using telegraphic speech might say "put cup in" or "cup in." The general theory behind assuming that telegraphic speech makes input more processable is that, by reducing the

length of the utterance by dropping presumably nonessential words, both comprehension and expressive imitation might be promoted (van Kleeck et al., 2010). However, the current study's finding that high rates of grammatically informative input were positively related to expressive verb vocabulary is in line with previous work suggesting that inclusion of morphosyntactic elements in adult input to children with ASD is not distracting, but facilitative for word learning (e.g., Naigles et al., 2011; Shulman & Guberman, 2007; Venker et al., 2015). Venker et al. (2015) found that omission of grammatical information in adult input was associated with poorer language outcomes for children with ASD. Specific to verbs, two studies have suggested that, for at least some children with ASD, syntactic elements in input are useful for child verb acquisition (Naigles et al., 2011; Shulman & Guberman, 2007). The current study thus expands upon the growing evidence base supporting children with ASD's ability to use morphosyntactic elements for word learning and the use of grammatical speech with children with ASD.

Future Research

To control for third variable explanations to the current study's correlational findings, an internally valid experimental design is needed in which quantity, diversity, or grammatical informativeness of parent verb input in follow-in utterances is manipulated. Two example experimental designs are adapted alternating treatment designs (AATD) and between-groups experiments. For example, an AATD might be used to test whether the data path representing production of a set of nonsense verbs that have been presented in frequent, grammatically informative follow-in utterances has a steeper therapeutic trend than a data path representing production of an equivalent set of control nonsense verbs (i.e., untrained nonsense verbs). The AATD has the advantages of representing when during the treatment phase superior performance occurs and the potential to infer a functional relation with a small number of participants. A between-groups experiment could be conducted to determine whether the mean production of a set of real verbs is higher in children with ASD in a randomly assigned group of parents who have been trained to frequently use a diverse set of verbs in grammatically informative follow-in utterances than a randomly assigned group that did not receive such training. The between-groups design has the advantage of enabling a causal inference with real verbs and affords a stronger inference if learned verbs are used in a variety of measurement contexts that differ from the treatment context

on a number of dimensions (e.g., location, person, interaction style, and materials).

Finally, future research may also evaluate if there is a range of grammatical informativeness that is optimal for supporting verb acquisition in young children with ASD. There may be a “sweet spot” that achieves the hypothesized informativeness of verb-related morphosyntactic elements while not overwhelming the child learner. The idea of balancing input with child readiness for intake is not unprecedented in the word learning literature (e.g., He & Arunachalam, 2017; Kidd, Bavin, & Brandt, 2013; Trueswell & Gleitman, 2007). However, more research is needed that is specifically focused on if and how the degree of grammatical informativeness in input should be altered to best fit child readiness to harness this information for successful verb learning.

Clinical Implications

If future studies confirm the associations found in this study and provide causal evidence that quality of parent verb input affects children’s expressive verb vocabulary, these results have implications for improving parent-mediated language interventions for children with ASD. Current interventions that emphasize adult expansions of child utterances or the use of follow-in utterances generally make no distinction between noun phrase expansion and verb phrase expansion. Furthermore, examples of expansions often focus more on noun phrase elaboration than verb phrase elaboration. The unfortunate consequence of implicitly underemphasizing verb phrases in language expansions and follow-in utterances may be impoverished verb input and possibly limited child verb vocabularies (e.g., the overreliance seen in many children with ASD on a small number of verb forms, such as “want” or “need”). Parents might instead be explicitly taught to frequently use diverse verbs in grammatically informative follow-in utterances to support child expressive verb vocabulary.

An additional implication is couched within the telegraphic versus grammatical speech debate described earlier. Some clinicians may still be concerned that the greater complexity of grammatically informative verb phrases might make it difficult for children with ASD to process input or to identify the verb of interest. One approach to simplifying input is to shorten utterances while maintaining grammatical correctness (Venker et al., 2015). Verb-related morphosyntactic elements are potentially useful for child language learners seeking to extrapolate the meaning of a novel verb through the content and prosody cues in the utterance. Broadly speaking, content words tend to be stressed relative to function words in spoken language. This stress pattern may serve as a cue for children in the early stages of word learning for identifying key information (i.e., content words) within an utterance. Maintaining grammatical correctness maintains the prosody of connected speech, which may aid processability of the input. Rather than eliminating function words or other morphosyntactic elements as a means of highlighting novel verbs, parents or clinicians who still wish

to further emphasize the key novel verbs might do so through other methods, such as with intonation or volume (Venker et al., 2015).

