



Definitions of Nonverbal and Minimally Verbal in Research for Autism: A Systematic Review of the Literature

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Abstract

This systematic review examined definitions of “nonverbal” or “minimally verbal” and assessment measures used to evaluate communication in intervention studies focusing on improving expressive verbal communication in children with autism spectrum disorder (ASD). We reviewed sample size, number of participants, participant age, and male/female representation. Our analysis yielded relatively few studies with non/minimally verbal children with ASD focusing on verbal expressive communication. Further, we found large inconsistencies in measures used, definitions of “nonverbal” and “minimally verbal”, and ages targeted. Guidelines are suggested to create a more uniform assessment protocol with systematic descriptions of early communication learners as a foundational step for understanding the heterogeneity in this group and replicating research findings for this subgroup of children with ASD.

Keywords Autism · Nonverbal · Minimally verbal · Expressive words · Communication treatment

A challenge for developing and systematically testing interventions relates to defining “nonverbal” (NV) and “minimally verbal” (MV). The lack of consensus and consistency among researchers as to the definitions of NV and MV in the literature magnifies the ongoing challenge of developing, comparing, selecting, systematically testing, and replicating interventions. Yet, these definitions are important constructs, as outcomes may vary depending on how NV and MV are defined (e.g., the presence of words, phonetically consistent

forms, spoken words versus gestures, receptive language level, sound imitation) and interventions may be more appropriate for subpopulations of individuals with ASD depending on their verbal levels at intake. For example, preschoolers with even one consistent expressive verbal word seem to have better outcomes than those with no expressive words (Tager-Flusberg and Kasari 2013). Similarly, children who are able to imitate and exhibit appropriate attentional behaviors are likely to have better communicative outcomes (Koegel et al. 2009a).

Ultimately, replicated identification methods and clear inclusionary and exclusionary criteria in communication related skills and across studies are necessary to compare outcomes and to design more effective treatments. For example, divergent exclusionary criteria are often seen in the literature (e.g., the apparent presence of cognitive impairment or lack of responsiveness during standardized testing precludes many NV children from being included in some research studies) (Green et al. 2010), but not others (Bal et al. 2016). Such exclusion, when implemented, suggests that the most communicatively complex individuals with ASD may be understudied with inconsistencies in the literature regarding key aspects of the NV and MV ASD phenotypes.

In addition, it is important to bear in mind that nearly all toddlers younger than about 18 months of age are NV or MV (e.g., using relatively few or no words, see Hoff 2013).

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Because of this, early intervention studies of ASD toddlers can rightfully be classified as including “MV” or “NV” participants. However, one could argue that limited verbal ability during the toddler years is meaningfully different from that during later childhood due to the developmental trajectory of language. Calls for additional research on MV and NV children with ASD focus on this latter group of children in later childhood (Chenauksy 2017; IACC 2011; Jack and Pelfrey 2017; Tager-Flusberg et al. 2009; Tager-Flusberg and Kasari 2013). This observation is not a critique of early intervention studies that focus on toddlers with or at risk for ASD; rather, it is important to distinguish these groups when reporting outcomes for verbal (spoken) intervention studies.

In addition to applying variable methods for identifying verbal level, many studies have discussed the lack of conformity in the diagnosis of ASD, the variability of outcome trajectories (Kim et al. 2018), and the challenge that the heterogeneity of the diagnosis presents (Lombardo et al. 2019). All of these issues translate to challenges in provision of clinical services, counseling of families, and understanding of long-term outcomes, as well as other concerns regarding evidence-based assessment and implementation. ASD represents a very wide range of symptomology and severity of these symptoms, so there is an imminent need to more coherently understand how researchers have addressed assessment of individuals most communicatively impacted by ASD and, if needed, to refine these methods. Therefore, the purpose of the present systematic review was to identify how intervention studies over the past nearly 60 years have defined, described, and measured “NV” and “MV” in regard to individuals with ASD in research studies designed to target verbal communication.

Estimates indicate that more than one third of children diagnosed with ASD will remain NV or MV throughout the lifespan after receiving years of intervention (National Research Council 2001; Rose et al. 2016; Tager-Flusberg and Kasari 2013). The failure to develop expressive verbal communication is one of the most commonly reported first concerns in parents of children with ASD (Franchini et al. 2018) and can interfere with development in many areas, including academics, behavior, socialization, independent living, and later employment. The 2017 Interagency Autism Coordinating Committee (IACC) strategic plan highlighted the pressing need to study children with ASD who have extremely limited verbal abilities, identifying this most severely affected subgroup of ASD as grossly underrepresented in the behavioral intervention literature (e.g., see p. 45, IACC 2017). While the research literature focusing on individuals with ASD has increased over the past three decades—as evidenced by an approximately 24-fold increase in the number of papers published with the term “autism” (Pubmed index) (Chakrabarti 2017)—the overwhelming majority of these publications have focused on the autism

phenotype with relatively few support needs, variously described as “high functioning,” “HFA,” “Asperger’s Disorder,” or “mild autism.” That is, only about 11% of studies have targeted the most comprehensively impacted individuals with ASD (Jack and Pelfrey 2017). Consequently, more research is needed relating to communication, outcomes, development, and prognosis of children with ASD with significant communication challenges such as those who are NV or MV.

There have been a number of systematic reviews of Alternative and Augmentative Communication (AAC) interventions for MV and NV children with ASD over the past decade (Holyfield et al. 2017; Lorah et al. 2015; Schlosser and Wendt 2008), but there is a pressing need to understand the literature on verbal interventions in this population. Further, while many of the general issues related to AAC are relevant to all individuals with significant and complex communication needs (e.g., lack of inclusion, need to address quality of life, poor outcomes), the AAC research has largely addressed skills specific to AAC activation and use (c. f., Light and McNaughton 2015) and barriers that interfere with the use of AAC by parents and others (c.f., Baxter et al. 2012; Moorcroft et al. 2019) rather than understanding the populations for which verbal communication programs are implemented. Therefore, the intent of this review was to examine and classify definitions of individuals with ASD receiving interventions focused on improving *expressive verbal* communication.

