

# Psychoeducational Interventions for Adults With Level 3 Autism Spectrum Disorder: A 50-Year Systematic Review

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**Abstract:** There is face validity to the expectation that adults with level 3 autism spectrum disorder (ASD-3) will benefit from a range of psychoeducational interventions. This paper reviews the empirical evidence supporting the effectiveness of these interventions, many of which are currently used in clinical settings. We reviewed 56 peer-reviewed studies of psychoeducational interventions for adults with ASD-3, written in English and since 1968, that met our criteria. The reviewing team included educators, clinicians, researchers, and a biostatistician. The available literature was limited, and most, if not all, of the studies presented some significant methodological limitations. When using Cochrane's criteria to assess seven key outcome domains—activities of daily living, aggressive/destructive behaviors, emotional functioning, language/communication skills, self-injurious behaviors, stereotypy/mannerisms, and vocational skills—we found only moderately reliable evidence to support the effectiveness of interventions designed to improve emotional functioning in adults with ASD-3. The reliability of evidence relevant to the six other outcome domains was rated as low or very low. Based on this review, we suggest directions for future study of interventions for adults with ASD-3, including topics, sub-populations, and approaches that should be explored. We also

propose some crucial changes in how future studies regarding this population should be designed, analyzed, and documented, while balancing clinical considerations with scientific/educational utility.

**Key Words:** autism, psychoeducational intervention, applied behavioral analysis, behavioral training

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ASD = autism spectrum disorder. ASD-3 = level 3 autism spectrum disorder.

It is generally assumed that children with autism spectrum disorder (ASD) may benefit from a variety of psychoeducational interventions (ie, nonmedical interventions that attempt to modify behavior), just as such interventions have long been assumed to benefit typically developing children. This assumption has helped guide legislation in many countries. In the United States, for example, children with ASD are entitled by federal law to a free specialized public education, which may include services such as speech therapy, occupational therapy, vocational training, and behavioral support (Individuals with Disabilities Education Act, 2004).

However, even in the United States, government support for education and other training services for individuals with autism (and those with other disabilities) typically ends by age 21 at the latest, which is problematic. It is clear that the need and capacity for learning new skills in typically developing individuals continue throughout adulthood and well into old age (Stoner et al, 2006). There are reasons to believe this is also true (if not more true) for individuals with developmental disabilities such as ASD (Howard-Jones, 2014). Because many 21-year olds with ASD can expect to have three quarters or more of their lives ahead of them, it can hardly be expected that their learning requirements will end at age 21; however, persisting inequality in access to educational opportunities poses the risk that the learning capacities of adults with ASD remain untapped.

This lack of psychoeducational and other services for adults with ASD is particularly problematic for adults with level 3 ASD, referred to as ASD-3. ASD-3 is defined

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by the most recent version of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM–5; American Psychiatric Association, 2013) as “requiring very substantial support” due to severe impairments in social communication and restrictive/repetitive behaviors. Although the scale of severity described in the *Diagnostic and Statistical Manual* is defined by key functional impairments such as poor social communication and restricted/repetitive behaviors, it is important to consider a potential heterogeneous set of comorbid impairments, including intellectual disability and behavioral impairments, that could also require substantial support. Interventions aimed at reducing the impact of these impairments and facilitating individuals with ASD in practicing self-care, employment, and participation in recreational activities would arguably significantly improve their quality of life and also help reduce the enormous cost of social care (Leigh and Du, 2015).

To our knowledge, no prior reviews have investigated the availability and quality of psychoeducational interventions for adults with ASD–3. The only reviews we located focused on psychoeducational interventions for adults with mixed- and/or higher level ASD, and these supported the effectiveness of applied behavioral analysis (Aylott, 2000), social skills interventions (Aylott, 2000; Lorenc et al, 2018; Reichow and Volkmar, 2010), vocational skills interventions (Lorenc et al, 2018; Nicholas et al, 2015), and video modeling interventions (Reichow and Volkmar, 2010). One prior review of psychoeducational interventions for mixed-age individuals with ASD–3 also supported the effectiveness of social skills interventions using video-based, developmental, peer-mediated, behavioral, and structured teaching approaches (Walton and Ingersoll, 2013). Several other published reviews of interventions for children and mixed-aged individuals with ASD notably highlighted the lack of research into interventions for adults with ASD–3 and called for more attention to the topic (Kasari et al, 2014; Lorenc et al, 2018; Matson, 1996; Shattuck et al, 2012; Taylor et al, 2012; Weiss and Harris, 2001).

## OBJECTIVE

We conducted this review in order to clarify what psychoeducational interventions have been shown to work best for what behavioral outcomes within the ASD–3 category. At present, behavioral training methods that have proven effective in the treatment of behavioral deficits in children with ASD (Heflin and Simpson, 1998) have been widely adopted and adapted for adults with ASD. Nonetheless, there are considerable controversies as to the suitability of these methodological adaptations for adults with ASD–3, as well as to what knowledge or skills should be taught (Heflin and Simpson, 1998). For instance, given the inevitable limitations in time and resources facing clinicians and educators, what skills and competencies should be psychoeducationally targeted and how? Should we try to improve independent self-care skills, social skills, and/or work-related competencies? Should we focus

instruction on improving skills that are deficient, enhancing best individual abilities, or developing compensatory mechanisms? These same questions have concerned educators and psychologists studying the ASD–3 population for decades, as have the best potential psychoeducational strategies.

The main aims of this review were to (a) assess the psychoeducational interventions that have thus far been applied to adults with ASD–3, (b) identify how rigorously these interventions have been applied and assessed (eg, adherence to protocols, data collection, and analyses) using quality assessment/risk of bias tools, (c) evaluate the efficacy of the interventions used so far within the adult ASD–3 population, and (d) suggest practical ways to advance the field of psychoeducational interventions.

## METHODS

### Search and Information Sources

We searched articles and reports within the 50-year period from 1968, when applied behavioral analysis first appeared in the literature (Baer et al, 1968), to the present. Our inclusion criteria were adults (age  $\geq 18$  years) with a primary diagnosis of ASD at level 3 on the severity scale (“requiring very substantial support”; American Psychiatric Association, 2013).

We started with relatively broad searches of the PubMed and Google Scholar electronic databases, using the search terms (“1968”[PDAT]: “3000”[PDAT]) AND (“autism”[All Fields] OR “autistic”[All Fields] OR “ASD”[All Fields] OR “PDD”[All Fields]) AND “adult” [All Fields] AND (“intervention”[All Fields] OR “treatment”[All Fields] OR “therapy”[All Fields] OR “training”[All Fields]). We used broad search terms because recent debates regarding the suitability of specific terminology to describe severity level (eg, low-functioning, Asperger’s) made it difficult to synthesize search terms that would extract our specific target population. Also, we wanted to evaluate the far-reaching conclusions and impacts of a wide range of interventions.

Because our review was limited to studies on psychoeducational interventions, we did not include literature reviews, meta-analyses, books, or program reports (see *Eligibility Criteria and Study Selection*), although several were identified in the electronic search. However, we did manually scrutinize the reference lists of literature reviews and meta-analyses (Aylott, 2000; Bishop-Fitzpatrick et al, 2013; Broadstock et al, 2007; Brugha et al, 2015; Committee on Children With Disabilities, 1998; DeJong et al, 2014; El Achkar and Spence, 2015; Gates et al, 2017; Kasari et al, 2014; Lorenc et al, 2018; Matson et al, 2011, 2016; Millar et al, 2006; Nicholas et al, 2015; Ratto and Mesibov, 2015; Reichow and Volkmar, 2010; Reichow et al, 2013; Rutter, 1996; Schreibman, 1996; Shattuck et al, 2012; Sinha et al, 2004, 2006; Sturmey, 2012; Taylor et al, 2012; Tsai, 1999; Vismara and Rogers, 2010; Volkmar et al, 1999, 2014; Walton and Ingersoll, 2013; Weiss and Harris, 2001; Wong et al, 2015), books (Sheridan and Raffield, 2008; Volkmar et al, 2014), and program

reports (Young et al, 2010) in order to identify relevant studies that did not appear in the electronic search.

### Eligibility Criteria and Study Selection

After completing the literature search, we screened abstracts and full texts of all identified studies to determine which to include in our review. Two eligibility reviewers (K.S.D. and S.A.K.) screened the studies to make sure they met our inclusionary criteria and then rated the articles on a dichotomous scale (ie, include or exclude); any differences in global eligibility ratings were arbitrated by a third reviewer (A.D.).

We included studies based on the following criteria:

- Types of participants
  - Participants had to be adults (ie,  $\geq 18$  years).
  - Participants had to be diagnosed with ASD-3, as retroactively determined (if necessary) from the information available in the paper. If the ASD severity level was not explicitly stated, level 3 was assumed if the participants had any intellectual disability, language deficits, or poor activities of daily living; were in a residential treatment setting; and/or presented with highly frequent stereotyped/repetitive behaviors.
- Types of interventions
  - The study included participants who took part in a psychoeducational intervention.
- Types of studies
  - Quantitative pre-intervention data were reported either in the published article or in freely available supplemental information.
  - Quantitative postintervention data were reported either in the published article or in freely available supplemental information.
  - The published study had to be available on an electronic database and written in English.

We excluded studies based on the following criteria:

- Types of participants
  - Participants were children and/or adolescents (ie, aged  $<18$  years).
  - Participants were not adults with ASD (eg, participants were either children of, or family members and caregivers of, individuals with ASD).
  - ASD severity was below level 3 (ie, the severity level was determined to be level 1 or 2, or the level could not be determined from the available data).
- Types of interventions
  - The study was not a true intervention study (ie, it was a systematic review, meta-analysis, prevalence study, description of symptoms, follow-up study), and/or it was another type of nonempirical study (eg, position paper, book review).
  - The study consisted of pharmacological or other “physical” intervention methods.

- Types of studies
  - Quantitative data relevant to the psychoeducational intervention, either pre, post, or both, were not reported in the article nor in freely available supplemental information.
  - The published study was not available in English.

Regarding terminology, we use the term “psychoeducational” in this review as an umbrella term for all efforts attempting to modify behaviors via nonmedical approaches. We interpreted psychoeducational broadly and inclusively. We included, but did not limit our consideration to, practical applications of applied behavioral analysis as well as methods that may have been given more specific names, such as “discrete trial training”; “developmental, individual-differences, relationship-based floortime”; “pivotal response analysis”; “verbal behavior therapy”; “early start Denver model”; “relationship development intervention”; “milieu teaching”; and “social communication/emotional regulation/transactional support.” Our use of the term psychoeducational specifically excludes methods that involve pharmacological agents, electrical brain stimulation, or any other methods that would traditionally be considered “physical” interventions.

