

Supplementary Materials

Table 1

Search term, strategies and yields for electronic databases

Database	Search strategy	Yield	Total minus duplicates
Medline (Ovid)	Exp Intellectual Disability/ AND Autistic Disorder/ AND Communication Aids for Disabled/ AND Language Development Disorder/	11	
CINAHL (Ebscohost)	(MM "Intellectual Disability+") AND (MM "Alternative and Augmentative Communication") AND (MM "Language Disorders+")	344	341
Academic Search Complete (Ebscohost)	"Disab* AND (child* OR pediatric OR paediatric) AND (Augmentative and alternative communication OR communication aid* OR "communication system*" OR augmented input OR "speech generating device*" OR "voice output communication aid*" OR gesture* OR "finger spell*" OR "manual sign*" OR sign* OR "simultaneous communication" OR symbol OR "graphic symbol" OR total communication) AND (Comprehension OR "receptive language" OR understand* OR interpret* OR receptive vocabulary)	2750	2692
ERIC (Ebscohost)	"Disab* AND (child* OR pediatric OR paediatric) AND (Augmentative and alternative communication OR communication aid* OR "communication system*" OR augmented input OR "speech generating device*" OR "voice output communication aid*" OR gesture* OR "finger spell*" OR "manual sign*" OR sign* OR "simultaneous communication" OR symbol OR "graphic symbol" OR total communication) AND (Comprehension OR "receptive language" OR understand* OR interpret* OR receptive vocabulary)	820	448
PsychINFO (Ebscohost)	"Disab* AND (child* OR pediatric OR paediatric) AND (Augmentative and alternative communication OR communication aid* OR "communication system*" OR augmented input OR "speech generating device*" OR "voice output communication aid*" OR gesture* OR "finger spell*" OR "manual sign*" OR sign* OR "simultaneous communication" OR symbol OR "graphic symbol" OR total communication) AND (Comprehension OR "receptive language" OR understand* OR interpret* OR receptive vocabulary)	2373	1377
LLBA (ProQuest)	Disab* AND (child* OR pediatric OR paediatric) AND (Augmentative AND alternative communication OR communication aid* OR "communication system*" OR augmented input OR "speech generating device*" OR "voice output communication aid*" OR gesture* OR "finger spell*" OR "manual sign*" OR sign* OR "simultaneous communication" OR symbol OR "graphic symbol" OR total communication) AND (Comprehension OR "receptive language" OR understand* OR interpret* OR receptive vocabulary)	493	454

Exp = exploded subject heading in Medline

MM = major concept

+ = exploded subject heading in CINAHL

* = to broaden the search by finding words that start with the same letters

Table 2*Title and Abstract Relevance Screening Tool*

Title of article: _____ _____		
Authors: _____		
Year: _____		
1. Does the citation report on children (younger than 18)? <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Can't tell		
2. Does the citation report on a developmental disability ? <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Can't tell		
3. Does the citation include an intervention classified as being within the scope of AAC? (See Table 2 for a list of AAC interventions) <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Can't tell		
4. Is the citation published in English? <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Can't tell		
<u>Reviewer Decision:</u> <ul style="list-style-type: none"> • If the reviewer answered NO to any of the questions, the citation will be excluded. • If the reviewer answered YES to all questions, the article will be included for full-text screening. • If the reviewer answered CAN'T TELL to any or all of the questions, the article will be included for full-text screening 		
<u>NO</u>	<u>YES</u>	<u>CAN'T TELL (full text screening)</u>

