Impact of AAC Interventions on Participation Outcomes in Children with Complex Communication Needs: A scoping review

by

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ETHICS STATEMENT

The author, whose name appears on the title page of this dissertation, has obtained, for the research described in this work, the applicable research ethics approval.

The author declares that she has observed the ethical standards required in terms of the University of Pretoria's Code of ethics for researchers and the Policy guidelines for responsible research.

ABSTRACT

Participation or taking part in life situations, is a fundamental human right. Participation is a complex and multidimensional construct. The importance of participation on health, education, and well-being for children and youth with disabilities have extensively been indicated by literature. Being able to communicate is an essential component of full participation in various life situations such as at school, with peers and in the community. Communication provides a means to participate and specially to participate socially. Complex communication needs usually limit the opportunities of children or youth with disabilities to have social interaction with peers. Augmentative and Alternative Communication (AAC) interventions aim to facilitate communication competency and effectiveness to increase social interaction and independence. Importantly, participation in all aspects of life – which is considered the ultimate goal of AAC intervention – is a complex and multifaceted construct. Evidence suggests that there is little research on participation-related intervention outcomes for children who use AAC. The purpose of the current study was to use the family of Participation and Related Constructs (fPRC) framework to review and describe the reported outcomes of AAC intervention for children and youth with complex communication needs. The scoping review identified a total of 270 studies for inclusion and the data was extracted and mapped onto the fPRC. The results indicate that although many studies report on participation-related constructs such as activity competence and context, there is still a paucity of focus on the constructs of attendance and involvement, sense of self and environment-related constructs. The study therefore highlights the need for future research on these constructs. Participation should be the primary focus of intervention and the long-term wellbeing of children and youth using AAC should be enhanced by developing comprehensive participatory goals in collaboration with all stakeholders.

Keywords: Augmentative and alternative communication**,** AAC intervention, complex communication needs, fPRC, ICF, participation.

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LIST OF ABBREVIATIONS

AAC	Augmentative and Alternative Communication
AiLgS	Aided Language Stimulation
ALM	Aided Language Modelling
APA	American Psychological Association
ASD	Autism Spectrum Disorder
ASHA	American Speech-Language-Hearing Association
CAS	Childhood Apraxia of Speech
CCN	Complex Communication Needs
CP	Cerebral Palsy
CINAHL	Cumulative Nursing and Allied Health Literature
DS	Down Syndrome
ERIC	Educational Resources Information Centre
fPRC	family of Participation-Related Constructs
ICF	International Classification of Functioning, Disability and Health
ICF/CY	International Classification of Functioning, Disability and Health Child and Youth Version
MeSH	Medical Subject Heading
LLBA	Linguistics and Language Behaviour Abstracts
PECS	Picture Exchange Communication System
PIO	Population, Intervention and Outcome
PRISMA-(ScR)	Systematic Review and Meta-Analysis extension for Scoping Reviews
RIS	Research Information System
SAL	System for Augmenting Language
SGD	Speech-Generating Devices
UP	University of Pretoria
VOCA	Voice Output Communication Aids
WHO	World Health Organization

SECTION 1: PROBLEM STATEMENT AND LITERATURE REVIEW

1.1 Participation

Children and youth with disabilities are entitled to the full enjoyment of all human rights, including participation in activities at home, at school and in their community environments (United Nations, 2006). Research indicates that participation has a positive influence on health and wellbeing (United Nations, 2006; World Health Organization, 2001, 2007) and it can be viewed as the ultimate shared goal by children with disabilities and their families (Eriksson & Granlund, 2004; Law, 2002; Light & McNaughton, 2012). According to the International Classification of Functioning, Disability and Health (ICF) and the ICF-Child and Youth Version (ICF-CY), the definition of participation as "involvement in life situations" is commonly used in literature (Adair et al., 2015; WHO, 2007, p. 10). Similarly, communicative participation is a commonly used term in the field of Augmentative and Alternative Communication (AAC) and has been defined as taking part in "life situations where knowledge, information, ideas and or feelings are exchanged" (Eadie et al., 2006, p. 309). Communicative participation is measured in a social context (Eadie et al., 2006).