### Data Collection and Analysis

#### *Data Extraction and Management*

Information was extracted by K.S.D. and was checked by S.A.K. for sampling, recruitment, types of intervention, methods of data collection and analysis, and results (Higgins and Green, 2011). S.A.K. attempted to follow-up with the corresponding authors of the identified studies to obtain missing information. We received responses from only some of these authors, but we included what data we could extract from all of the articles included in our review so as not to risk bias.

#### *Risk of Bias Within Studies*

We assessed each identified study for quality and for risk of bias using standards outlined in the Cochrane Risk of Bias data extraction template for randomized interventions (Higgins and Green, 2011), the Cochrane Risk of Bias in Non-Randomized Studies template for non-randomized interventions (Sterne et al, 2016), and the Reichow Risk of Bias template for case studies (Reichow et al, 2018). Because bias domains in the Cochrane Risk of Bias, Cochrane Risk of Bias in Non-Randomized Studies, and Reichow Risk of Bias tools overlap, we mapped bias domains from the Cochrane Risk of Bias in Non-Randomized Studies and the Reichow Risk of Bias onto the original scoring conventions of the Cochrane Risk of Bias. We identified five key bias domains (selection bias, performance bias, detection bias, attrition bias, and reporting bias) and design-specific criteria for each domain (Table 1). We assessed each bias domain as being low risk, moderate risk, high risk, or very high risk. Quality assessment was carried out independently by S.A.K.,

**TABLE 1.** Bias Domain Definitions

	<b>Selection Bias</b>	<b>Performance Bias</b>	<b>Detection Bias</b>	<b>Attrition Bias</b>	<b>Reporting Bias</b>
Cochrane RoB	Random sequence generation/allocation concealment: “Describe the method used to generate the allocation sequence in sufficient detail to allow an assessment of whether it should produce comparable groups. Describe the method used to conceal the allocation sequence in sufficient detail to determine whether intervention allocations could have been foreseen in advance of, or during, enrollment.”	Blinding of participants and personnel: “Describe all measures used, if any, to blind study participants and personnel from knowledge of which intervention a participant received. Provide any information relating to whether the intended blinding was effective.”	Blinding of outcome assessment: “Describe all measures used, if any, to blind outcome assessors from knowledge of which intervention a participant received. Provide any information relating to whether the intended blinding was effective.”	Incomplete outcome data: “Describe the completeness of outcome data for each main outcome, including attrition and exclusions from the analysis. State whether attrition and exclusions were reported, the numbers in each intervention group (compared with total randomized participants), reasons for attrition/exclusions where reported, and any re-inclusions in analyses performed by the review authors.”	Selective reporting: “State how the possibility of selective outcome reporting was examined by the review authors, and what was found.”
Cochrane ROBINS	Allocation bias: “ROBINS-I also addresses time-varying confounding. This only needs to be considered in studies that partition follow up time for individual participants into time spent in different intervention groups. Time-varying confounding occurs when the intervention received can change over time (for example, if individuals switch between the interventions being compared), and when postbaseline prognostic factors affect the intervention received after baseline.”	Performance bias: “Bias may occur when these differences arise because of knowledge of the intervention applied and the expectation of finding a difference between experimental intervention and comparator consistent with the hypothesis being tested in the study.”	Measurement bias/observer bias: “Differential misclassification occurs when misclassification of intervention status is related to the outcome or the risk of the outcome, and is likely to lead to bias. It is therefore important that, wherever possible, interventions are defined and categorized without knowledge of subsequent outcomes.”	Bias due to missing data: “Reasons for missing data include attrition (loss to follow up), missed appointments, incomplete data collection and participants being excluded from analysis by primary investigators.”	Outcome reporting bias: “Selective outcome reporting occurs when an effect estimate for a particular outcome measurement is selected from among multiple measurements, for example a measurement made at one of a number of time points or based on one of multiple pain scales.”
Reichow SCD RoB	Sequence generation: “The procedures used to allocate participants to intervention conditions or the order of the conditions to which participants are exposed.”	Blinding of participants and personnel: “The methods used to ensure members of the research team remain unaware of when the intervention is implemented to whom.”	Blinding of outcome assessors: “The procedures used to ensure the individuals collecting outcome data are unaware of the study conditions and research purpose.”	Selective outcome reporting: “The completeness of the data reported for all participants who began the study including those who withdrew.”	Selective outcome reporting: “The completeness of the data reported for all participants who began the study ... for each of the dependent variables.”

**Cochrane RoB** = Cochrane Risk of Bias. **Cochrane ROBINS** = Cochrane Risk of Bias in Non-Randomized Studies. **Reichow SCD RoB** = Reichow Risk of Bias.

A.D., and K.S.D., and any differences in opinion were arbitrated by R.L.S.

### Summary Measures

In order to derive treatment effect sizes, we calculated standardized mean difference scores and 95% CIs using pre- and postintervention scores of the primary outcome variables for each study (Higgins and Green, 2011; Olive and Smith, 2005). Several of the studies from our electronic and hand searches included some participants who were not diagnosed with ASD-3; for those studies, we considered only the findings for the participants with ASD-3.

### Synthesis of Results

Inconsistencies and variability in reporting of intervention content and outcome measures made a structured meta-analysis impossible. Thus, we organized our synthesized results according to behavioral outcome.

### Risk of Bias Across Studies

In order to rate the certainty of evidence supporting psychoeducational interventions targeting specific behavioral outcomes, we used the Cochrane GRADE approach to rate the literature, taking into account the quality of the evidence and the magnitude of the effect (Schünemann et al, 2013).

## RESULTS

### Study Selection

Our electronic search yielded 4357 studies across PubMed and Google Scholar (PubMed  $k = 4348$ , Google

Scholar  $k = 9$ , no duplicates); our hand search yielded 24 studies. Figure 1 is a flow diagram of our literature search.

We excluded studies for the following reasons: they were intervention studies in which participants were not adults with ASD (ie, children and/or adolescents with ASD or family members of individuals with ASD,  $k = 2819$ ); they were intervention studies in which participants did not meet the criteria for ASD-3 or it was impossible to isolate the results for participants with ASD-3 ( $k = 190$ ); they were studies of pharmacological interventions ( $k = 405$ ); they were nonempirical studies or quantitative data relevant to the psychoeducational intervention were not provided ( $k = 907$ ); or the study was not available in English ( $k = 4$ ).

Ultimately, a total of 56 studies were included in this review: 46 (82%) from the electronic search and 10 (18%) from the hand search. Of the studies identified by electronic search, 16 were published in the last 10 years, and 40 were published earlier; of the studies identified by hand search, one was published in the last 10 years, and nine were published earlier. The 56 studies that ultimately met our criteria for inclusion in this review are summarized in Table 2.

### Risk of Bias Within Studies

Given the difficulties in studying the ASD population, as well as the evolution of research standards over the last 50 years, we (as expected) found many methodological limitations in all of the studies. Considering current terminology, these limitations raise the possibility of biases in the interpretation of the data. Because they were common between studies, the limitations will be reported

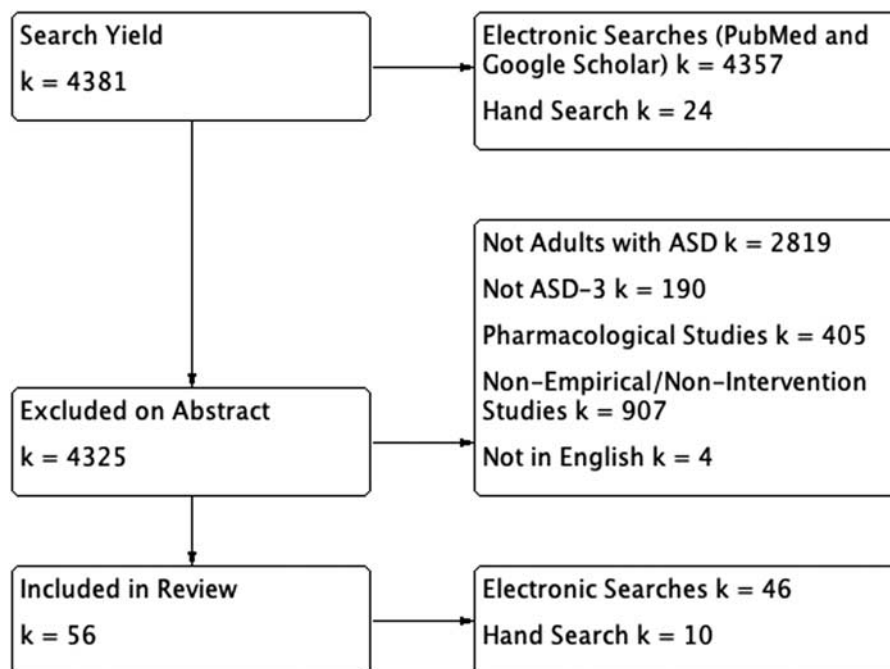


FIGURE 1. Flow diagram of our literature search. ASD-3 = level 3 autism spectrum disorder.