Table 3*Data Extraction spreadsheet*

	Variable & Key	Category	Reporting Objectives
1	Identification number (ID)		None
2	Date form completed		None
3	Name of person extracting data		None
4	Author/s		None
5	Year		To determine a trend in the number of publications by determining the frequency of publications per year
6	Title		None
7	Aim of the research study: - Purpose - Dependent variable - Independent variable		Allow qualitative analysis of research aims Facilitate linking aims to main findings, research limitations and future research recommendations
<u>Methods</u>			
8	Study design	<input type="checkbox"/> True experimental <input type="checkbox"/> Quasi-experimental <input type="checkbox"/> Single-subject <input type="checkbox"/> Group <input type="checkbox"/> Other, please specify	To determine the frequencies of different types of study designs
9	Sampling	<input type="checkbox"/> Probability <input type="checkbox"/> Random <input type="checkbox"/> Simple random <input type="checkbox"/> Systematic <input type="checkbox"/> Stratified random <input type="checkbox"/> Cluster <input type="checkbox"/> Nonprobability <input type="checkbox"/> Convenience <input type="checkbox"/> Purposeful <input type="checkbox"/> Quota <input type="checkbox"/> Other, please specify	To determine the frequencies of different sampling methods
10	Study participants and sample size	<input type="checkbox"/> Number of children with disabilities =	To calculate the overall number of participants included in the scoping review
11	Sample size breakdown in terms of gender	<input type="checkbox"/> Number of boys = <input type="checkbox"/> Number of girls =	To determine frequencies of the genders who participate in the research studies
12	Name and age of child	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	To determine frequencies of the ages included in research studies
13	Disability description	<input type="checkbox"/> Autism <input type="checkbox"/> Pervasive developmental disorder <input type="checkbox"/> Cerebral Palsy <input type="checkbox"/> Intellectual disability <input type="checkbox"/> Down Syndrome <input type="checkbox"/> Severe <input type="checkbox"/> Multiple <input type="checkbox"/> Other, please specify	To determine the frequencies of the type of disabilities included in research studies
14	Test used to assess receptive language skills	<input type="checkbox"/> Clinical Evaluation of Language Fundamentals (CELF)	To determine the frequencies of the type of receptive language

Variable & Key	Category	Reporting Objectives
(indicate edition of test if applicable)	<input type="checkbox"/> Comprehensive Assessment of Spoken Language (CASL) <input type="checkbox"/> Comprehensive Receptive and Expressive Vocabulary Test (CREVT) <input type="checkbox"/> Emerging Literacy Language Assessment (ELLA) <input type="checkbox"/> MacArthur-Bates Communicative Development Inventory – words and gestures <input type="checkbox"/> Mullen Scales of Early Learning (MSEL) (Receptive Language Subscale) <input type="checkbox"/> Peabody Picture Vocabulary Test (PPVT) <input type="checkbox"/> Receptive One Word Picture Vocabulary Test (ROWPVT) <input type="checkbox"/> Sequenced Inventory of Communication Development (SICD) <input type="checkbox"/> The Listening Comprehension Test <input type="checkbox"/> Test for Auditory Comprehension of Language (TACL) <input type="checkbox"/> Test of Adolescent Language (TOAL) <input type="checkbox"/> Test of Early Language Development (TELD) <input type="checkbox"/> Test of Written Language (TOWL) <input type="checkbox"/> Own, researcher developed <input type="checkbox"/> Other, please specify	tests used to assess receptive language
15 Receptive language skills before intervention		To determine the effect of the intervention on receptive language skills
16 Setting	<input type="checkbox"/> Home <input type="checkbox"/> Preschool <input type="checkbox"/> School <input type="checkbox"/> Community <input type="checkbox"/> Therapeutic <input type="checkbox"/> Other, please specify	To determine trends in settings where intervention was provided
<u>AAC approach used</u>		
17 Independent variable: type of intervention	<input type="checkbox"/> Aided language stimulation <input type="checkbox"/> Natural aided language <input type="checkbox"/> Aided language modelling <input type="checkbox"/> Aided AAC modelling <input type="checkbox"/> Scene cues <input type="checkbox"/> Visual Scene Displays <input type="checkbox"/> Animation <input type="checkbox"/> System for Augmenting Language <input type="checkbox"/> Graphic symbols <input type="checkbox"/> Communication board <input type="checkbox"/> Speech generating device <input type="checkbox"/> Gestures <input type="checkbox"/> Finger spelling <input type="checkbox"/> Manual signs <input type="checkbox"/> Sign language <input type="checkbox"/> Simultaneous communication <input type="checkbox"/> Total communication <input type="checkbox"/> Other, please specify	To determine trends in the types of AAC intervention used when targeting receptive language skills. This will also highlight where gaps in the research lie
18 Receptive language skills targeted	<input type="checkbox"/> Receptive language <input type="checkbox"/> Vocabulary acquisition <input type="checkbox"/> Symbol comprehension	To determine trends in the receptive language skills targeted in AAC interventions