Limitations

There are three primary limitations of the current study. First, it is possible that, like all exploratory studies, the findings are sample specific. That is, the current study’s findings need to be replicated. We have framed these findings as exploratory because the analyses were post hoc and the sample size was small. Both result in a heightened probability of sample-specific results. Second, the individual contributions of each component variable included in the parent verb input aggregate (quantity, diversity, and grammatical informativeness) could not be parsed out in the present analysis because they were so intercorrelated. Third, like all correlational designs, it is possible that there are third variable explanations for the observed relations. Potential explanatory third variables would be those that covary with early parent verb input and with later child expressive verb vocabulary. Although no correlational design prevents all third variable explanations, two potential alternative explanations were eliminated in this study: nonverb input and early child verb vocabulary.

Strengths

Despite the present limitations, the current study has two strengths. First, to our knowledge, it is among the first studies of parent verb input in relation to child verb vocabulary specifically in children with ASD. The use of a longitudinal correlational design in the current study also provides stronger evidence that individual differences in parent verb input may cause individual differences in child verb vocabulary than concurrent correlational designs. That is, the former provides evidence of association and temporal precedence, whereas the latter only provides evidence of association (Beakley & Ludlow, 1992). Second, using an aggregate measure of parent verb input probably stabilized and thus improved the validity of the measurement of the input variable relative to single measures of parent verb input (Yoder & Symons, 2010). Although the observations used to estimate our measures of the input variables were relatively short in duration, the research design assumes they are samples of what generally occurs outside the measurement context—otherwise the longitudinal associations would not occur. The confirmation of the predicted relation (i.e., the aggregate parent verb input variable estimated from these observations was positively related to later child expressive verb vocabulary) supports our assumption.

Summary

The current study is one of the first studies of verb input and its potential influence on verb vocabulary for the ASD population specifically. Acquiring verbs likely contributes to morphosyntactic development. Such language

development is important because it is predictive of future adaptive and social outcomes in children with ASD (Howlin et al., 2004; Tager-Flusberg et al., 2009). Although this study's findings are exploratory and correlational, it is hoped that they will shed light on this often-understudied domain of language learning and promote further investigation of the aspects of adult input that promote verb acquisition in children with ASD.

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Appendix

Definitions and Examples of Informativeness in Follow-In Utterances With Verbs

Element	Definition	Example
Verb morphology		
Past tense regular <i>-ed</i>	Verbs marked with the <i>-ed</i> suffix used to denote regular past tense	"You jump <u>ed</u> !"
Present progressive <i>-ing</i>	Verbs marked with the suffix <i>-ing</i> that are preceded by the auxiliary form of (i.e., "helping verbs") "be" and its derivations in written, standard English	"She's drive <u>ing</u> the truck."
Past tense irregular form	Past tense form of verbs that do not take the regular <i>-ed</i> suffix	"He <u>ran</u> away."
Present tense third-person singular irregular form	Third-person singular forms of verbs "say" "do" and "have"	"He <u>does</u> like milk." "She <u>says</u> hi." "He <u>has</u> all the beads."
Auxiliaries		
Concatenative auxiliaries	"Pseudo-auxiliaries" as in "hafta," "gonna," "s'pose(ta)," or "wanna" preceding a main lexical verb	"Are you <u>gonna</u> come play?"
Primary auxiliaries	"Be," "do," and "have" used as auxiliaries before main lexical verbs. These may be contracted or may not be contracted	"She/'s driving the truck." "She <u>is</u> driving the truck."
Modal auxiliaries	Auxiliaries that denote mood or possibility, such as may/might, can/could, shall/should, will/would	" <u>Will</u> you clean up?"
Predicate elaborations		
Adverbs, adverbial phrases, and prepositional phrases	Words or phrases that modify the verb in time, place, or process	"Put them <u>in the bucket</u> ." "Roll it <u>slowly</u> ."
Infinitive "to"	"To" preceding a verb in its infinitive form	"Want <u>to</u> put them on?"