**TABLE 2.** Characteristics of Included Studies

Reference	Design	Sample Size	Excluded		M Age (Years)	Intervention Description	Timing of Measurements	Outcome	Outcome Measurement Type	Standard M Difference	ASD-3 Diagnosis
			From Review	% Male							
Adelinis and Hagopian (1999)	ABAB	1	0	100.0	27	Behavioral intervention for aggressive behavior using symmetrical “do” and “don’t” requests	During each session	Aggressive/ Destructive behaviors	Behavioral observation	2.30 [-1.89, 6.50]	History
Baker et al (2005)	AB	1	0	100.0	45	Intervention for coprophagia by introduction of highly spiced, flavorful food options for each meal and as snacks	Daily	Self-injurious behaviors	Behavioral observation	7.13 [2.76, 11.49]	History
Banda et al (2010)	ABA	1	1 (child)	100.0	21	Communication skills training using video-recorded, individualized vignettes that showed modeling of requesting of objects	During each session	Language/ Communication skills	Behavioral observation	NE	Confirmed by direct assessment
Bebko et al (1996)	ABCD	1	19 (children or not ASD-3)	100.0	20	Examined shared communication method, facilitated communication	During each session	Language/ Communication skills	Behavioral observation	NE	History
Bennett et al (2010)	ABA	2	1 (not ASD-3)	100.0	26	Vocational skills training using physical and vocal feedback in the form of praise, guidance, and correction statements delivered via covert audio coaching	During each session	Vocational skills	Behavioral observation	NE	History
Boso et al (2007)	AB	8	0	87.5	30.2	Active musical activities aimed at facilitating social engagement, improving behavioral problems, and enhancing creative music making (drumming, piano playing, singing)	Postintervention at 26 and 52 weeks	Aggressive/ Destructive behaviors	Rating scale	2.13 [0.84, 3.45]	Confirmed by direct assessment
Breen et al (1985)	ABC	4	0	100.0	18.8	Social skills training using direct instruction, modeling, and prompting in a job setting	Baseline probes: at least 1 time out of every 5 consecutive work days Generalization probes: daily Training probes: per session	Language/ Communication skills	Behavioral observation	2.71 [0.39, 5.04]	History
Campillo et al (2014)	AB	3	0	66.7	27.5	Intervention for anxiety behaviors in waiting situations, using Tic-Tac software tool	Daily for 2 months	Emotional functioning	Behavioral observation	1.83 [-0.56, 4.21]	Unspecified
Carminati et al (2007)	AB	19	0	Cohort 1: 80.0; cohort 2: 77.8	Cohort 1: 38.3; cohort 2: 39.7	Highly structured and individualized residential program inspired by TEACCH that focuses on increasing autonomy in domestic and educational activities	Every 3 months	Aggressive/ Destructive behaviors	Behavioral observation and rating scale	1.28 [0.30, 2.26]	Confirmed by direct assessment
Carr et al (1997)	ABA	1	2 (children)	100.0	20	The role of unanticipated idiosyncratic stimulus variables in the outcome of a functional analysis for an intervention for problem behaviors	During each session	Self-injurious behaviors	Behavioral observation	0.55 [-7.30, 8.41]	Confirmed by direct assessment
Cividini-Motta and Ahearn (2013)	AB	1	3 (children)	100.0	38	Evaluated 2 iterations of differential reinforcement for overcoming prompt dependency and facilitating skills acquisition	During each session	Language/ Communication skills	Behavioral observation	2.04 [-6.75, 10.83]	History

Duker and Schaapveld (1996)	ABA	2	3 (children)	100.0	26	Response-contingent interruption-prompting intervention aimed at facilitating on-task behaviors and improving stereotypic and inappropriate behaviors	During each session	Stereotypy/ Mannerisms	Behavioral observation	0.76 [-3.95, 5.46]	Confirmed by direct assessment
Edrisinha et al (2011)	ABA	4	0	100.0	36	Skills training using video modeling and vocal praise	During each session	Activities of daily living	Behavioral observation	6.99 [-32.63, 46.61]	Confirmed by direct assessment
Elliott et al (1991)	Repeated measures	23	0	82.6	26	Examined the effects of 2 instructional methods on language generalization and long-term retention	Phase 1: 1 week baseline assessment Phase 2: After 1 month training, baseline repeated Phase 3: Phase 1 baseline procedures were readministered at least 8 weeks after the termination of instruction in Phase 1	Language/ Communication skills	Behavioral observation	NE	Confirmed by direct assessment
Elliott et al (1994)	Randomized controlled trial	6	0	50.0	30.4	1: Behavioral intervention for stereotypic behavior using general motor training activities 2: Behavioral intervention for stereotypic behavior using aerobic exercise 3: Tabletop activities, ie, board games, puzzles, arts, and crafts	Pre- and postsession	Aggressive/ Destructive behaviors, self-injurious behaviors, stereotypy/ mannerisms	Behavioral observation	NE, NE, NE	Confirmed by clinical evaluation
Fava and Strauss (2010)	Between-subjects group; Pre- and posttest	9	18 (not ASD-3)	NS	Entire sample: 37.8; ASD only group: NS	1: Social skills training with a Snoezelen room and limited caregiver interaction 2: Social skills training with a stimulus preference room where stimuli are adapted to individual choice and a more structured approach is used to prompt and reinforce behaviors 3: Social skills training in a natural setting with no structured approach	Pre-, during, and postintervention and at follow-up	Aggressive/ Destructive behaviors, stereotypy/ mannerisms	Behavioral observation	0.17 [-8.61, 8.95]; 0.07 [-8.71, 8.84]	History
Garcia-Villamisar and Dattilo (2010)	Randomized controlled trial	71	0	Intervention group: 59.5; wait list group: 55.9	Intervention group: 31.5; wait list group: 30.1	Leisure program including exposure to various preferred activities presented in several levels of difficulty with associated levels of support	Pre- and postintervention	Emotional functioning	Rating scale	1.93 [1.37, 2.48]	Confirmed by clinical evaluation
Gaylord-Ross et al (1984)	ABCD	2	2 (children)	100.0	19	1: Social skills training using direct instruction, modeling, and role play with 3 leisure objects (a radio, a video game, and gum) 2: Social skills training using direct instruction, modeling, and role play with 3 leisure objects (a radio, a video game, and gum)	During each generalization probe and at follow-up (4 months later)	Language/ Communication skills	Behavioral observation	7.02 [-1.24, 15.28]	Confirmed by clinical evaluation

TABLE 2. (continued)

Reference	Design	Sample Size	Excluded From Review	% Male	M Age (Years)	Intervention Description	Timing of Measurements	Outcome	Outcome Measurement Type	Standard M Difference	ASD-3 Diagnosis
Gerber et al (2011)	Repeated measures	31	0	74.2	43	1: Autism programme with a structured method with chosen objectives focused on the development of autonomy 2: Traditional program for intellectual disability (not an autism programme with a structured method) based on systemic pedagogy and a variety of approaches, ie, developmental and individualized approaches; chosen objectives focused on strengthening the processes of socialization	Aberrant Behavior Checklist: 3 months Quality of Life Inventory: at the beginning, after 12 months and at the end of the study Child Autism Rating Scales: approximately every 12 months	Emotional functioning, language/communication skills, stereotypy/mannerisms	Rating scale	1.51 [0.75, 2.28]; 0.87 [0.17, 1.57]; 0.09 [-0.57, 0.76]	Confirmed by direct assessment
Gilson and Carter (2016)	ABA	2	1 (not ASD-3)	100.0	21.5	One-on-one coaching through an earpiece of social and task-related skills	During each session	Language/Communication skills	Behavioral observation	0.63 [-3.46, 4.73]	History
Goodson et al (2007)	ABAB	3	1 (did not receive intervention)	100.0	34.3	1: Skills training using video modeling and voice-over instructions 2: Skills training using video modeling, voice-over instructions, error correction, and modeling	Twice per week per session	Activities of daily living	Behavioral observation	2.77 [-13.03, 18.58]	Confirmed by direct assessment
Graff and Gibson (2003)	ABAB	1	2 (children)	100.0	20	Tangible preference assessments were compared with pictorial preference assessments	During each session	Language/Communication skills	Behavioral observation	5.73 [1.42, 10.03]	History
Hagopian et al (2011)	ABABCBC	1	1 (child)	100.0	19	Treatment of Pica using response interruption and differential reinforcement of alternative behavior	During each session	Self-injurious behaviors	Behavioral observation	1.96 [-4.31, 8.23]	History
Hanley et al (2000)	Multi-element design	2	1 (not ASD-3)	50.0	46	Behavioral intervention for stereotypic behavior: 1: by allowing continuous access to materials 2: through prompting to manipulate materials 3: through restricting access to stereotypy (ie, response blocking) 4: by allowing access to stereotypy contingent on material manipulation 5: free play condition where the participant had free access to leisure materials	During each session	Stereotypy/Mannerisms	Behavioral observation	1.60 [-7.68, 10.88]	History
Haring et al (1987)	ABCA	3	0	66.7	20	Subjects trained to purchase items; training was conducted in 1 setting with concurrent generalization probes taken in 3 community stores	During each session	Activities of daily living	Behavioral observation	2.27 [-0.45, 4.98]	History
Hume and Odom (2007)	ABAB	1	2 (children)	100.0	20	Vocational skills training using a visually organized space where previously mastered work is practiced or performed under direct supervision of the trainer	Daily	Vocational skills	Behavioral observation	0.28 [-4.18, 4.76]	Confirmed by clinical evaluation



Jerome et al (2007)	ABA	2	1 (not ASD-3)	100.0	33	Skills training using errorless learning and backward chaining	During each session	Activities of daily living	Behavioral observation	4.35 [-20.31, 28.99]	History
Kaplan et al (2006)	Experiment 1: ABA; Experiment 2: ABAB	3	0	66.7	49.5	Behavioral intervention using a multi-sensory room (Snoezelen) in different settings 1: Snoezelen occupational therapy treatment 2: Non-Snoezelen occupational therapy treatment consisting of proprioceptive and vestibular calming exercises	Postsession	Aggressive/Destructive behaviors, emotional functioning	Behavioral observation	0.32 [-16.65, 17.30]; 0.08 [-25.78, 25.93]	History
Kennedy (1994)	Phase 1: multi-element design Phase 2: multiprobe design	1	2 (not ASD-3)	100.0	20	Manipulation of interspersal and fading as antecedents to alter the stimulus control by task demands over problem behavior	During each session	Aggressive/Destructive behaviors, self-injurious behaviors, stereotypy/mannerisms	Behavioral observation and rating scale	0.91 [-6.70, 8.52] (combined effect size for aggressive/ destructive behaviors, self-injurious behaviors, and stereotypy/mannerisms)	History
Kuhn et al (1999)	ABAB	1	0	100.0	35	Escape and sensory extinction as behavioral interventions for self-injurious behaviors	During each session	Self-injurious behaviors	Behavioral observation	1.50 [-3.77, 6.77]	History
Lattimore et al (2008)	AB	3	0	100.0	33.7	Work skills training using most-to-least invasive support in completing steps (physical guidance, shadowing, vocal prompts, gestural prompts) and error prevention	During each session	Vocational skills	Behavioral observation	6 [-0.01, 12.02]	History
Lattimore et al (2009)	ABA	3	1 (did not receive intervention)	100.0	34.7	Work skills training using most-to-least invasive support in completing steps (physical guidance, shadowing, vocal prompts, gestural prompts) and error prevention	Pre-intervention and at follow-up	Vocational skills	Behavioral observation	4.2 [-0.16, 8.55]	Unspecified
Lee et al (2002)	AB	1	2 (children)	100.0	27	The effect of lag schedules of differential reinforcement on social and communication skills	During each session	Language/Communication skills	Behavioral observation	0.53 [-8.02, 9.09]	History
Liu et al (2013)	AB	14	0	71.4	24.6	Group education sessions, including teaching, modeling, and role playing of social and work behaviors, and individualized instruction	Pre- and postintervention with monthly observations to determine continued appropriateness of program	Language/Communication skills, vocational skills	Behavioral observation and rating scale	0.44 [0.01, 0.88]	Unspecified
Lundqvist et al (2009)	Randomized controlled trial	10	10 (did not receive intervention)	65.0	37	Effects of vibroacoustic chair and music therapy on participant behaviors	Pre-intervention	Aggressive/Destructive behaviors, self-injurious behaviors	Rating scale	0.00 [-0.88, 0.88]; 0.57 [-0.033, 1.47]	History