Variable & Key	Category	Reporting Objectives
	<input type="checkbox"/> Word comprehension <input type="checkbox"/> Sentence comprehension <input type="checkbox"/> Discourse comprehension <input type="checkbox"/> Grammar comprehension <input type="checkbox"/> Other, please specify	
19 Duration of intervention		To determine trends in the duration of interventions
20 Mechanism of input of message to participants	<input type="checkbox"/> Object <input type="checkbox"/> Photograph <input type="checkbox"/> Graphic symbol (line drawing) <input type="checkbox"/> Gesture/sign <input type="checkbox"/> Animated symbols <input type="checkbox"/> Speech generating device <input type="checkbox"/> Spoken word <input type="checkbox"/> Other, please specify If used in combination: <input type="checkbox"/> Simultaneous combination <input type="checkbox"/> Sequential combination <input type="checkbox"/> Other, please specify	To determine how receptive language was facilitated in each study
21 Instructional format	<input type="checkbox"/> Individual <input type="checkbox"/> Small group <input type="checkbox"/> Large group <input type="checkbox"/> Other, please specify	To determine frequencies of various instructional formats
<u>Results and Discussion</u>		
22 Receptive language post-test measure	<input type="checkbox"/> Clinical Evaluation of Language Fundamentals (CELF) <input type="checkbox"/> Comprehensive Assessment of Spoken Language (CASL) <input type="checkbox"/> Comprehensive Receptive and Expressive Vocabulary Test (CREVT) <input type="checkbox"/> Emerging Literacy Language Assessment (ELLA) <input type="checkbox"/> MacArthur-Bates Communicative Development Inventory – words and gestures <input type="checkbox"/> Mullen Scales of Early Learning (MSEL) (Receptive Language Subscale) <input type="checkbox"/> Peabody Picture Vocabulary Test (PPVT) <input type="checkbox"/> Receptive One Word Picture Vocabulary Test (ROWPVT) <input type="checkbox"/> Sequenced Inventory of Communication Development (SICD) <input type="checkbox"/> The Listening Comprehension Test <input type="checkbox"/> Test for Auditory Comprehension of Language (TACL) <input type="checkbox"/> Test of Adolescent Language (TOAL) <input type="checkbox"/> Test of Early Language Development (TELD) <input type="checkbox"/> Test of Written Language (TOWL) <input type="checkbox"/> Own, researcher developed <input type="checkbox"/> Other, please specify	To determine how receptive language was measured after intervention was provided
23 Receptive language post-test score		To compare to the pre-test score
24 Intervention effect on receptive language	<input type="checkbox"/> Complete <input type="checkbox"/> Partial/mixed <input type="checkbox"/> No	To determine trends in the effects of various AAC interventions provided

	Variable & Key	Category	Reporting Objectives
25	Mechanism of output measurement for receptive language	<input type="checkbox"/> Object <input type="checkbox"/> Photograph <input type="checkbox"/> Graphic symbol (line drawing) <input type="checkbox"/> Gesture/sign <input type="checkbox"/> Animated symbols <input type="checkbox"/> Speech generating device <input type="checkbox"/> Spoken word <input type="checkbox"/> Other, please specify	To determine how the participants demonstrated their receptive language skills-what participant factors were observed when determining comprehension
		If used in combination: <input type="checkbox"/> Simultaneous combination <input type="checkbox"/> Sequential combination <input type="checkbox"/> Other, please specify	
<u>Quality appraisal</u>			
26	Design	<input type="checkbox"/> Sound design <input type="checkbox"/> Strong design <input type="checkbox"/> Flaw in design	In order to determine the quality of the included study
27	Inter-observer agreement (IOA)	<input type="checkbox"/> Adequate or better <input type="checkbox"/> Inadequate <input type="checkbox"/> Not reported	
28	Treatment integrity	<input type="checkbox"/> Adequate or better <input type="checkbox"/> Inadequate <input type="checkbox"/> Not reported	
29	Quality appraisal based on design, IOA and treatment integrity	<input type="checkbox"/> Conclusive evidence <input type="checkbox"/> Preponderant evidence <input type="checkbox"/> Suggestive evidence <input type="checkbox"/> Inconclusive	In order to compare the certainty of evidence if the included studies
<u>Future Research</u>			
30	Future research	<input type="checkbox"/> None reported <input type="checkbox"/> Specified by researcher	In order to determine gaps in the research conducted to date