For this analysis, we aggregated information designed to identify key parameters and processes employed when assessing language abilities in studies targeting expressive verbal skills of NV and MV individuals with ASD. For the purpose of this study, “expressive verbal” refers to the use of spoken communication. This review is a first step in: (a) informing future studies regarding more consistent definitions that may facilitate replication, treatment selection, and outcome comparisons; (b) yielding cohesive insights into previous methodologies employed to capture participant characteristics; and (c) potentially identifying gaps in the current literature that reduce or even preclude aggregating intervention data into subsequent systematic reviews, meta-analyses, and Cochrane reviews with the goal of refining intervention methods for NV and MV children with ASD.

Method

Our approach involved a systematic review of studies that focused on intervention applied with participants with ASD who were identified by the study author(s) as NV or MV. We began with a systematic search of articles. These articles were screened first by title and abstract before the full articles were reviewed, as detailed below. Independent

reliability was gathered for title, abstract, and article level screening in addition to definitions of MV and NV and measures of verbal and communication skills gleaned from these papers in the subsequent article summaries.

Search Procedures

We used a systematic search procedure to identify studies for inclusion in this review. Specifically, we conducted a search using Vanderbilt University's ProQuest databases using the keywords "autism", "autistic", "Asperger", "autisms", or "ASD" AND "minimally verbal", "minimally fluent", "preverbal", "pre-verbal", "nonverbal", "non-verbal" or "mute" AND "vocabulary", "words", "communication", "language", or "lexical". Although "Asperger" would generally not fall into the NV/MV classification, we included it to capture as many potentially relevant articles for screening purposes. All available databases ($N = 83$) were searched. Data bases included PsychArticles, PsychInfo, and ProQuest Central. The publication span entered was 1960 to 2018. Search results were then imported into Mendeley (<https://www.mendeley.com/reference-management/reference-manager>) to be screened and reviewed. Our search yielded a total of 2007 results, which were then alphabetized by article title. Duplicates were removed, yielding a total of 1231 articles.

Inclusion and Exclusion Criteria

Only scholarly articles and peer-reviewed articles were included. Dissertations, Master's Theses, and conference papers and proceedings were not included. The following exclusion and inclusion criteria were applied: (a) Assessment. Articles were excluded that were assessment only, with no intervention provided; (b) Intervention. Articles were excluded that did not provide an intervention that targeted verbal expressive communication (e.g., receptive communication exclusively, reading, vision, pointing) or used AAC or sign language that was not a component of an intervention designed to target verbal expressive communication skills; (c) Diagnosis. To be included, participants were required to have been diagnosed with ASD and identified by the author(s) as minimally verbal, nonverbal, or another description of the communication abilities of the participants indicating early word production (i.e., first words) was the verbal developmental level (although we did review studies with "Asperger" and the general ASD literature. We excluded studies whose participants were more advanced than early/first words), highly verbal participants (e.g., "High Functioning Autism", PDD-NOS wherein verbal skills were advanced or relatively unimpaired, Asperger Disorder), or advanced verbal communication goals (e.g., verbal conversation skills, complex language structures) were excluded; (d) Measurement. Included studies involved

verbal behavior (words, word attempts, or sounds/syllables) as a dependent variable. Nonverbal modes of communication such as augmentative, sign language, etc. that did include verbal output or explicitly list that the approach was used as a precursor or path to verbal communication but wherein verbal words were not measured were excluded; (e) Design. Commentaries, book reviews, reviews of the literature, errata, or uncontrolled case studies (e.g., $N = 1$) were excluded. Studies that involved systematic, experimentally controlled investigation intervention were included. Example research designs meeting inclusion criteria were randomized controlled trials, quasi-experimental designs, and single-case designs with at least two participants; or (f) Language. Studies conducted in a spoken language other than English were excluded. This later criterion was adopted due to the limited expertise of the authors and coders in the pantheon of spoken languages appearing in the topic search rather than any a priori assumption as to the relative advantages or disadvantages of any particular spoken language other than English. Again, our goal was to assess definitions of individuals with ASD expected to be acquiring initial verbal communication.

Screening Measures

Title Screening. First, the titles were independently read and screened by the first and fifth (last) authors, who were most senior and most familiar with the research, in order to capture studies that targeted MV or NV individuals. The first author served as the primary coder and the last author served as the reliability coder. Our reliability for the title screening of the 1231 articles was 90%. Articles from the title screening that were included by only one screener were included for the abstract review. The title search of the 1231 studies yielded 237 articles meeting our inclusion criteria. Most of the articles excluded in the title screening related to interventions not fitting our criteria (e.g., facilitated communication, AAC, eye movements, gestures, pointing).

Abstract Screening. Following the title search, abstracts from the 237 articles were screened. The first and last authors screened the first 50 abstracts with 96% reliability. To assess reliability, the second and third authors also screened the first 50 abstracts. Their reliability with the primary coder (first author) was 87%. This served as a training, as the 13% of articles that were not reliable were discussed as to the reasons they should be included/excluded in regard to the stated guidelines. Next, half (94) of the remaining 187 abstracts were screened by the first (primary coder) and fourth (serving as a reliability coder) authors and the remainder (93) were screened by the second (primary coder) and third (serving as a reliability coder) authors. Thus, reliability was completed for all 237 articles. The overall reliability from the abstract screening was 89%. Abstracts identified

by only one author were included for the full article review, as not to miss any articles. The abstract search yielded 67 articles meeting the inclusion criteria. Most of the studies excluded in the abstract search related to participant characteristics (e.g., highly verbal), intervention targets (e.g., social conversation, advanced language targets), and interventions used (e.g., focused on parent education with no child data).