TABLE 2. (continued)

Reference	Design	Sample Size	Excluded From Review	% Male	M Age (Years)	Intervention Description	Timing of Measurements	Outcome	Outcome Measurement Type	Standard M Difference	ASD-3 Diagnosis
McClean et al (2007)	AB	2	3 (not ASD-3)	100.0	23	Positive behavior support in community settings as an intervention for serious physical injury resulting from challenging behaviors	Behavior: throughout the duration of the study Mini Psychiatric Evaluation Scales for Adults with Developmental Disabilities: at baseline, and at 6 and 12 months, and postintervention Quality of Life Questionnaire: pre- and postintervention Medication: every month Costs: at baseline and at 18 months	Aggressive/Destructive behaviors, self-injurious behaviors	Behavioral observation and rating scale	0.63 [-3.45, 4.72] (combined effect size for aggressive/destructive behaviors and self-injurious behaviors)	History
McKee et al (2007)	ABAB	3	0	100.0	30.3	Social skills training using a Snoezelen room	Daily monitoring of disruptive behaviors and hourly monitoring of prosocial behaviors for 7 hours	Aggressive/Destructive behaviors, language/communication skills	Behavioral observation	0.20 [-1.81, 1.41]; 0.08 [-1.52, 1.69]	History
McKeegan et al (1984)	AB	1	0	100.0	28	Behavioral intervention for stereotypic behavior using a nonexclusionary time-out procedure	During each session and at 1 and 6 month follow-ups	Stereotypy/Mannerisms	Behavioral observation	4.64 [0.61, 8.68]	History
McKeegan et al (1987)	AB	1	0	100.0	23	Controlled eating technique and a procedure that combined controlled eating with differential reinforcement of other behavior for the reduction of rumination	During each session and 6 month follow-up	Self-injurious behaviors	Behavioral observation	2.36 [-1.34, 7.90]	History
McNally et al (1988)	AB	1	0	0.0	24	Use of edibles and reductions in activity demands to reward water refusal as an intervention for psychogenic polydipsia	Daily	Aggressive/Destructive behaviors, self-injurious behaviors	Behavioral observation	NE, NE	Unspecified
Moore (2009)	Multiprobe design	1	0	100.0	18	Stereotypic behavior intervention using a self-management treatment package across 3 generalization settings	During each session	Stereotypy/Mannerisms	Behavioral observation	2.76 [-2.90, 8.42]	History
Reese et al (1998)	ABA	1	0	100.0	26	Differential reinforcement of other intervention, token fines, and prompted relaxation for agitated-disruptive behavior	During each session	Aggressive/Destructive behaviors	Behavioral observation	0.31 [-6.51, 7.12]	Unspecified
Rehfeldt and Chambers (2003)	Multi-element design; BABAB	1	0	100.0	23	Intervention for verbal perseverations consisting of differential reinforcement of appropriate verbal responses and extinction of perseverative verbal responding	During each session	Language/Communication skills	Behavioral observation	2.40 [-1.39, 6.19]	History

Saiano et al (2015)	Between-subjects group; Pre- and posttest	3	4 (not ASD-3)	100.0	40	Safety skills training using direct instruction, modeling, and verbal/physical prompting in a virtual environment	Familiarization: sessions/weeks 1-5 Training: sessions/weeks 7-9 Assessment: sessions/weeks 6 and 10	Activities of daily living	Behavioral observation	2.10 [-9.92, 14.11]	Confirmed by clinical evaluation
Shabani and Fisher (2006)	ABAB	1	0	100.0	18	Intervention for needle phobia consisting of stimulus fading plus differential reinforcement	During each of 9 sessions over the course of 2 weeks	Emotional functioning	Behavioral observation	NE	History
Sheehan and Matuozzi (1996)	Naturalistic exploratory	1	2 (children)	100.0	24	Facilitated communication intervention using modeling and prompting in a message-passing format	During each of 4 sessions that occurred over approximately 3 months	Language/Communication skills	Behavioral observation	NE	History
Siaperas and Beadle-Brown (2006)	Repeated measures	12	0	66.7	21.3	Structured residential program using Treatment and Education of Autistic and Related Communication-Handicapped Children (TEACCH) guidelines effect on 3 specific areas of functioning: personal independence, social abilities, and functional communication	Pre- and postintervention	Activities of daily living, language/communication skills	Behavioral observation and rating scale	0.44 [-0.37, 1.25]; 0.42 [-0.15, 0.99]	Confirmed by direct assessment
Sigafoos et al (2004a)	AB	1	1 (child)	0.0	20	Communication breakdown repair skill training using direct instruction, role play, and prompting	During each session	Language/Communication skills	Behavioral observation	NE	History
Sigafoos et al (2004b)	ABA	1	2 (children)	0.0	20	Voice Output Communication Aid location skills training using a least-to-most prompting procedure	During each session	Language/Communication skills	Behavioral observation	NE	History
Smith (1986)	AB	1	0	0.0	24	Intervention for self-stimulatory behavior consisting of presentation of alternative but similar sensory experiences	Daily for 14 months	Self-injurious behaviors	Behavioral observation	NE	Unspecified
Smith (1987)	ABA	1	0	100.0	23	Intervention for Pica using differential reinforcement of incompatible behavior	Daily for 82 days and follow-up at 12 months	Self-injurious behaviors	Behavioral observation	2.55 [-2.72, 7.82]	Unspecified
Smith and Belcher (1985)	AB	4	1 (not ASD-3)	25.0	26	Life skills training in a community-based residential program using direct instruction, error correction, and modeling	NS	Activities of daily living	Behavioral observation	1.27 [-0.37, 2.90]	Unspecified
Smith and Coleman (1986)	AB	3	0	100.0	26	Management of behavior problems using on-the-job training procedures that include: 1: instructions on how to ask for assistance, role play, and response cost 2: report card and points 3: differential reinforcement	Case 1: daily following 1 month of baseline Case 2: Daily Case 3: NS	Self-injurious behaviors, vocational skills	Behavioral observation	5.12 [0.06, 10.18]; NE	Unspecified

TABLE 2. (continued)

Reference	Design	Sample Size	Excluded From Review	% Male	M Age (Years)	Intervention Description	Timing of Measurements	Outcome	Outcome Measurement Type	Standard M Difference	ASD-3 Diagnosis
Van Bourgon-dien et al (2003)	Randomized controlled trial	6	26 (did not receive intervention)	NS	25	Residential program, based on the TEACCH model, focused on improving residents' ability to function independently within the community	6-month intervals	Activities of daily living	Rating scale	NE	Confirmed by direct assessment
Vuran (2008)	AB	2	0	100.0	22	Skills training using verbal and physical feedback	During each intervention session and at 6 week follow-up	Activities of daily living	Behavioral observation	3.84 [-17.98, 25.67]	History
Wong et al (1991)	AB	1	0	100.0	31	Subject treated with a differential reinforcement of other behavior schedule and compliance training	During each session	Self-injurious behaviors	Behavioral observation	4.90 [-8.65, 10.57]	History
<b>Averages Totals</b>	ABAB: <i>k</i> = 8; AB: <i>k</i> = 17; ABA: <i>k</i> = 12; ABCD: <i>k</i> = 2; ABC: <i>k</i> = 1; Repeated measures: <i>k</i> = 3; Randomized controlled trial: <i>k</i> = 4; Between subjects: <i>k</i> = 2; ABABCBC: <i>k</i> = 1; Multi-element design: <i>k</i> = 3; ABCA: <i>k</i> = 1; Multiprobe design: <i>k</i> = 1; BABAB: <i>k</i> = 1; Naturalistic exploratory: <i>k</i> = 1	5.2		83.5	27.7			Activities of daily living: <i>k</i> = 9; aggressive/ destructive behaviors: <i>k</i> = 12; emotional functioning: <i>k</i> = 5; language/ communication skills: <i>k</i> = 17; self-injurious behaviors: <i>k</i> = 14; stereotypy/ mannerisms: <i>k</i> = 8; vocational skills: <i>k</i> = 6	Behavioral observation: <i>k</i> = 51 Rating scale: <i>k</i> = 10		History: <i>k</i> = 31; Confirmed by direct assessment: <i>k</i> = 11; Confirmed by clinical evaluation: <i>k</i> = 5; Unspecified: <i>k</i> = 9

ASD-3 = level 3 autism spectrum disorder. NE = no effect size calculated. NS = not stated.

as general themes rather than discussing them study by study. Figures 2 and 3 depict our bias assessments.

There was a high risk of bias in terms of the study design of the studies we included in our review (Higgins and Green, 2011; Reichow et al, 2018; Sterne et al, 2016). First, only a few of the studies were randomized controlled trials; this, by default, introduces selection bias to the sampling strategy. In most of the studies, the participants were selected based on the subjective judgment of the clinicians. It is important to note that it is extremely difficult to conduct randomized controlled trials on this population given that few institutions provide regular access to participants. Other ethical and logistical considerations associated with this population—including, but not limited to, obtaining consent for participation, transportation to and from sessions, and compensation for participation—make this population relatively challenging to recruit. Nevertheless, we did identify four randomized controlled trials containing both a treatment group and a control group (Elliott et al, 1994; García-Villamisar and Dattilo, 2010; Lundqvist et al, 2009; Van Bourgondien et al, 2003). However, the process of randomization was clearly described in only three of these (Elliott et al, 1994; Lundqvist et al, 2009; Van Bourgondien et al, 2003), and all four studies provided inadequate descriptions of the inclusion and exclusion criteria as well as limited information on other potential neurodevelopmental factors that may have influenced participant performance. Thus, it is difficult to tell how representative the participants in the four studies were of the population as a whole (which, as mentioned, is heterogeneous in itself). Moreover, it was impossible to determine the presence of any confounding factors relevant to the outcomes tested. Only three of the 56 studies (Carminati et al, 2007; Fava and Strauss, 2010; Gerber et al, 2011) blinded the participants, investigators, and outcome assessments; the remainder of the included studies did not consider the impact of performance and detection bias in their designs.

We also found that the assessment of interrater reliability was often insufficient, which is of particular concern for studies of psychosocial and behavioral functioning, in which assessment of the outcome is subjective. Missing data were also encountered in many of the studies in our review; however, few of the studies discussed this issue, and there are no available published analyses of the possible patterns of missing data that may have confounded the reported findings and their interpretation.