Table 4*Included Studies on the effects of AAC interventions*

Study	Purpose	Participants (n): diagnosis ^a , Age range [years, months],	Design	Independent variable (IV) ^b Dependent variables relating to receptive language (DV).	Effect (Cohen's d)/ (PND)	Quality Appraisal
Unaided AAC interventions						
1. Remington & Clarke (1993a)	To compare the efficacy of Extensive and Mediated Sign Training for speech comprehension in sign training.	(3): NS, 12.1-12.6 (3): DS, 6.8-11.6	Single-case alternating treatments, across participants.	IV: Extensive or Mediated Sign Training DV: Speech comprehension	PND: Could not calculate Extensive training in neither condition addressed overselectivity nor facilitated comprehension.	Conclusive: Sound design, adequate or better IOA and TI
2. Acosta (1981) †	To investigate the effects of the use of total communication on receptive vocabulary acquisition	(4): DS, 3.0-4.11	Single-case: with reversals, across participants.	IV: Total communication or oral communication DV: Vocabulary acquisition	PND: Oral Phase 80.56%*** Total Communication Phase 85.71%*** No participants reached criterion in the oral phase. Ascending trends in all TC phases for all participants.	Preponderant; strong design; IOA and TI not reported.
3. Remington & Clarke (1993b)	To compare Extensive and Differential Sign Training for efficacy in reducing stimulus over-selectivity	(4): DS, 4.3-11.5	Single-case alternating treatments, across participants.	IV: Extensive or Differential Sign training DV: Word and sign comprehension	PND: Extensive sign training: 43.82%* Differential sign training: 75.20%***	Suggestive: sound design, adequate or better IOA, TI not reported
4. Kennedy (1994) †	To investigate the impact of total communication on comprehension	(3): CP, 1.8-5.8 (10): DD, 2.1-7.0 (9): ASD, 2.6-5.1 (3): BD 2.1-2.6 (2): LD, 2.5-2.6	Group	IV: Total communication DV: Comprehension gain score and Word comprehension	Effect: Age: Large effects for younger group TC to Speech only (d=1.383)*** and TC to no intervention for younger (d=2.329)*** and older (d=0.819)*** groups. Medium effects speech only to no intervention, younger (d=0.428)** and older (d=0.520)** groups. Small effect TC to speech older group (d=0.239)*. Presentation: Large effect TC to no intervention (d=1.414). Medium effect	Suggestive: flaw in design; inadequate IOA; TI not reported

Study	Purpose	Participants (n): diagnosis ^a , Age range [years, months],	Design	Independent variable (IV) ^b Dependent variables relating to receptive language (DV).	Effect (Cohen's d)/ (PND)	Quality Appraisal
					TC to Speech only (d=0.786)** and speech only to no intervention (d=0.462)**.	
5. Poulton (1981) †	To investigate the effects of the components of simultaneous communication (SC) on comprehension of children with ASD.	(3) ASD, 14.2, 8.6, 7.10	Single-case: alternating treatments across participants.	IV: Signs, Speech and SC DV: Comprehension of object labels and word comprehension	PND: SC 100% **** Signs: 70.56% *** Speech: 70% ***	Suggestive: sound design; IOA and TI not reported.
6. Ronski & Ruder (1984)	To compare the effects of speech and speech + sign on the comprehension of action + object relational meaning	10: DS, 3.1, 4.3, 4.5, 4.9, 5.2, 6.4, 6.11, 7.2, 7.2, 7.10	Single-case: reversal design across conditions, with withdrawal, across participants.	IV: Speech or speech + sign instruction DV: Comprehension of action + object relational meanings and Phrase/ sentence comprehension	PND – Could not calculate. No significant differences were identified. 7/10 children took fewer trials to reach criterion (100%) For Speech+Sign than Speech only.	Inconclusive: flaw in design; IOA adequate or better; TI not reported
<u>Aided AAC intervention</u>						
7. Dada & Alant (2009)	Describe the effects of aided language stimulation on vocabulary acquisition	(3): CP, 8.1- 10.1 (4): DS, 12;1, DS	Single- case multiple probe across three activities, and four participants.	IV: Aided language stimulation [pointing to pictures while speaking(Goossens', 1989)] DV: The number of target items identified when responding to verbal stimuli	PND: Vocabulary Acquisition: 66.67%** Acquisition was maintained during a withdrawal phase.	Conclusive: Strong design, adequate or better IOA and TI