Article Review and Data Evaluation

Articles were then divided equally among four of the authors (first, second, third, and fifth authors) who served as the primary coders. The fourth author assessed for reliability and was blinded to the coding from the other authors. Of the 67 articles, 19 articles (28%) were reviewed for reliability purposes relating to inclusion/exclusion (described above) along with the information extracted from each article presented in Table 1. Two additional articles were excluded after discussion by the first and last author during the analysis (one was conducted in a non-English (foreign) language and the other targeted advanced NV social behaviors in individuals with Asperger Disorder). During our reading of the articles, two additional studies were located and included in the analysis. Thus, reliability on inclusion/exclusion was 89%.

The full review yielded a total of 31 research articles that met all the inclusion criteria and were analyzed in detail. Excluded articles were fairly evenly distributed across all categories described above. In addition, four studies (Almirall et al. 2016; DiStefano et al. 2016; Kasari et al. 2014; Shire et al. 2018), with overlapping participants were reviewed but were not counted as unique (different) participants in our evaluation.

These articles spanned a period of 58 years (1960–2018). Included studies were summarized in regard to (a) sample size; (b) male or female; (c) age of participants; (d) NV or MV; and (e) measure used to assess verbal ability. For independent coding of sample size, reliability differed only on one article for the number of participants (this study cited a different number of participants in the abstract and text, the N in the text was included in the review). Thus, reliability on the number of participants was 95%. One inconsistency was found in the age of participants, thus reliability on that measure was 95%. Additionally, one inconsistency was found on the number of male vs female participants, also resulting in 95% reliability. Regarding whether participants were described as NV or MV, reliability was 84%, primarily due to differences and ambiguities in the descriptions of the participants. Reliability on the assessment measures used was 100%, although some coders inserted more detail than others. If any discrepancies in reliability occurred, the first and last authors read and discussed the articles and made a consensus decision relating to the information that would be included in Table 1.

Following the creation of the summary table of the articles, each coder re-checked the articles that s/he coded for accuracy. The Results were written by the first author, and twenty-two numerical findings in the Results section were checked by the second author to assure correspondence with Table 1. Reliability for those results was above 90%. For the five findings that were below 100%, the fifth author re-read the article and made the final decision on which of the two scores would be placed in the Results.

Results

The aggregate number of unique participants with ASD that participated in intervention across the 31 studies was 650. Four studies included the same subjects (Almirall et al. 2016; DiStefano et al. 2016; Kasari et al. 2014; Shire et al. 2018), so only the largest study was included in the systematic review to preclude counting the same participant multiple times. Of the 27 studies that reported males vs. females (or could be deduced from child identifiers or individual descriptions), 78% of participants were males and 22% of participants were females.

Participant Ages

The studies varied greatly in regard to participant ages with participants ranging from 1 year 4 months to 23 years. Eight studies exclusively targeted children in the toddler/preschool years (under 4 years 11 months), with a total of 293 participants. Of the toddler/preschool studies, two studies (Drash et al. 1999; Koegel et al. 2009a) included only NV children with a total of six participants. Two studies included a combination of MV and NV participants; a total of twenty participants from Schreibman and Stahmer (2014) and 5 participants from Harris et al. (1983) were NV. Other studies did not clearly specify whether the children were MV or NV.

Eleven studies exclusively included participants in elementary school (ages 5; 0–12; 11). Within these studies, 250 children were included. Of those elementary school aged children, 48 were NV (some studies did not specify NV or MV and others reported the children to be NV but did not clearly specify how this was measured).

Ten studies included a combination of preschool and elementary school aged children for a total of 224 participants. Within these studies, 59 participants from 6 studies were NV (Gordonet al. 2011, had a subset specified as no words). Two additional studies (Miller and Miller 1973; Tardiff et al. 2017) encompassed a heterogeneous group of 21 participants with a wide age range (5–23 years old) that included a total of 19 NV participants.

Table 1 Studies' definitions of nonverbal or minimally-verbal children with ASD

Authors and year	Sample size (N)	N _{Male}	N _{Female}	Age of participants in years	NV or MV	Assessment Measure (used to assess NV/MV)
Almirall et al. (2016)	61	51	10	4;5–9;0	MV	Defined as fewer than 20 spontaneous novel words in a 20-min natural language sample
Chenausky et al. (2016)	30	20	3	3;5–9;8	MV <20 intelligible words; no productive syntax	Parent report and baseline assessments Kaufman Speech Praxis Test (KSPT) phoneme repetition test repeat ≥ 2 speech sounds
Charlop-Christy et al. (2002)	3	3	0	3;8–12	NV and MV “did not speak or rarely spoke”; imitated sounds, phrases, or requested food items (bl shows one child used spont word combinations and one said a single word)	Minnesota Child Developmental Inventory, PPVT, VABS (tests differed across participants), behavioral observations and probes
DiStefano et al. (2016)	55	Not reported		5–8	MV Mean # of diff words 17.3 MLU 1.3	ADOS Leiter, PPVT, Natural language sample (20 min)
Drash et al. (1999)	3	3	0	2;6–3;6	NV (no functional language)	Researchers evaluated participants' initial levels of mands, echoics, and tacts
Esch et al. (2009)	2	2	0	2;6 & 7;1	NV	NV defined as “no functional speech” Kaufman Speech Praxis Test for Children (both failed)
Franco et al. (2013)	6	5	0	5;1–8;3	NV	NV defined as “lack of functional communication (i.e., no consistent use of vocalizations, eye gaze, or gestures to communicate)”, verified via parent interview and REEL-3
Green et al. (2010)	152	124	28	2;0–4;11	Not specified	Not specified: –Participants had to be diagnosed with core autism –Children with a nonverbal age equivalent to 12 months or younger on the MELS were excluded
Gevarter and Horan (2018)	6	5	1	3;6–5;3	MV	Could imitate 25 syllables and reduplicated syllables, Vineland Communication
Gordon et al. (2011)	84	73	11	4–10	38 no words, 31 single words, 15 at least 1 phrase	ADOS, Expressive One Word Vocabulary Test; Mullen
Harris et al. (1983)	9	10	1	2;3–4;6	NV or MV (5 no words/4 some words)	Verbal Level Nonverbal or Minimally Verbal Two half-hour videos