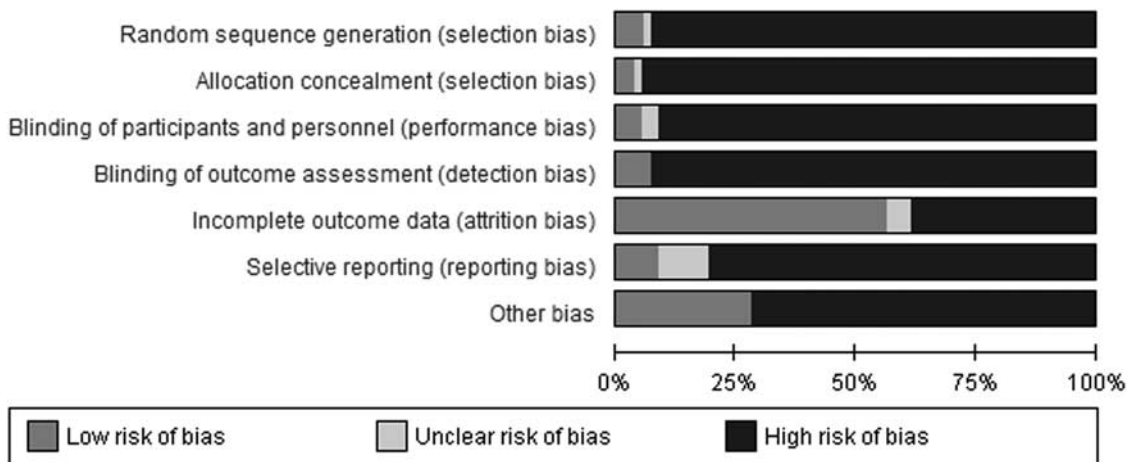
To assess whether the methodological quality of the studies improved over time, we correlated the number of methodological issues identified with the publication date of each study. The quality of study methods did show a trend toward improvement with time, but this trend was not significant ( $r = -0.211, P = 0.110$ ; Figure 4).

### Descriptive Review of the Findings

Despite the aforementioned issues, the studies we reviewed did provide useful evidence concerning psychoeducational interventions for adults with ASD-3. This evidence will be qualitatively evaluated here by behavioral outcome (see Tables 3 and 4, and Figure 5, for a complete summary of the data).

### Activities of Daily Living

Due to a very low proportion of studies that showed a significant effect of the intervention yet showed a very high risk of bias, the quality of the evidence supporting the effectiveness of interventions to improve daily activities in adults with ASD-3 was very low. This behavioral outcome was investigated in nine studies: Edrisinha et al (2011), Goodson et al (2007), Haring et al (1987), Jerome et al (2007), Saiano et al (2015), Siaperas and Beadle-Brown (2006), Smith and Belcher (1985), Van Bourgondien et al (2003), and Vuran (2008). One study involved a social skills training program as the intervention (Siaperas and Beadle-Brown, 2006); the other eight studies focused on behavioral techniques as the intervention (Edrisinha et al, 2011; Goodson et al, 2007; Haring et al, 1987;

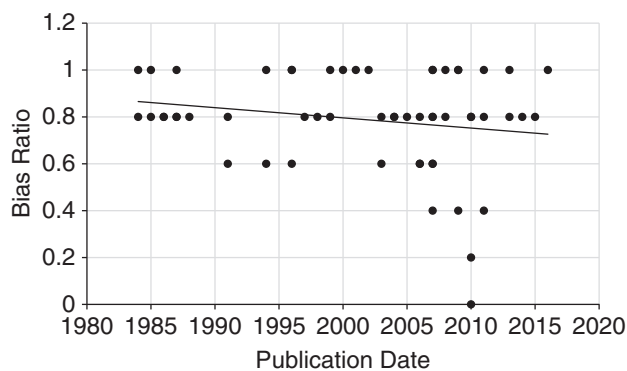


**FIGURE 2.** Risk of bias graph: Review authors’ judgments about each risk-of-bias item presented as percentages across the 56 studies.

	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants and personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)	Other bias
Adelinis & Hagopian, 1999	+	+	+	+	+	+	+
Baker et al, 2005	+	+	+	+	+	+	+
Banda et al, 2010	+	+	+	+	+	+	+
Bebko et al, 1996	+	+	+	+	+	+	+
Bennett et al, 2010	+	+	+	+	+	+	+
Boso et al, 2007	+	+	+	+	+	+	+
Breen et al, 1985	+	+	+	+	+	+	+
Campillo et al, 2014	+	+	+	+	+	+	+
Carminati et al, 2007	+	+	+	+	?	?	?
Carr et al, 1997	+	+	+	+	+	+	+
Cividini-Motta & Ahearn, 2013	+	+	+	+	+	+	+
Duker & Schaapveld, 1996	+	+	+	+	+	+	+
Edrinsha et al, 2011	+	+	+	+	+	+	+
Elliott et al, 1991	+	+	+	+	+	+	+
Elliott et al, 1994	+	+	+	+	+	+	+
Fava & Strauss, 2010	+	+	+	+	?	?	?
García-Villamizar & Dattilo, 2010	?	?	?	?	+	+	+
Gaylord-Ross et al, 1984	+	+	+	+	+	+	+
Gerber et al, 2011	+	+	+	+	+	?	?
Gilson & Carter, 2016	+	+	+	+	+	+	+
Goodson et al, 2007	+	+	+	+	+	+	+
Graff & Gibson, 2003	+	+	+	+	+	+	+
Hagopian et al, 2011	+	+	+	+	+	+	+
Hanley et al, 2000	+	+	+	+	+	+	+
Haring et al, 1987	+	+	+	+	+	+	+
Hume & Odom, 2007	+	+	+	+	+	+	+
Jerome et al, 2007	+	+	+	+	+	+	+
Kaplan et al, 2006	+	+	+	+	+	+	+
Kennedy, 1994	+	+	+	+	+	+	+
Kuhn et al, 1999	+	+	+	+	+	+	+
Lattimore et al, 2008	+	+	+	+	+	+	+
Lattimore et al, 2009	+	+	+	+	+	+	+
Lee et al, 2002	+	+	+	+	+	+	+
Liu et al, 2013	+	+	+	+	+	+	+
Lundqvist et al, 2009	+	+	?	+	+	+	+
McClean et al, 2007	+	+	+	+	+	+	+
McKee et al, 2007	+	+	+	+	+	+	+
McKeegan et al, 1984	+	+	+	+	+	+	+
McKeegan et al, 1987	+	+	+	+	+	+	+
McNally et al, 1988	+	+	+	+	+	+	+
Moore, 2009	+	+	+	+	+	+	+
Reese et al, 1998	+	+	+	+	+	+	+
Rehfeldt & Chambers, 2003	+	+	+	+	+	+	+
Saiano et al, 2015	+	+	+	+	+	+	+
Shabani & Fisher, 2006	+	+	+	+	+	+	+
Sheehan & Matuozzi, 1996	+	+	+	+	+	+	+
Siaperas & Beadle-Brown, 2006	+	+	+	+	+	+	+
Sigafoos et al, 2004a	+	+	+	+	+	+	+
Sigafoos et al, 2004b	+	+	+	+	+	+	+
Smith, 1986	+	+	+	+	+	+	+
Smith, 1987	+	+	+	+	+	+	+
Smith & Belcher, 1985	+	+	+	+	?	+	+
Smith & Coleman, 1986	+	+	+	+	+	+	+
Van Bourgondien et al, 2003	+	+	+	+	+	?	+
Vuran, 2008	+	+	+	+	+	+	+
Wong et al, 1991	+	+	+	+	+	+	+

**FIGURE 3.** Risk of bias summary: Review authors’ judgments about each risk-of-bias item for each included study. + = high risk. - = low risk. ? = unclear risk.

Jerome et al, 2007; Saiano et al, 2015; Smith and Belcher, 1985; Van Bourgondien et al, 2003; Vuran, 2008). Of the seven studies for which we could calculate an effect size, none showed a significant effect.



**FIGURE 4.** Bias ratio by publication date: Ratio of bias domains judged to have high risk plotted against publication date.

### Aggressive/Destructive Behaviors

Due to a very low proportion of studies that showed a significant effect of the intervention yet showed a high risk of bias, the quality of the evidence supporting the effectiveness of interventions to reduce aggressive/destructive behaviors in adults with ASD-3 was low. This outcome was investigated in 12 studies: Adelinis and Hagopian (1999), Boso et al (2007), Carminati et al (2007), Elliott et al (1994), Fava and Strauss (2010), Kaplan et al (2006), Kennedy (1994), Lundqvist et al (2009), McClean et al (2007), McKee et al (2007), McNally et al (1988), and Reese et al (1998). Two studies used recreational therapies as the intervention (Boso et al, 2007; Lundqvist et al, 2009), seven used behavioral techniques (Adelinis and Hagopian, 1999; Carminati et al, 2007; Elliott et al, 1994; Kennedy, 1994; McClean et al, 2007; McNally et al, 1988; Reese et al, 1998), and three used multisensory rooms (Fava and Strauss, 2010; Kaplan et al, 2006; McKee et al, 2007). Of the 10 studies for which we could calculate an effect size, two showed a significant positive effect (Boso et al, 2007: 2.13 [0.84, 3.45]; Carminati et al, 2007: 1.28 [0.30, 2.26]). Boso et al (2007) included active musical activities (ie, drumming, piano playing, singing) for a predominantly male (87.5% male) group of eight adults (M age = 30.2); Carminati et al (2007) included a structured applied behavioral analysis approach to a residential program for a predominantly male (78.9% male) group of 19 adults (M age = 39).