The ICF/ICF-CY conceptualises and organises both "Activities and Participation" components as a single section that covers a range of life dimensions (WHO, 2001; WHO, 2007). The ICF/ICF-CY manual describes them as two separate components, yet combines the conceptualisation of two subcomponents as one domain in the classification system – with 'performance' as the qualifier for participation and 'capacity' as the qualifier for activities (WHO, 2001; WHO, 2007; Granlund et al., 2012; Whiteneck & Dijkers, 2009). Failing to distinguish between activity and participation allows for performance to be the only possible qualifier that can be used to develop measures of participation (Granlund et al., 2012; Whiteneck & Dijkers, 2009). Activity with the 'capacity' qualifier is defined as "the individual's ability to execute the task" (WHO, 2007, p. 13), while participation with the 'performance' qualifier is described as "executing a task in the current environment" (WHO, 2007, p. 10) Thus, participation is operationalised as attending to or doing a specific activity in a life situation (Granlund, 2013).

Discussions in literature indicate that performance is only one dimension of participation and additional subjective qualifiers may be required to produce a comprehensive view of participation (Granlund et al., 2012). Furthermore, a footnote on page 13 of the ICF-CY manual suggests that perhaps there is a need for an additional qualifier and to distinguish between involvement and a subjective experience of "sense of belonging" (Granlund et al., 2012; WHO, 2007). This lack of a well-defined conceptualisation of participation has steered several different definitions and allowed for participation to be operationalised in different ways (Granlund, 2013). Although the publication of the ICF provided increased literature focus on participation outcomes in practice and research, the construct of participation is evidently complex and multidimensional and can be viewed as both a process and an outcome (Granlund, 2013; Imms et al., 2017; Imms & Green, 2020; King et al., 2013). Furthermore, consensus and clarity are needed on the definition of the construct of participation so as to enable meaningful interpretation of intervention outcomes (Rainey et al., 2014).

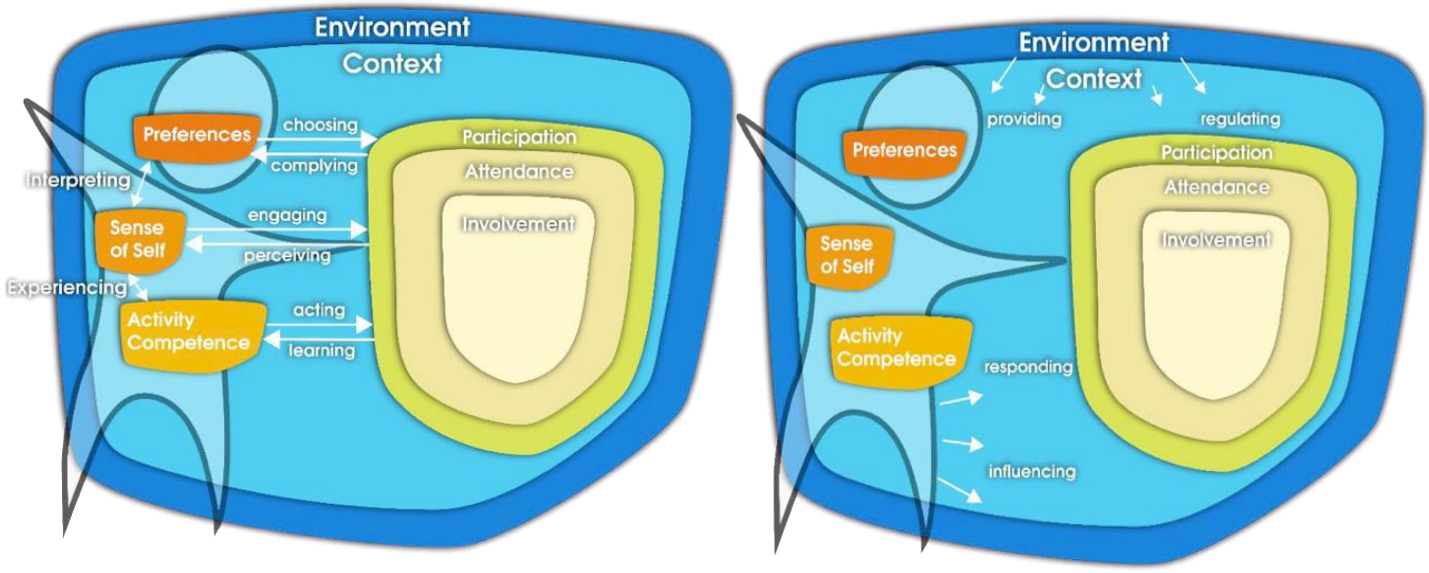
1.2 Family of Participation and Related Constructs (fPRC)

A team of researchers conducted a series of systematic reviews between 2015 and 2018 in an attempt to provide conceptual clarity and consistency in language for participation outcomes regarding children and youth with childhood onset disabilities (Adair et al., 2015, 2018; Imms et al., 2016). The reviews found considerable conceptual inconsistencies relating to participation outcomes (Adair et al., 2015; Imms et al., 2016). Consequently, the conceptual family of Participation-Related Constructs framework (fPRC) was proposed (Imms et al., 2017). The fPRC incorporates the ICF/ICF-CY framework as a foundation for understanding body structure and function of individuals but proposes a detailed understanding of the participation constructs (Imms et al., 2017; Imms & Green, 2020).