Table 1 (continued)

Authors and year	Sample size (N)	N _{Male} N _{Female}	Age of participants in years	NV or MV	Assessment Measure (used to assess NV/MV)
Hingegen and Churchill (1969)	4	4, 0	4;0–5;11	NV “mute”	Mute and showed little or no language comprehension, but uttered noncommunicative sounds with varying frequency, no measures were provided
Jones (2009)	2	2, 0	3;2 & 4;11	Likely MV (not specified in the article)	Child 1: Preschool Language Scale 4th edition (Exp Lang SS = 58, receptive = 57) VABS (comm SS = 64) Child 2: Preschool Evaluation Scale: low average range (3rd percentile) with his expressive language and social emotional subscale scores falling in the below average range (standard scores of 1 and 2, respectively)
Kasari et al. (2014)	61 (30/31 in each group)	Not reported	5–8	MV < 20 spont words during language sample with trained clinicians	20 min natural language sample, receptive lang of 24 mos, proficient use of an SGD, ave of 17 different words at bl (5 children had 26–51 words) Adult was responsive to child but did not prompt the child to talk (maybe higher than shown)
Koegel et al. (1987)	2	Not reported	4;5–5;8	NV	Intake description, Vineland Verbal Level: No words. Vineland Social 1;6 and 2;8
Koegel et al. (2009a)	3	3, 0	3;0–4;8	NV	CDI no functional words and no object–label correspondence;
Koegel et al. (2009b)	3	3, 0	3;2–3;5	MV	2 Children < 10 functional word, 1 ~ 75 words Vineland age equivalency scores were used to describe participants but not used to determine eligibility
Laski et al. (1988)	8 (4 nonverbal, 4 echolalic)	7, 1	5–9.6	NV and MV	3 of 4 NV children could imitate sounds and a few words but no spontaneous words. 1 NV with no receptive vocab. 4 echolalic children could use phrases
Miller and Miller (1973)	19	12, 7	5–23	NV “most severely disturbed and unresponsive”	“Creak” score assigned to each child after observation and consultation with appropriate teachers, Little to no ability to understand spoken words

Table 1 (continued)

Authors and year	Sample size (N)	N _{Male} N _{Female}	Age of participants in years	NV or MV	Assessment Measure (used to assess NV/MV)
Ozonoff and Cathcart (1998)	22	18, 4	2;7–5;9	MV (Did not specify in article, pretest Mean Verbal age was 14.9 months in the treatment group and 19.1 in the control group)	Cognitive verbal age level on the Psychoeducational Profile-Revised
Oxman et al. (1979)	10	5, 5	9;1–9;5	NV	Not specified: “minimal or no speech skills”
Rogers et al. (2006)	10	10, 0	1;8–5;5	NV (<5 functional words/day)	Parent report and clinician observation of <5 spontaneous functional words/day
Sandiford (2013)	10 (9/1)	5, 7	5;0–7;6	NV	ADOS (not clear on how NV was ID'd)
Scanlan et al. (1963)	8	7, 1	5;2–9;6	NV and MV	Defined as “completely nonverbal or if they did not use words for purposes of communication”. Assessed by an initial language/communication examination including naming of objects or pictures, pantomiming the use of an object or picture, answering questions, etc
Schriebman and Stahmer (2014)	39 (34/5)	20, 45	1;8–3;9	NV and MV	20 had no words; 18 had 1–10 words. CDI; VABS; Mullen Scales of Early Learning; ADOS, EOWPVT; and a 25-min parent-child interaction
Shire et al. (2018) *Partial data from 1 site of a multi-site study	22	22, 0	5–8 Mean = 6.74	MV < 20 words	10 min family Naturalistic Language Sample Receptive lang 2.38 and exp 1.83 on TELD) Dev age of at least 24 months
Strasberger and Ferreri (2014)	4	4, 0	5;8–12.11	NV (no functional speech)	Parent and teacher report, observation
Tardif et al. (2017)	2	2, 0	5;6 & 16	Not specified: Ss had verbal delay	Participant 1 presented a moderately delayed verbal development with verbal stereotypes Participant 2: extremely poor level of verbal expression (he could pronounce some syllables and repeat some words approximately but never spontaneously)
Wan et al. (2011)	6	5, 1	5;9–8;9	NV	EVT and Mullen

Table 1 (continued)

Authors and year	Sample size (N)	N _{Male} N _{Female}	Age of participants in years	NV or MV	Assessment Measure (used to assess NV/MV)
Wetherby et al. (2014)	82	71, 11	1;4–1;8	NV and MV inferred but not specified	VABS; participants were matched on pre-treatment NV developmental level - from the 2 recruitment sites: FSU recruited children from primary care screening by using the Communication and Symbolic Behavior Scales (CSBS) while UM children were referred because of parental or professional concern
Yoder and Layton (1988)	60	Not specified	Mean 5.0–5;6 (SD 1.2–2.1 across groups)	MV	Expressive and receptive ages of less than 28 months on the Sequenced Inventory of Communication Development (SICD); -Demonstrate pre-treatment expressive vocabulary of 25 words or less as assessed by a parent questionnaire

*Articles with more than 3 authors are listed as et al.