### Emotional Functioning

Due to a moderate proportion of studies that showed a significant effect of the intervention yet showed a moderate risk of bias, the quality of the evidence supporting the effectiveness of interventions to improve emotional functioning in adults with ASD-3 was moderate. This outcome was investigated in five studies: Campillo et al (2014), García-Villamizar and Dattilo (2010), Gerber et al (2011), Kaplan et al (2006), and Shabani and Fisher (2006). One study used recreational therapies as the intervention (García-Villamizar and Dattilo, 2010), three used behavioral techniques (Campillo et al, 2014; Gerber et al, 2011; Shabani and Fisher, 2006), and one used a multisensory room (Kaplan et al, 2006). Of the two studies

**TABLE 3.** Effectiveness of Interventions for Each Behavioral Outcome

Type of Intervention	Activities of Daily Living	Aggressive/ Destructive Behaviors	Emotional Functioning	Language/ Communication Skills	Self-Injurious Behavior	Stereotypy/ Mannerisms	Vocational Skills
Social Skills Intervention	Siaperas and Beadle-Brown (2006), 0.44 [-0.37, 1.25]			Banda et al (2010), NE; Bebko et al (1996), NE; <b>Breen et al (1985), 2.71 [0.39, 5.04]</b> ; Cividini-Motta and Ahearn (2013), 2.04 [-6.75,10.83]; Elliott et al (1991), NE; Gaylord-Ross et al (1984), 7.02 [-1.24, 15.28]; Gilson and Carter (2016), 0.63 [-3.46, 4.73]; <b>Graff and Gibson (2003), 5.73 [1.42, 10.03]</b> ; Lee et al (2002), 0.53 [-8.02, 9.09]; <b>Liu et al (2013), 0.44 [0.01, 0.88]</b> ; Siaperas and Beadle-Brown (2006), 0.42 [-0.15, .99]; Sigafoos et al (2004a), NE; Sigafoos et al (2004b), NE; Sheehan and Matuozzi (1996), NE			Liu et al (2013), NE
Behavioral Techniques for Skill Improvement	Edrisinha et al (2011), 6.99 [-32.63, 46.61]; Goodson et al (2007), 2.77 [-13.03, 18,58]; Haring et al (1987), 2.27 [-0.45, 4.98]; Jerome et al (2007), 4.35 [-20.31, 28.99]; Saiano et al (2015), 2.10 [-9.92, 14.11]; Smith and Belcher (1985), 1.27 [-0.37, 2.90]; Van Bourgondien et al (2003), NE; Vuran (2008), 3.84 [-17.98, 25.67]						Bennett et al (2010), NE; Hume and Odom (2007), 0.28 [-4.18, 4.76]; Lattimore et al (2008), 6 [-0.01, 12.02]; Lattimore et al (2009), 4.2 [-0.16, 8.55]; <b>Smith and Coleman (1986), 5.12 [0.06, 10.18]</b>

TABLE 3. (continued)

Type of Intervention	Activities of Daily Living	Aggressive/Destructive Behaviors	Emotional Functioning	Language/Communication Skills	Self-Injurious Behavior	Stereotypy/Mannerisms	Vocational Skills
Recreational Therapy		<b>Boso et al (2007), 2.13 [0.84, 3.45];</b> Lundqvist et al (2009), 0.00 [-0.88, 0.88]	<b>García-Villamisar and Dattilo (2010), 1.93 [1.37, 2.48]</b>		Lundqvist et al (2009), 0.57 [-0.33, 1.47]		
Behavioral Techniques for Problem Behavior Reduction		Adelinis and Hagopian (1999), 2.30 [-1.89, 6.50]; <b>Carminati et al (2007), 1.28 [0.30, 2.26];</b> Elliott et al (1994), NE; Kennedy (1994), 0.91 [-6.70, 8.52]; McNally et al (1988), NE; McClellan et al (2007), 0.63 [-3.45, 4.72]; Reese et al (1998), 0.31 [-6.51, 7.12]	Campillo et al (2014), 1.83 [-0.56, 4.21]; <b>Gerber et al (2011), 1.51 [0.75, 2.28];</b> Shabani and Fisher (2006), NE	Gerber et al (2011), 0.09 [-0.57, 0.76]; Rehfeldt and Chambers (2003), 2.40 [-1.39, 6.19]	<b>Baker et al (2005), 7.13 [2.76, 11.49];</b> Carr et al (1997), 0.55 [-7.30, 8.41]; Elliott et al (1994), NE; Hagopian et al (2011), 1.96 [-4.31, 8.23]; Kennedy (1994), 0.91 [-6.70, 8.52]; Kuhn et al (1999), 1.50 [-3.77, 6.77]; McClellan et al (2007), 0.63 [-3.45, 4.72]; McKeegan et al (1987), 2.36 [-1.34, 7.90]; McNally et al (1988), NE; Smith (1986), NE; Smith (1987), 2.55 [-2.72, 7.82]; Smith and Coleman (1986), NE; Wong et al (1991), 4.90 [-8.65, 10.57]	Duker and Schaapveld (1996), 0.76 [-3.95, 5.46]; Elliott et al (1994), NE; <b>Gerber et al (2011), 0.87 [0.17, 1.57];</b> Hanley et al (2000), 1.60 [-7.68, 10.88]; Kennedy (1994), 0.91 [-6.70, 8.52]; Moore (2009), 2.76 [-2.90, 8.42]; <b>McKeegan et al (1984), 4.64 [0.61, 8.68]</b>	
Multisensory Room		Fava and Strauss (2010), 0.17 [-8.61, 8.95]; Kaplan et al (2006), 0.32 [-16.65, 17.30]; McKee et al (2007), 0.20 [-1.81, 1.41]	Kaplan et al (2006), 0.08 [-25.78, 25.93]	McKee et al (2007), 0.08 [-1.52, 1.69]		Fava and Strauss (2010), 0.07 [-8.71, 8.84]	

95% CIs reported. Citations bolded to indicate significant effect size.  
NE = no effect size calculated.



**TABLE 4.** Cochrane Grades of Recommendation, Assessment, Development and Evaluation (GRADE) Working Group Evaluation

Domain	Study	Number of Participants	Effect Size	Significance of Effect Size	Proportion Significant Effect	Significance Level	Total Bias	Bias Level	Quality of Evidence
Activities of Daily Living		39			0	Very low	0.84444444	Very high	Very low
	Edrisinha et al (2011)	4	6.99 [-32.63, 46.61]	NS			1	Very high	
	Goodson et al (2007)	3	2.77 [-13.03, 18.58]	NS			1	Very high	
	Haring et al (1987)	3	2.27 [-0.45, 4.98]	NS			1	Very high	
	Jerome et al (2007)	2	4.35 [-20.31, 28.99]	NS			1	Very high	
	Saiano et al (2015)	3	2.10 [-9.92, 14.11]	NS			0.8	Very high	
	Siaperas and Beadle-Brown (2006)	12	0.44 [-0.37, 1.25]	NS			0.6	High	
	Smith and Belcher (1985)	4	1.27 [-0.37, 2.90]	NS			0.8	Very high	
	Van Bourgondien et al (2003)	6	NE				0.6	High	
	Vuran (2008)	2	3.84 [-17.98, 25.67]	NS			0.8	Very high	
Aggressive/Destructive Behaviors		64			0.16666667	Very low	0.63333333	High	Low
	Adelinis and Hagopian (1999)	1	2.30 [-1.89, 6.50]	NS			0.8	Very high	
	Boso et al (2007)	8	2.13 [0.84, 3.45]	S			0.6	High	
	Carminati et al (2007)	19	1.28 [0.30, 2.26]	S			0.4	Moderate	
	Elliott et al (1994)	6	NE				0.6	High	
	Fava and Strauss (2010)	9	0.17 [-8.61, 8.95]	NS			0.2	Low	
	Kaplan et al (2006)	3	0.32 [-16.65, 17.30]	NS			0.6	High	
	Kennedy (1994)	1	0.91 [-6.70, 8.52]	NS			1	Very high	
	Lundqvist et al (2009)	10	0.00 [-0.88, 0.88]	NS			0.4	Moderate	
	McClellan et al (2007)	2	0.63 [-3.45, 4.72]	NS			0.8	Very high	
	McKee et al (2007)	3	0.20 [-1.81, 1.41]	NS			0.6	High	
	McNally et al (1988)	1	NE				0.8	Very high	
	Reese et al (1998)	1	0.31 [-6.51, 7.12]	NS			0.8	Very high	
	Emotional Functioning		109			0.4	Moderate	0.52	Moderate
Campillo et al (2014)		3	1.83 [-0.56, 4.21]	NS			0.8	Very high	
García-Villamizar and Dattilo (2010)		71	1.93 [1.37, 2.48]	S			0	Low	
Gerber et al (2011)		31	1.51 [0.75, 2.28]	S			0.4	Moderate	
Kaplan et al (2006)		3	0.08 [-25.78, 25.93]	NS			0.6	High	
Shabani and Fisher (2006)		1	NE				0.8	Very high	
Language/Communication Skills		100			0.176470588	Very low	0.81176471	Very high	Very low
	Banda et al (2010)	1	NE				0.8	Very high	
	Bebko et al (1996)	1	NE				0.6	High	
	Breen et al (1985)	4	2.71 [0.39, 5.04]	S			1	Very high	

TABLE 4. (continued)

Domain	Study	Number of Participants	Effect Size	Significance of Effect Size	Proportion Significant Effect	Significance Level	Total Bias	Bias Level	Quality of Evidence	
Self-injurious Behavior	Cividini-Motta and Ahearn (2013)	1	2.04 [-6.75, 10.83]	NS			0.8	Very high		
	Elliott et al (1991)	23	NE				0.6	High		
	Gaylord-Ross et al (1984)	2	7.02 [-1.24; 15.28]	NS			1	Very high		
	Gerber et al (2011)	31	0.09 [-0.57, 0.76]	NS			0.4	Moderate		
	Gilson and Carter (2016)	2	0.63 [-3.46, 4.73]	NS			1	Very high		
	Graff and Gibson (2003)	1	5.73 [1.42, 10.03]	S			1	Very high		
	Lee et al (2002)	1	0.53 [-8.02, 9.09]	NS			1	Very high		
	Liu et al (2013)	14	0.44 [0.01, 0.88]	S			1	Very high		
	McKee et al (2007)	3	0.08 [-1.52, 1.69]	NS			0.6	High		
	Rehfeldt and Chambers (2003)	1	2.40 [-1.39, 6.19]	NS			0.8	Very high		
	Sheehan and Matuoizzi (1996)	1	NE				1	Very high		
	Siaperas and Beadle-Brown (2006)	12	0.42 [-0.15, 0.99]	NS			0.6	High		
	Sigafoos et al (2004a)	1	NE				0.8	Very high		
	Sigafoos et al (2004b)	1	NE				0.8	Very high		
			31			0.071428571	Very low	0.78571429	High	Low
		Baker et al (2005)	1	7.13 [2.76, 11.49]	S			0.8	Very high	
		Carr et al (1997)	1	0.55 [-7.30, 8.41]	NS			0.8	Very high	
		Elliott et al (1994)	6	NE				0.6	High	
		Hagopian et al (2011)	1	1.96 [-4.31, 8.23]	NS			0.8	Very high	
		Kennedy (1994)	1	0.91 [-6.70, 8.52]	NS			1	Very high	
	Kuhn et al (1999)	1	1.50 [-3.77, 6.77]	NS			1	Very high		
	Lundqvist et al (2009)	10	0.57 [-0.33, 1.47]	NS			0.4	Moderate		
	McClean et al (2007)	2	0.63 [-3.45, 4.72]	NS			0.8	Very high		
	McKeegan et al (1987)	1	2.36 [-1.34, 7.90]	NS			0.8	Very high		
	McNally et al (1988)	1	NE				0.8	Very high		
	Smith (1986)	1	NE				0.8	Very high		
	Smith (1987)	1	2.55 [-2.72, 7.82]	NS			0.8	Very high		
	Smith and Coleman (1986)	3	NE				0.8	Very high		
Stereotypy/ Mannerisms	Wong et al (1991)	1	4.90 [-8.65, 10.57]	NS			0.8	Very high		
		53			0.25	Low	0.75	High	Low	
	Duker and Schaapveld (1996)	2	0.76 [-3.95, 5.46]	NS			1	Very high		
	Elliott et al (1994)	6	NE				0.6	High		
	Fava and Strauss (2010)	9	0.07[-8.71, 8.84]	NS			0.2	Low		