Study	Purpose	Participants (n): diagnosis ^a , Age range [years, months],	Design	Independent variable (IV) ^b Dependent variables relating to receptive language (DV).	Effect (Cohen's d)/ (PND)	Quality Appraisal
8. Drager, et al., (2006)	To describe the effect of aided language modelling (ALM) on symbol comprehension and expression	(2): ASD, 4.0-4.5	Single-case: multiple probe design across three activities, and participants.	IV: ALM DV: Target items correctly identified with a) graphic and verbal stimuli b) graphic stimuli only or c) verbal stimuli only.	PND: Symbol Comprehension: 74.3%***	Conclusive: Strong design, adequate or better IOA and TI
9. Harris & Reichle (2004)	To determine whether aided language stimulation increased symbol comprehension	(2): DS 3.10-5.4 (1): NS 4.2	Single-case: multiple probe design across symbol sets, and participants.	IV: Aided language stimulation DV: Symbol comprehension	PND: Symbol comprehension: 72.89*** 2 participants showed a decrease in the number of presentations required to reach criterion on symbol sets 2 and 3.	Conclusive: sound design, adequate or better IOA and TI
10. Ho (2000) †	Compare the efficacy of modelling to Paired association (PA) instruction for teaching graphic symbols.	(3): CP, 4.7-7.8	Single-case multiple probe, across symbol sets, in a parallel-treatment design, across participants.	IV: Symbol use modelling during storybook reading or direct paired-associate instruction DV: Symbol comprehension: the percentage of symbols accurately identified and number of sessions to criterion.	PND: Modeling: 60.10%** PA: 87.37%*** No effect: higher percentage of symbols identified for PA word sets rather than modelling word sets.	Conclusive: Sound design, adequate or better IOA and TI
11. Mims, et al. (2009)	To determine if prompting would increase independent	(2) CP+VI 2.9-6.0	Single-case: Multiple probe across materials	IV: Objects embedded in story book DV: The number of correct independent selections to	PND: Comprehension: 74.66%*** Increase from baseline, after intervention seen across participants and books. Criterion for success not mentioned.	Conclusive: Sound design, adequate or

Study	Purpose	Participants (n): diagnosis ^a , Age range [years, months],	Design	Independent variable (IV) ^b Dependent variables relating to receptive language (DV).	Effect (Cohen's d)/ (PND)	Quality Appraisal
	comprehension during a story-based lesson		and two participants.	answer comprehension questions asked during the activity.		better IOA and TI
12. Preis (2006)	To compare the effect of pictures on verbal directions.	(5): ASD 5.3-6.7	Single case: alternating treatments design, across participants.	IV: Presence or absence of pictures DV: Follow-through of command	PND: Could not be calculated No therapeutic difference between treatments was observed	Conclusive: sound design, Adequate or better IOA and TI
13. Ronski et al. (2010)	To compare the symbolic language development of children assigned to parent-coached language intervention groups.	(62): DD, mean age 2;6	Randomised control group design	IV: 3groups- 1. Spoken communication (S) 2. Augmented communication input (AC-I) 3. Augmented communication output (AC-O) DV: Vocabulary acquisition	Effect: Words spoken: medium effect AC-I (d=0.534)**, small effect AC-O (d=0.256)*. Augmented word use, AC-I<AC-O, medium effect (d=0.637)**. Child and parent communication: Child: large effect type token ratio (d=0.931)***, and intelligibility (d=1.405)***. Medium effects for: mean length utterance (d=0.588)**, mean length of turn (d=0.562)**, utterance rate (d=0.633)** and total turns (d=0.557)**. Parent: medium effects for mean length of turn (d=0.-474)** and total turns (d=-0.369)**.	Conclusive: sound design, adequate or better IOA and TI