Assessment Measures

We found a lack of consistency across studies for the assessment measures used to determine whether the participants were verbal or NV. Four of the 31 studies (13%) assessed the participants during natural language interactions, either as the sole measure or in combination with other tests. Eight (26%) included nonstandard behavioral observations or qualitative descriptions of the participants exclusively. Four (13%) of the 31 studies included informal parent reports and an additional 8 studies included a more standardized parent measure, such as the Vineland Adaptive Behavior Scales (VABS) (six studies), the MacArthur–Bates Communicative Development Inventories (CDI; two studies), or a non-specified parent questionnaire (one study). Two studies included teacher reports. In regard to additional measures, four studies (13%) reported using the Autism Diagnostic Observation Scale (ADOS) for the purpose of assessment of communication (in addition to being utilized as an indicator of ASD), although it was unclear how the ADOS was utilized to determine whether a participant was NV or MV because the ADOS is not designed to differentiate verbal from NV or MV children. One study that included MV participants and one that included NV participants used the Kaufman Speech Praxis Test (KSPT). Two studies included expressive vocabulary tests and three studies included receptive vocabulary tests. The remainder of the studies reported measures that were not used by other studies reviewed, including the Autism Diagnostic Interview (ADI), picture-based assessments, phoneme repetition tests, language tests (The Receptive-Expressive Emergent Language Scale, Third Edition [REEL-3], Preschool Language Scale, Test of Language Development, Sequenced Inventory of Communication Development, and Communication and Symbolic Behavior Scales [CSBS-DP]), or the Communication and Symbolic Behavior Scales (CSBS). Five of the 31 studies included a verbal or NV IQ test or a more general test of functioning that was not language specific. In regard to cognitive functioning, three studies gave the Mullen Scales of Early Learning (MSEL), one study gave the Psychoeducational Profile-Revised (PEP-R), and one gave the Leiter International Performance Scale- Revised (Leiter-R). Table 2 lists the various assessment measures in the reviewed literature.

Descriptions of Participant Communication Skills

The authors' descriptions of NV and MV varied considerably and many articles were ambiguous, imprecise, or otherwise unclear with regard to the participants' communication levels. For example, with regard to variability in the literature, several studies classified "MV" using strikingly different criteria: fewer than 20 spontaneous novel words in a 20-min language sample (Almirall et al. 2016; Kasari et al.

Table 2 Measures used in the studies reviewed and what each assesses

Assessment tool	Measures
Standardized	
Autism Diagnostic Interview (ADI)	behavioral and background information, including early development, language acquisition, current functioning, and social development, based on accounts by relatives and/or caregivers (Rutter et al. 2003)
Behavioral Intervention Rating Scale (BIRS)	teachers' perceptions of classroom intervention treatment effectiveness (Strasberger et al. 2014)
Communication and Symbolic Behavior Scales Developmental Profile (CSBS-DP)	communicative competence (use of eye gaze, gestures, sounds, words, understanding, and play) of children with a functional communication age between 6 and 24 months; included Caregiver Questionnaire and Behavior Sample (Green et al. 2010)
Early Social-Communication Scales (ESCS)	individual differences in nonverbal communication skills in children with mental ages between 8 and 30 months of age (Almirall et al. 2016)
Expressive One-Word Picture Vocabulary Test (EOWPVT)	verbal expression of individuals aged 2 years to 80+ (Schriebman and Stahmer 2014)
Fisher-Logemann Test of Articulation Competence	analysis and categorization of articulation errors (Oxman et al. 1979)
Kaufman Speech Praxis Test for Children (KSPT)	child's imitative responses to the clinician, motor-speech proficiency (Esch et al. 2009)
Leiter International Performance Scale-Revised (Leiter-R)	cognitive functions in children and adolescents ages 2–20 (Almirall et al. 2016)
MacArthur–Bates Communicative Development Inventories (MB-CDis or CDI)	early language, including vocabulary comprehension, production, gestures, and grammar; parent report (Green et al. 2010; Koegel et al. 2009a; Rogers et al. 2006; Schriebman and Stahmer 2014)
Mullen Scales of Early Learning (MSEL)	gross motor, fine motor, visual reception (or non-verbal problem solving), receptive language, and expressive language in children from birth to 68 months (Rogers et al. 2006; Schriebman and Stahmer 2014; Wetherby et al. 2014)
Psychoeducational Profile-Revised (PEP-R)	skills and behaviors (learning strengths, uneven development, emerging abilities) of children with autism and communication disabilities who are between developmental ages of 6 months and 7 years Ozonoff and Cathcart 1998
The Receptive-Expressive Emergent Language Scale, Third Edition (REEL-3)	Developmental age equivalent for receptive and expressive language (Franco et al. 2013)
Vineland Adaptive Behavior Scales (VABS)	Personal and social skills, receptive and expressive communication, and motor skills of individuals from birth through adulthood (Green et al. 2010; Rogers et al. 2006; Schriebman and Stahmer 2014; Wetherby et al. 2014)
Non-standardized	
Naturalistic language sample	Naturalistic communication, including spontaneous communicative utterances, spontaneous requests, imitation, behaviors, receptive and expressive communication, peer-to-peer interactions, articulation
Structured play assessment	Number of unique play actions (Almirall et al. 2016)
Phoneme imitation task	Ability to repeat phonemes (Esch et al. 2009)
Rating forms/surveys	Teachers' impressions of children's language abilities (Green et al. 2010), parent satisfaction (Schriebman and Stahmer 2014)
Interview	Teachers' and caregivers' perceptions of children's language abilities (Green et al. 2010)

2014; Shire et al. 2018), fewer than 20 intelligible words and no productive syntax (Chenausky et al. 2016), fewer than 5 spontaneous functional words per day (Rogers et al. 2006), 1–10 words (Schriebman and Stahmer 2014), and 25 words or fewer (Yoder and Layton 1988). Other studies provided a mean number of different words (e.g. 17.3 and an MLU

of 1.3) (DiStefano et al. 2016) or described the ability to imitate syllables and reduplicated syllables (Gevarter and Horan 2018).