Gerber et al (2011)	31	0.87 [0.17, 1.57]	S	0.166666667	Very low	0.4	Moderate
Hanley et al (2000)	2	1.60 [-7.68, 10.88]	NS			1	Very high
Kennedy (1994)	1	0.91 [-6.70, 8.52]	NS			1	Very high
McKeegan et al (1984)	1	4.64 [0.61, 8.68]	S			0.8	Very high
Moore (2009)	1	2.75 [-2.90, 8.42]	NS			1	Very high
	26			0.166666667	Very low	0.9	Very high
Bennett et al (2010)	2	NE	NS			0.8	Very high
Hume and Odom (2007)	1	0.28 [-4.18, 4.76]	NS			0.8	Very high
Lattimore et al (2008)	3	6 [-0.01, 12.02]	NS			1	Very high
Lattimore et al (2009)	3	4.2 [-0.16, 8.55]	NS			1	Very high
Liu et al (2013)	14	NE	S			1	Very high
Smith and Coleman (1986)	3	5.12 [0.06, 10.18]	S			0.8	Very high

NE = no effect size calculated. NS = not significant. S = significant.

for which we could calculate an effect size, both showed a significant positive effect (García-Villamizar and Dattilo, 2010: 1.93 [1.37, 2.48]; Gerber et al, 2011: 1.51 [0.75, 2.28]). García-Villamizar and Dattilo (2010) included leisure activities for a mixed-gender (59.5% male) group of 71 adults (M age = 31.49); Gerber et al (2011) included a structured behavioral program (physical agent modalities) that focused on the development of autonomy in a mixed-gender (74.1% male) group of 31 adults (M age = 43).

**Language Communication Skills**

Due to a very low proportion of studies that showed a significant effect of the intervention yet showed a very high risk of bias, the quality of evidence supporting the effectiveness of interventions to improve language and communication skills in adults with ASD–3 was very low. This outcome was investigated in 17 studies: Banda et al (2010), Bebko et al (1996), Breen et al (1985), Cividini-Motta and Ahearn (2013), Elliott et al (1991), Gaylord-Ross et al (1984), Gerber et al (2011), Gilson and Carter (2016), Graff and Gibson (2003), Lee et al (2002), Liu et al (2013), McKee et al (2007), Rehfeldt and Chambers (2003), Sheehan and Matuozzi (1996), Siaperas and Beadle-Brown (2006), and Sigafoos et al (2004a, 2004b). Fourteen of the studies included behavioral programs designed to improve social skills as the intervention (Banda et al, 2010; Bebko et al, 1996; Breen et al, 1985; Cividini-Motta and Ahearn, 2013; Elliott et al, 1991; Gaylord-Ross et al, 1984; Gilson and Carter, 2016; Graff and Gibson, 2003; Lee et al, 2002; Liu et al, 2013; Sheehan and Matuozzi, 1996; Siaperas and Beadle-Brown, 2006; Sigafoos et al, 2004a, 2004b), two included behavioral techniques (Gerber et al, 2011; Rehfeldt and Chambers, 2003), and one included a multisensory room (McKee et al, 2007). Of the 10 interventions for which we could calculate an effect size, three showed a significant positive effect (Breen et al, 1985: 2.71 [0.39, 5.04]; Graff and Gibson, 2003: 5.73 [1.42, 10.03]; Liu et al, 2013: 0.44 [0.01, 0.88]). Graff and Gibson (2003) used preference assessments to increase requesting behaviors for one 20-year-old man; Liu et al (2013) included teaching, modeling, and role playing of social behaviors for a mixed-gender (71.4%) social skills group of 14 adults (M age = 24.6); and Breen et al (1985) included a social skills training program for four men (M age = 18.75) that included direct instruction, modeling, and prompting in a job setting. All 17 of the interventions involved behavioral techniques (ie, directness, instruction, modeling, and prompting), but none were explicit as to whether they were practical applications of applied behavioral analysis.

**Self-injurious Behaviors**

Due to a very low proportion of studies that showed a significant effect of the intervention yet showed a high risk of bias, the quality of evidence supporting the effectiveness of interventions to reduce self-injurious behaviors in adults with ASD–3 was low. This outcome was investigated in 14 studies: Baker et al (2005), Carr et al (1997), Elliott et al (1994), Hagopian et al (2011), Kennedy (1994), Kuhn et al (1999),

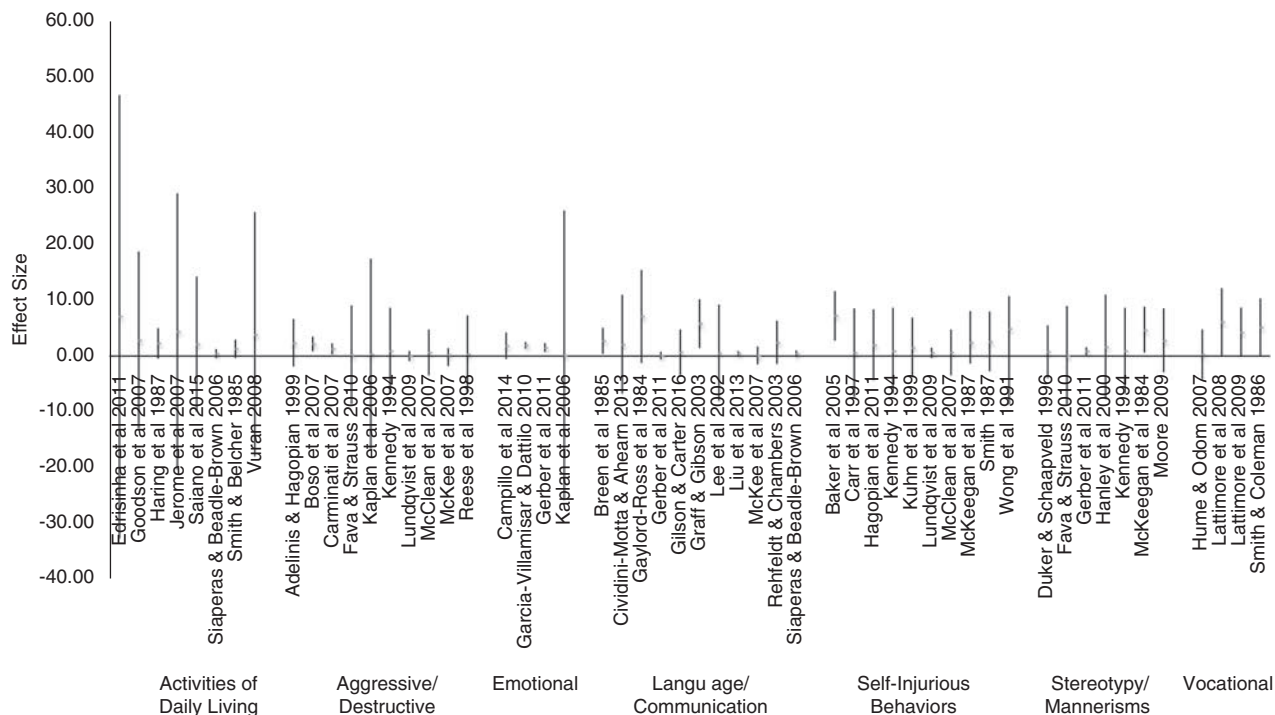


FIGURE 5. Forest plot of comparison: Pre- versus postintervention scores, effect sizes (ie, standardized mean differences).

Lundqvist et al (2009), McClellan et al (2007), McKeegan et al (1987), McNally et al (1988), Smith (1986, 1987), Smith and Coleman (1986), and Wong et al (1991). One study used recreational therapies as the intervention (Lundqvist et al, 2009), and 13 used behavioral techniques (Baker et al, 2005; Carr et al, 1997; Elliott et al, 1994; Hagopian et al, 2011; Kennedy, 1994; Kuhn et al, 1999; McClellan et al, 2007; McKeegan et al, 1987; McNally et al, 1988; Smith 1986, 1987; Smith and Coleman, 1986; Wong et al, 1991). Of the 10 studies for which we could calculate an effect size, one showed a significant positive effect: Baker et al, 2005: 7.13 [2.76, 11.49]. Baker et al (2005) reduced coprophagia in one 45-year-old man by introducing flavorful meal options.

**Stereotypy/Mannerisms**

Due to a low proportion of studies that showed a significant effect of the intervention yet showed a high risk of bias, the quality of evidence supporting the effectiveness of interventions to reduce stereotypy/mannerisms in adults with ASD-3 was low. This outcome was investigated in eight studies: Duker and Schaapveld (1996), Elliott et al (1994), Fava and Strauss (2010), Gerber et al (2011), Hanley et al (2000), Kennedy (1994), McKeegan et al (1984), and Moore (2009). Seven studies used behavioral techniques as the intervention (Duker and Schaapveld, 1996; Elliott et al, 1994; Gerber et al, 2011; Hanley et al, 2000; Kennedy, 1994; McKeegan et al, 1984; Moore, 2009), and one used a multi-sensory room (Fava and Strauss, 2010). Of the seven studies for which we could calculate an effect size, two showed a significant positive effect (Gerber et al, 2011: 0.87 [0.17, 1.57]; McKeegan et al, 1984: 4.64 [0.61, 8.68]). Gerber et al (2011)

was a structured behavioral program (autism program with a structured method) that focused on the development of autonomy in a mixed-gender (74.1% male) group of 31 adults (M age = 43 years), and McKeegan et al (1984) used a non-exclusionary time-out procedure on one 28-year-old man.