Within the fPRC framework, attendance and involvement are identified as two essential components of participation (Imms et al., 2017). Attendance is an objective phenomenon and is defined as 'being there' and measured as the frequency of attending and/or the range of diversity of the activity. It can be measured either through time-use devices, diaries and surveys, and by observation, self or proxy report (Imms et al., 2016; Imms & Green, 2020). Involvement or 'in the moment' experience of participation, is defined as the experience of participation while attending, and is more subjective and complex to observe and measure (Adair et al., 2018; Imms

et al., 2016; Imms & Green, 2020). Although involvement and engagement have been used as an interchangeable term to describe the participation experiences, the fPRC framework proposes that engagement may be a linking construct that can be expressed at multiple levels of human functioning – akin to Vygotsky's notion of 'zone of proximal development' (Imms et al., 2017; Vygotsky, 1978). Additionally, engagement includes not only an internal state expressed through behaviour, but also enables direction or 'directedness' to external people, things and events (Bright et al., 2015; Imms et al., 2017). Thus, two individuals who participate in the same activity may be engaging in different aspects of the activity. For example, one child may engage in requesting more food, while another child may be commenting on the taste of the food using a personalised AAC system such as a communication board during snack time at school. Involvement may also include elements of motivation, persistence, social connection, and level of affect (Imms et al., 2017). Furthermore, the fPRC proposes three intrinsic elements and two extrinsic elements that influence – and are influenced by – participation (Imms et al., 2016, 2017).

The fPRC continues to propose that participation can be viewed as an entry point (process) and an endpoint (outcome) of engaging in a range of activities across a multitude of life situations (Imms et al., 2017; Imms & Green, 2020) – thus, allowing research and intervention to consider participation as either a dependent or an independent variable. For instance, participation in a classroom discussion (participation as a process) may potentially lead to increased peer interactions that may in turn possibly improve a child's social skills. Peer interaction may therefore lead to increased participation in classroom discussion (participation as an outcome). In addition, participation as described by the fPRC can be viewed as a transactional mechanism of engagement between a person and a context (Batorowicz et al., 2016; Imms et al., 2017), thus indicating that the person also has an effect on the environment through their engagement in activities. The framework emphasises the implications of understanding that participation as a process and outcome of engaging or involvement in activities may change over time (Imms et al., 2017). Figure 1 presents the fPRC framework and its hypothetical interchangeable processes. The bi-directional arrows and associated verbs symbolise the transactions between the constructs (Imms et al., 2017).



(a) (b)

Figure 1. *The family of Participation-Related Constructs*

Panel (a) in Figure 1 displays the person-focused processes and Panel (b) displays the environment-focused processes (Imms et al., 2017, p. 19).

The intrinsic person-related concepts are factors that are influenced by past and present participation and may influence future participation (Imms et al., 2017). Opportunities for engagement at a personal level lead to the outcomes that are associated with the intrinsic concepts of activity competence, sense of self and preferences (Imms et al., 2016). According to the ICF, activity competence can be defined as the extent to which an individual can perform an activity/task and it can be measured as capability, capacity and performance (Imms et al., 2017; Imms & Green, 2020; WHO, 2007). To illustrate, activity competence can relate to the ability of a child using an AAC device to request a different book during story time. Additionally, sense of self relates to intrapersonal factors such as confidence, self-esteem, satisfaction and self-determination (Imms et al., 2017). Self-determination also involves internal and external regulation and is linked to relatedness, competence and autonomy (Imms & Green, 2020; Ryan & Deci, 2000). Preferences are defined as activities that hold meaning (Imms et al., 2016). They are established through interactions with people with similar beliefs and values, and through past experiences of enjoyment and success, creating a positive association with certain experiences (Imms et al., 2017; Skille & Øterås, 2011). Preferences can therefore be viewed as an antecedent and/or a consequence of participation (Imms et al., 2017). These intrinsic elements may then be

considered targets of intervention or outcomes expected to change after participation (Adair et al., 2018). Figure 1(a) presents the relationship between participation and the intrinsic factors (Imms et al., 2017).