Descriptions of NV individuals were similarly variable. For example, some “NV” individuals were described as “severely language-delayed and none produced functional

language,” although a complete description indicated that participants’ parents reported hearing functional or non-functional words, and some were able to imitate sounds and/or words (Drash et al. 1999). Other studies described no functional speech or no consistent use of vocalizations (Esch et al. 2009; Franco et al. 2013). Some studies showed repeated baseline measures of few or no words (Koegel et al. 1987; Koegel et al. 2009a). Some studies described the participants as NV but did not indicate how this was determined (e.g., Sandiford et al. 2013). Finally, studies sometimes included standardized measures but did not include parent report, observation, nor language sample to validate classification as NV (Wan et al. 2011). Table 2 lists the measures used in the studies reviewed and what area each assesses.

Discussion

Our systematic review identified relatively few intervention studies focusing on teaching expressive verbal communication to MV or NV individuals with ASD despite the ongoing high priority for developing effective treatments for this population (e.g., Interagency Council on Autism 2017). It was particularly remarkable that very few studies have focused on NV individuals with ASD. For example, we found only two studies from more than five decades of published research that focused exclusively on teaching verbal communication to NV preschool children, with an aggregate of only six children participating. Additionally, due to variability in measures and descriptions of the children in the article, it was unclear whether the participants were completely NV.

In regard to this population, researchers and strategic plans to address the needs of people with ASD have recommended assessment of pre-linguistic behaviors that may be precursors to expressive verbal communication, such as joint attention engagement, attentiveness, play, and social motivation (c.f., Bopp et al. 2009; Sherer and Schreibman 2005; Tager-Flusberg and Kasari 2013). However, only a handful of the studies herein included any type of pre-linguistic assays. Those that did focused on sound imitation (Esch et al. 2009) or behaviors such as vocalizations and eye gaze (Franco et al. 2013). To be sure, there is an extensive literature on teaching social and cognitive skills hypothesized to be precursors to verbal communication in toddlers (e.g., joint attention, object play). The studies included in this review were designed to directly increase verbal skills in NV children, so largely excluded measures of pre-linguistic behaviors.

Further, in regard to the studies conducted with children described as NV, one study reported that parents had heard their children produce words, but the children had no functional language (Drash et al. 1999); thus, it was difficult to

determine the actual verbal level of the participants. The majority of the studies did not collect any type of communication samples or behavioral assessments in the participants’ natural settings, despite the fact that this is common practice in the field of speech-language pathology and would seem to be a key aspect of assessing NV children (Campbell et al. 2003; Pavelko et al. 2016; Pavelko et al. 2016). Tager-Flusberg and Kasari (2013) discussed important areas of assessment for this population that would help understand children’s progress with communication, including a better understanding of areas such as speech sound development, the relationship between expressive language and intelligence quotient scores, oral-motor skills, imitation, and social withdrawal, so it would be beneficial if studies of this population systematically included measures of these domains as well as verbal skills.

With regard to studies focusing on participants described as “MV,” participants in the studies we analyzed ranged considerably in age from toddlers and preschoolers through adolescents (range 2;0–16). The number of words spoken among the children described as NV or MV ranged greatly and was grossly inconsistent across studies. Participant descriptions included measurements of the ability to repeat sounds and syllables (Gevarter and Horan 2018), the presence of some verbal (Harris et al. 1983), less than 10 intelligible words (Koegel et al. 2009b), 20 intelligible or consistent words (Almirall et al. 2016), 25 words or less (Yoder and Layton 1988), up to 51–75 words (Kasari et al. 2014; Koegel et al. 2009b) and communication at the phrase level (Gordon et al. 2011). This is a broad range and one that likely has a profound impact on key aspects of intervention and outcomes. For example, pooling or aggregating outcomes for children with one or two verbal words at the onset of intervention with those starting off with 51–75 words under the phenotype “MV” may lead to inaccurate interpretations.

Throughout the literature, we found a general consensus suggesting that it may be more difficult to teach verbal communication to children after the age of five, particularly if they have no expressive words or symbolic gestures; however, some children beyond age 5 can learn to communicate verbally (Koegel 2000; Pickett et al. 2009). In contrast, the outcomes for toddlers and preschoolers with one or two words at the onset of intervention is likely to be much different than those for older children or adults. Therefore, studies of NV and MV individuals should include homogeneous grouping of ages, and clear classifications of NV and MV individuals with ASD is recommended. In addition, longitudinal studies have shown that the presence of both verbal and NV behaviors predict the subsequent development of verbal expressive communication (Franchini et al. 2018). Consequently, these areas should be measured consistently and systematically reported in future studies of individuals with ASD to better understand NV areas that may benefit from

instruction prior to the expected onset of first words, expansion beyond first words, and variables related to improved prognosis.