**Vocational Skills**

Due to a very low proportion of studies that showed a significant effect of the intervention yet showed a very high risk of bias, the quality of evidence supporting the effectiveness of interventions to improve vocational skills in adults with ASD-3 was very low. This outcome was investigated in six studies: Bennett et al (2010), Hume and Odom (2007), Lattimore et al (2008, 2009), Liu et al (2013), and Smith and Coleman (1986). One of the studies used a social skills program as the intervention (Liu et al, 2013), and five used behavioral techniques (Bennett et al, 2010; Hume and Odom, 2007; Lattimore et al, 2008, 2009; Smith and Coleman, 1986). Of the four studies for which we could calculate an effect size, only one showed a significant positive effect (Smith and Coleman, 1986: 5.12 [0.06, 10.18]). The intervention in that study involved on-the-job training with role play, token economies, and differential reinforcement of behaviors for three adult males (M age = 26 years).

**DISCUSSION**

To our knowledge, this is the only review of the efficacy of available psychoeducational interventions for adults with ASD-3. This is not altogether surprising, as published studies into this research niche are rare in

comparison to the extensive body of literature on interventions for children with ASD or adults with ASD–1 and –2. Following a broad search, we found only 56 relevant studies, published in the past 50 years, that attempted to quantitatively test the effects of psychoeducational interventions on adults with ASD–3.

Of the seven outcome domains studied (activities of daily living, aggressive/destructive behaviors, emotional functioning, language/communication skills, self-injurious behaviors, stereotypy/mannerisms, and vocational skills), only moderately reliable evidence, per Cochrane criteria, existed to support the effectiveness of interventions designed to improve emotional functioning in adults with ASD–3; reliability of evidence for all other domains was assessed as low or very low. Despite the general lack of reliable evidence to support specific interventions, we propose that this review is useful as a guide for future intervention studies involving the ASD–3 population because it provides some insight into how such studies should be better designed.

## Considerations for Future Research Topics

### *Other Cultural/Gender Groups*

The studies reviewed here involved males from Western countries, particularly the United States, almost exclusively. Females with ASD–3 have been suspected as having different clinical phenotypes and psychosocial factors from males with the same diagnosis (Lai et al, 2015) and arguably are exposed to different sociocultural environments and expectations in most cultures (Lips, 2017). Gender, ethnic/cultural, and socioeconomic differences are, therefore, likely to be worthwhile factors for investigation, specifically in terms of how these differences may moderate intervention efficacy (Gerber et al, 2017; Singh and Bunyak, 2019).

### *Other Outcomes*

The studies we reviewed did not explore interventions that target a wide range of behavioral outcomes. Interventions should be studied that target skills crucial to daily life, which include food preparation, cleaning and household chores, personal hygiene and grooming, home and community safety awareness, budgeting and banking, medication management, shopping, and managing appointments; vocational skills, which include applying for jobs, learning to select professional attire, collaborating and interacting with coworkers, and managing job stress; and neurocognitive skills, which include attention/executive functioning, psychomotor abilities, and learning/memory.

### *Other Intervention Methods*

The majority of studies we reviewed tested only applied behavioral analysis and cognitive-behavioral techniques; thus, other intervention methods warrant future study. Many well-known treatments based on behavioral principles (including pivotal response treatment [Koegel et al, 1999], verbal behavior intervention [Skinner, 1957], and relationship development intervention [Gutstein, 2009]) have not yet been studied in adults with ASD–3. Moreover,

several treatment modalities that are commonly used in children with ASD (including floortime/developmental, individual-differences, relationship-based therapy [Solomon et al, 2007], speech-language therapy, occupational therapy, and physical therapy) have also not yet been modified for and tested in adults with ASD–3. Finally, in our search, we came across studies reporting treatments for caregivers of adults with ASD–3 as the primary participants; although these were outside the scope of our review, these types of treatments could also be expected to be influential in improving the lives of individuals with ASD–3.

## Considerations for Future Methodologies

Based on our review, it is clear that studies of psychoeducational interventions for adults with ASD–3 should be designed to be conducive to and report high-quality evidence, even when investigating this challenging participant population (for a summary, see Figure 6).

### *Study Design*

Although randomized controlled trials are the gold standard in intervention research, they may not be feasible for the early evaluation of interventions. Other study designs such as clinical case reports, within-subjects and between-groups experimental studies, and pilot studies may provide a good balance between investigative rigor and practicality (Skolasky, 2016; Smith et al, 2007).

### *Data Analysis and Reporting of Results*

There are several ways in which future studies of interventions for adults with ASD–3 could minimize issues relating to the analysis and reporting of results. First, it would be helpful if studies used both visual and quantitative analyses to gain the most accurate inferences from the data and to allow for broader conclusions to be made across studies (Skolasky, 2016).

Second, future studies should attempt to be more rigorous in their handling of missing data. Relevant to this, the ASD–3 population presents a number of logistical challenges, including, but not limited to, issues related to transportation, which increase the likelihood of missing data. However, it is important that future studies make careful attempts to minimize missing data and address whatever issues arise using rigorous statistical methods (Skolasky, 2016). At the very least, missing data are a limitation that should be acknowledged. We are optimistic that future initiatives will more effectively reduce the impact of missing data, as widely used statistical packages such as R (R Core Team, 2018) allow researchers with no statistical background to effectively analyze challenging data sets, including those involving small sample sizes and case studies with missing data (Skolasky, 2016).

Third, although interventions may not show a significant effect size, they may still lead to meaningful behavior change. Thus, future studies should include mixed quantitative and qualitative methodologies so that any clinical impact (even if not statistically significant) may be comprehensively reported.

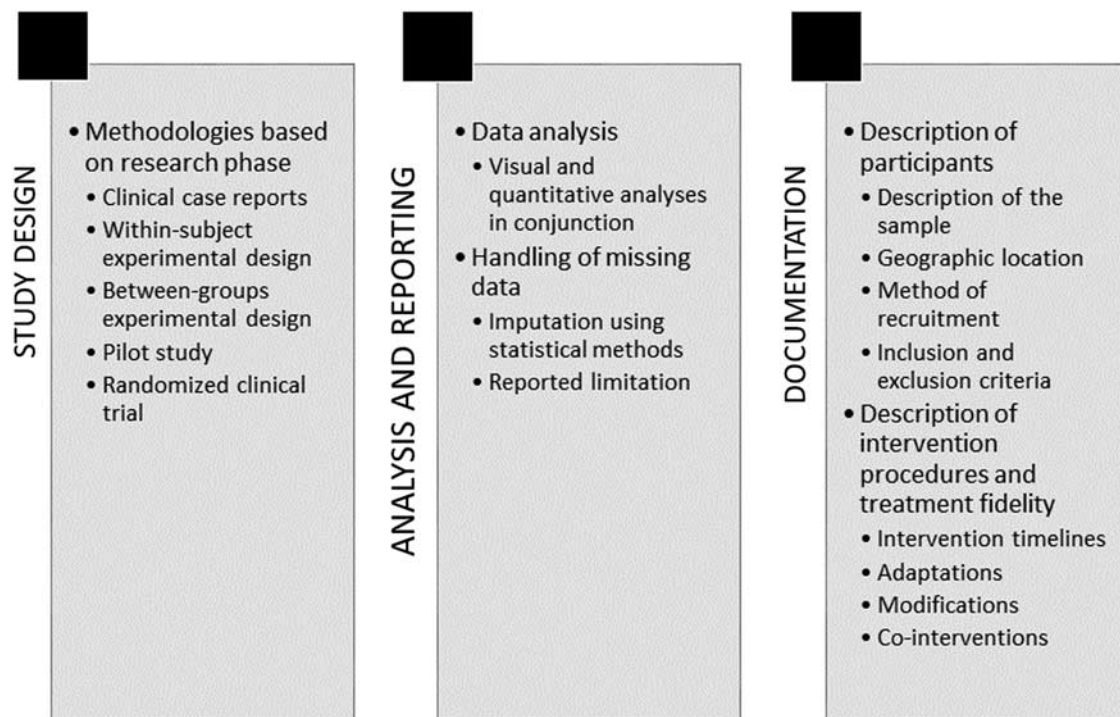


FIGURE 6. Checklist for future studies.

### Documentation of Methodologies and Procedures

It would be helpful if researchers documented detailed methodologies so as to allow other groups to replicate the results and translate the findings to clinical practice. First, it would serve the field well to standardize how participants are described. Many inconsistencies in reporting, to date, may be attributable to journals' adherences to different style manuals: for example, the American Medical Association (2007) requires that authors state how many participants were selected and how many did not agree to participate, whereas the American Psychological Association (2010) does not have this requirement. Going forward, it would help to address inconsistencies in reporting if journals were to implement reporting standards like those set forth in the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) statement (Liberati et al, 2009) and the Cochrane template (Higgins and Green, 2011); this could include a description of the sample, geographic location, setting, method of recruitment, and detailed inclusion and exclusion criteria.

Second, future studies should attempt to be more thorough in reporting their intervention procedures so that researchers and clinicians alike can make use of their findings. Studies should also provide assurances of treatment fidelity and coding reliability to ensure that interventions are delivered and measured as intended. Specifically, a full description of intervention time lines (ie, intensity and duration of treatment), adaptations, and modifications should be provided along with reporting of relevant co-interventions.

### Limitations of This Review

Our literature search process had limitations. First, our English-language requirement clearly biased our search toward Western populations and Western investigators. In the future, electronic translation should enable access to scientific literature from different countries.

Second, our heavy reliance on an electronic search was also a key limitation. Despite using what we considered were broad search terms, the electronic search failed to identify 10 studies that we identified as relevant in our manual search. This limitation of the electronic search probably has several bases, including the challenges of using an electronic search for materials that were produced before the electronic publishing era, the inconsistency in the type of information available in digital form, and the coding of potentially relevant studies. Because coding and tagging inevitably cannot capture all variables that may be of interest, we anticipate that the increasing use of full-text searches using synonyms may help address this pitfall.

Third, we required the literature to be peer reviewed. Although peer review helps ensure scientific rigor, it is hardly a guarantee of quality. We suspect there may be studies that could contribute to our knowledge of interventions for this population that were not peer reviewed, and therefore were not taken into consideration. We suspect a fundamental problem could be that many of the efforts into this field of research have not been documented. We are personally aware of several clinicians and educators who are designing and implementing interventions that seem to be successful, but, for various reasons, have not been documented or published. For these and other reasons, we believe this

current review necessarily underestimates the achievements made in the field as a whole.

## CONCLUSION

Although we found moderately reliable evidence to support the effectiveness of interventions designed to improve emotional functioning in adults with ASD–3, in general, the available literature on psychoeducational interventions for adults with ASD–3 was extremely limited and presented significant methodological limitations. Given the poor prognosis for adults with ASD–3, it is vitally important to continue to design and test targeted, scalable interventions for this often-overlooked clinical population. As we continue to improve methodological standards leading to the standardized practice of full and accurate reporting, we are optimistic that there will be more evidence-based interventions to help improve the lives of individuals with ASD–3.

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