Study	Purpose	Participants (n): diagnosis ^a , Age range [years, months],	Design	Independent variable (IV) ^b Dependent variables relating to receptive language (DV).	Effect (Cohen's d)/ (PND)	Quality Appraisal
14. Browder, et al. (2008)	To evaluate the effect of a the Literacy curriculum on language and literacy skills	(23): Severe- ID, Mean age of treatment group: 9.3	Randomised control group design	IV: Early Literacy Skills Builder curriculum or sight words and pictures. DV: Peabody Picture Vocabulary Test (PPVT-II)	Effect: Medium effect (d=0.459)** for vocabulary acquisition measured on the PPVT-III	Suggestive: sound design, IOA inadequate, TI adequate or better
15. Fujisawa, Inoue, Yamana & Hayashi (2011)	To examine the effects of animated symbols on the comprehension of action verbs	(1): CP, 11.9 (2): DS, 17.0- 18.0 (13): ID: 11.4-18.0	Group AB design with reversal.	IV: Animation DV: Comprehension of action words	Effect Large effect (d=1.191)*** for word comprehension in the experimental condition.	Suggestive: sound design, IOA and TI not reported
16. van der Schuit, et al. (2010)	Determine the effectiveness of the KLINc Studeo intervention on vocabulary acquisition.	(3): PMD, 2;9-6.8 (1) VFS 4.2 (3): ID, 2.11- 4.5 (1): ASD, 4.0 (2): DS, 5.0- 5.3	Group	IV: Intervention programme: "Kids Learning to take Initiatives in communication" (KLINc Studio) DV: Vocabulary acquisition	Effect: Large effect for receptive language (d=1.442)***.	Inconclusive: sound design but IOA and TI not reported

Effects:

****highly effective (PND>90%),

†unpublished dissertations and theses

^aDiagnosis

VI=visual impairment CP=Cerebral Palsy

DS=Down Syndrome

ASD=Autistic Spectrum Disorder LD=Language Delay

DD=Developmental Delay

NS=not specified

BD=Behavioural Disorder

ID=Intellectual disability

VFS=Velocardiofacial Syndrome MD=Multiple disabilities

PMD= psychomotor disability

^bVariables:

Total Communication (TC)

The use of all modes of communication as appropriate, including speech, manual signs, photographs and pictorial symbols alongside usual elements of non-verbal and paralinguistic communication (Powell & Clibbens, 1994).

<i>Over selectivity</i>	The child attends to a limited number of cues within their environment. e.g. When a child attends only to visual sign cues and not to simultaneously presented auditory cues (Lovaas, Koegel, & Schreibman, 1979).
<i>Extensive sign training</i>	Training of signs using both visual signs and auditory input and intermittent reinforcement (Remington & Clarke, 1993a).
<i>Mediated sign training</i>	Training of signs first focusing on the comprehension of the signs and only later the expression of these (Remington & Clarke, 1993a).
<i>Simultaneous communication (SC)</i>	The use of speech and signs presented simultaneously (Poulton, 1981)
<i>Differential sign training</i>	Training of signs using an alternating mixture of simultaneous communication and auditory input only (Remington & Clarke, 1993b).
<i>Aided Language Stimulation (ALS)</i>	pointing to pictures while providing verbal language stimulation(Goossens', 1989)
<i>Aided Language Modelling (ALM)</i>	pointing to an environmental referent and within 2 seconds to a graphic symbol of the referent while speaking the word for the symbol (Drager, Postal, Castellano, Gagliano, & Glynn, 2006)
<i>Augmented-communication input (AC-I)</i>	Speech from the communication partner is supplemented through the use of a speech generating device. The device has symbols on buttons which when pressed produce the word for the symbol (Ronski et al., 2010)
<i>Augmented-communication output (AC-O)</i>	The child is prompted using a prompting hierarchy and hand over hand prompts to use the speech generating device to produce communication (Ronski et al., 2010)
<i>Anchor-based intervention</i>	The core theme or shared starting event is "anchored" in the current development and interest of the child, in order to increase and broaden experiential knowledge and vocabulary associated with the anchor. (Verhoeven & Aarnoutse, 2000)