Based on our systematic review, the following suggestions are recommended in regard to use of communication:

1. **Participant Descriptions.** Participants should be unambiguously identified as NV or MV using systematic assessment that specifically captures this status (see below). Credible estimates of word counts should be included for MV individuals and credible procedures identifying individuals as NV should also be included in future studies. Our current review of published studies indicates considerable variability when labeling the individuals as minimally or NV.
2. **Language Samples.** Assessment should include a natural communication interaction (language sample) (e.g., Almirall et al. 2016), optimally with both a familiar communication partner (e.g., parent or caregiver) and a trained interactor and standard observational measures of verbal abilities. Valid and reliable assessment results for individuals with ASD are difficult to obtain and may underestimate their abilities (Koegel et al. 1997); therefore, behavioral observations are helpful. Although children generally produce more utterances with a parent, clinicians may have additional techniques for stimulating sound and word production from individuals with ASD, and therefore may be valuable. Natural language interactions provide a good indication of whether communication is generalizing in natural environments and may provide important information for those who do not tolerate or respond well to standardized testing.
3. **Speech Assessments.** Behavioral assessment of speech can include elicited production of phonemes, syllables, and word approximations. The ability to repeat sounds appears to be an indicator of more positive prognosis in regard to word acquisition. For individuals with no expressive words, assessing sound imitation may be helpful (e.g., Laski et al. 1988) and children who can verbally imitate a variety of sounds may potentially have better treatment outcomes (Gevarter and Horan 2018). These can also include observational checklists that capture speech sound ability (e.g., Charlop-Christy et al. 2002; Chenausky et al. 2016). Other research suggests that a complete evaluation of the child's phonetic repertoire may be helpful for prognosis and for potential use in intervention (cf., Koegel and Traphagen 1982; Tager-Flusberg et al. 2017). A phoneme inventory or other assay of speech production is recommended.
4. **Standardized Vocabulary and Language Tests.** Receptive and expressive vocabulary tests along with language functioning should be used if the child is MV (e.g., Jones 2009). Due to test-taking challenges experienced by some children with ASD, standardized measures should accompany parent-and teacher report instruments (e.g., MacArthur–Bates CDI) that have fairly strong validity and reliability.
5. **Echolalia.** Many children who are reported as using no functional words are also reported to produce echolalic utterances (Lovaas et al. 1973; McEvoy et al. 1988; Tardif et al. 2017). The nature and extent of the echolalia should be reported. Many of the studies reviewed did not distinguish between echolalic and typical utterances that included unprompted imitation (see Speidel and Nelson 1989) or excluded echolalia, thus making it difficult to capture the extent of the child's verbal communication.
6. **NV Social Behavior.** Areas such as joint attention, play, attentiveness, socially responsive behavior, and motor imitation have all been discussed as correlates of or precursors to the onset of first words and are also correlated with favorable outcomes in regard to learning verbal communication (c.f., Bopp et al 2009; Jones 2009; Iverson et al. 2019; Mundy and Newell 2007). Understanding these areas would be helpful in understanding the course of communicative skill acquisition. Some of the reviewed studies suggested that engagement and social behaviors may relate to outcome and are therefore important.
7. **Age.** Age is an important consideration in “NV” and “MV” phenotypes. Nearly all one-year-olds, regardless of whether disability is evident, are MV or NV. In contrast, “NV” and “MV” status is a clear clinical marker by the age of 24 months and is evidence of a severe disability by age 36 months. Thus, intervention research should include an age designation in the title and abstract. Suggested age designations include “infants” up to 12 months, “toddlers” age 1–3 years, “preschoolers” age 3–5, “school-age” 5–12, and “adolescent/adult” above age 12. Some of the studies reviewed used such broad age ranges that it was difficult to assess which interventions are appropriate for various age groups.
8. **Verbal and/or NV Estimates of Cognitive Ability.** Again, while cognitive tests may underestimate an individual with ASD's ability (Koegel et al. 1997), they do give an indication of a child's general functioning level (e.g., Gordon and Stark 2007; Ozonoff and Cathcart 1998). At a broad level, these measures are designed to yield information of both verbal reasoning and low verbal or NV reasoning (see Camarata and Swisher 1990; Camarata and Nelson 2002; Camarata et al. 2014). This information is helpful for post hoc analyses of intervention effects in NV and MV individuals with ASD and for aggregating subgroups (see Lancaster and Camarata 2019).
9. **Parent and Teacher Report.** Multiple standardized measures are available for providing parent and teacher input

(e.g., Rogers et al. 2006; Strasberger and Ferreri 2014; Yoder and Layton 1988) and they may contribute to robust evaluations of verbal ability. Many formal parent and teacher report instruments have fairly strong validity and reliability and given the fact that standardized testing is often difficult with this population and their true abilities may be underestimated (Koegel et al. 1997); therefore, parent and teacher report may be very helpful. However, reporting early word use by parents and other professionals not trained in word and language development may not provide an accurate indication of current and/or consistent word use. These measures should be combined with other standardized and observational measures when possible.

Please see Table 3 for a review of the most salient components of the definition guidelines. We believe that systematically—including as many of these measures as possible—in future studies of intervention for MV and NV children is warranted and, in fact, necessary, in order to systematically advance the knowledge and evidence base.

Given the enormous heterogeneity in language outcomes among the ASD population (Tager-Flusberg 2018), there is a great need for consistent terminology in order to better understand the phenotypes with which interventions are most effective given intake or pre-intervention characteristics. The following suggestions for classification and nomenclature described as important milestones in the literature are put forth:

1. *Preverbal* Children under 18 months of age who do not exhibit any expressive verbal words. It is difficult to distinguish between children with ASD characteristics and typical language developers at this age when they are clearly too young to be categorized as “NV”. As research focuses on identifying interventions during the early months of life, this topic becomes important (Bradshaw et al. 2015). While some children do begin to say first words after 18 months, if a child is not, an assessment may be helpful to provide guidelines for encouraging verbal communication and to assess whether more significant issues are present (e.g., the child is below the 10th percentile on word development) (Camarata 2014).
2. *Nonverbal* Children over 18 months of age characterized as NV should demonstrate no consistent verbal expressive words (intelligible or approximations) during standardized tests, across settings during observations, and according to parent report. Parents may need to learn how to differentiate words used consistently and words heard only occasionally in the past. Researchers should report the presence of echolalia and unprompted imitative word production. This latter category is quite common in typical development and should be classified as distinct from echolalia (see Speidel and Nelson 1989). Additionally, a description of the individual’s phonetic repertoire (imitative and spontaneous) as well as other NV and preverbal-symbolic behaviors should be reported. Evidently, if a child emits no expressive words by 18 months, a delay is present (e.g., Marchman 2006; Camarata 2014).
3. *Minimally verbal* MV individuals should be considered to be using some words, but significantly fewer than expected levels relative to age. For example, fewer than 5 words at 18 months and fewer than 50 words at 30 months of age or older correspond to word production levels below the 10th percentile (Fenson 2007). This quantitative criterium is based on the usual vocabulary level wherein two-word combinations begin (Brown 1973; Anisfeld et al. 1998). In all studies, the number of distinct words should be reported, as outcomes may vary depending on whether a few words or many different words are used.
4. *Limited verbal* It may be useful to add another category that reflects reduced verbal skills exceeding those at MV

Table 3 Review of the most salient components of the definition guideline

Area	Guideline
Identification	Participants should be identified as nonverbal or minimally verbal. For nonverbal children with ASD, credible procedures need to be reported. For minimally verbal children, a credible estimates of word counts should be reported
Language assessment	
Sampling context	Language assessment should include a natural interactive communication sample, optimally with a familiar communication partner
Measure	Measures could include elicited production of phonemes, syllables, words, and short phrases. For minimally verbal children with ASD, standardized receptive and expressive vocabulary tests could be included
Reporter	Formal parent and teacher reports can have strong validity and reliability. However, reporting early word use by parents and professionals not trained in word and language development may not provide an indication of consistent word use. Therefore, these measures should be combined with other standardized and observational measures
Cognitive assessment	A cognitive measure of verbal and/or nonverbal reasoning should be included because this information is crucial for understanding intervention effects in nonverbal and minimally verbal children with ASD

levels. Individuals considered to have limited verbal skills encompass those who have more than 50 consistent spontaneous words, which marks the 50th percentile for 18-month-old toddlers (Fenson 2007). After this point in typical language development, word combinations emerge (Brown 1973; Anisfeld et al. 1998). Also, generative language and communicative function should be considered. If an individual is using communication only for requests (e.g., “I want x” or “more x” or “x, please), s/he could be considered limited verbal. In all cases, limited verbal should only be applied to children whose expressive skills fall significantly below expected levels relative to the general population (e.g., below the 10th percentile)

In summary, there is a sparse literature on intervention for NV and MV individuals with ASD, and this literature is highly variable with regard to the procedures and data employed to characterize these children. Therefore, a standard assessment paradigm with more universal measures is recommended as a platform for quality research, and more homogeneous age grouping may be helpful for future research studies. There is an ongoing priority to develop intervention for the most-impacted children in order to understand the individual with ASD’s functioning level, prognosis, and trajectory; however, the current lack of systematicity restricts available evidence-based treatment options (Koegel et al. 2019). When comparing the definitions of the studies reviewed, one must bear in mind that the considerable differences across studies made it difficult to aggregate numbers for a meta-analysis. Therefore, we attempted to accurately describe the current literature in regard to definitions of NV and MV, but the participant descriptions made this distinction difficult to determine for many studies.

Limitations

In regard to limitations, many commonly used assessments (e.g., the Assessment of Basic Language and Learning Skills, Revised [ABLLS-R] and the Verbal Behavior Milestones Assessment and Placement Program [VB-MAPP]) have not been used in the research for this population, and could potentially provide more detailed analyses of communication. We attempted to use a variety of words, including rarely used adjectives in the current literature, such as “mute”, but acknowledge the possibility that some studies were missed in the analysis due to non-inclusion of the different key words that may be used to describe this population, such as “limited verbal” or “complex communication needs”. However, we do point to the breadth of the original article catchment as reducing the likelihood that a large

number of studies were missed. Additionally, studies that only included one participant but used a controlled ABAB design may have been missed as we only reviewed small N studies that included replications across at least two participants, such as multiple baseline designs. Further, many of the studies and/or methodologies we included in this paper did not fit some suggested criteria that have attempted to define “empirically-supported” research, such as lack of description of the sample, small number of participants, lack of replication (c.f., Chambless and Ollendick 2001). However, all reviewed studies in this paper were published in peer-reviewed journals and adhered to our inclusion/exclusion criteria. Finally, another limitation is that we did not review studies that used AAC exclusively as a treatment for NV and MV individuals. As previously noted, several studies have systematically reviewed the AAC literature (Holyfield et al. 2017; Lorah et al. 2015; Schlosser and Wendt 2008) and the goal of this review was to focus exclusively on verbal interventions in ASD. However, studying parent implementation and parent education programs with different communicative modalities may be fruitful for further research.

In conclusion, future research is warranted to determine best practices for individuals with ASD who are learning first words. In addition, a more comprehensive and standard assessment platform is crucial for addressing the communication needs of the most communicatively-impacted individuals with ASD.

IRB was not obtained, as no human subjects participated in this analysis. The authors have no conflicts of interest to report.

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*Indicates that the studies were used in the systematic analysis

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