The fPRC framework describes the extrinsic environment-related elements by separating context and the environment. An integrated model proposed by Batorowicz et al. (2016) separates the personal perspective as relating to social context and the environment as relating to the broader external social environment we live in. Personal contextual factors refer to the perspective of the person participating and involve the interaction between the people, place, activity, objects, and time in which participation occurs (Batorowicz et al., 2016; Imms et al., 2017). The broader environment considers the external physical and social environments in which people live (Batorowicz et al., 2016; Imms et al., 2017). The model by Batorowicz and colleagues highlights the dynamic and transactional nature of social context and the environment to enhance the capacity of both children and their environments (Batorowicz et al., 2016). This is also evident in Figure 1(b), which shows that the context and environment regulate and provide the participation (Imms et al., 2017). The fPRC framework further operationalises participation separate from activity and the life situation in which it occurs; thus, the participation concept can be applied to individuals at any competence level and to any activity or setting (Adair et al., 2018).

1.3 **AAC intervention and participation**

The American Speech-Language-Hearing Association (ASHA) defines AAC as an area of research and clinical practice that addresses the requirements of individuals with significant and complex communication needs (CCN) (ASHA n.d.; Beukelman & Light, 2020). AAC systems are referred to as an integrated group of components that are used to enhance communication (ASHA, n.d.). “These components include forms of AAC (for example aided or unaided), symbols, selection techniques, and strategies” (ASHA, n.d, practice portal, AAC, para. 4). AAC intervention strategies are augmentative when used to supplement existing speech, and alternative when used in place of speech that is absent or not functional (ASHA, n.d.). AAC interventions further include directly or indirectly implemented an AAC system, which augments or provide alternative receptive and/or expressive language communication. AAC systems may include a variety of components or tools such as gestures, fingerspelling, line drawings,

communication boards and speech-generating devices (SGD) to support communication (ASHA, n.d.; Beukelman & Light, 2020; Thistle & Wilkinson, 2015). Therefore, AAC interventions focus on implementing AAC strategies and methods to facilitate language development (Granlund et al., 2008). AAC has the overall goal to enhance communication competence and effectiveness, and to increase social interaction, quality of life, independence and participation in the everyday life of children with CCN (Beukelman & Light, 2020; Beukelman & Mirenda, 2013; Granlund et al., 2008; Light & McNaughton, 2015; Thomas-Stonell et al., 2016).

Intervention may involve a range of activities, including either direct interventions with the child who uses AAC and their communication partner (Beukelman & Light, 2020; Beukelman & Mirenda, 2013) or indirect interventions that work within the natural context to effect change (Granlund et al., 2008). Furthermore, facilitating participation in communication activities allows individuals with CCN to build communication competence and to participate fully in all aspects of life (Beukelman & Mirenda, 2013; Light & McNaughton, 2014). AAC supports a range of language and communication outcomes for a diverse range of individuals through the use of unaided modalities (such as eye gaze, gestures and the use of manual signs) and multiple aided modalities (techniques that utilise tools outside the body, such as graphic symbols) (Lynch et al., 2018; Murray & Goldbart, 2009; Sennott et al., 2016). In order for individuals with CCN to use symbols effectively, they may need to learn the meanings (receptive language) and how to produce them (expressive language) in communicative contexts (Beukelman & Mirenda, 2013). Key elements of intervention are the instructional strategies or procedures used within interventions to achieve the various intervention goals (Beukelman & Mirenda, 2013; Lynch et al., 2018). Various intervention techniques – including explicit instruction, incidental teaching, modelling of AAC use in naturalistic interactions, conversational coaching and strategy instruction – can be utilised to expand communication competence for individuals who use AAC (Beukelman & Light, 2020).

Although AAC may facilitate communication in various activities and environments such as at school or at home, the use of AAC influences the conversational dynamics and the nature and extent of communication interactions (Murray & Goldbart, 2009; Raghavendra et al., 2011; Smith & Murray, 2016). Due to the degree of support needed to communicate, individuals using AAC may take a respondent role in social situations, reduce initiation of interactions and become

reliant on their competent communication partners (Raghavendra et al., 2011; Raghavendra et al., 2012). Communication partners of individuals using AAC mainly include immediate family members and adult communication partners who are familiar with and competent in communicating using certain AAC systems, or caretakers and others paid to communicate with them (Alant & Lloyd, 2005; Batorowicz et al., 2014; King, Batorowicz, Rigby, McMain-Klein et al., 2014). Having to depend on their parents, caregivers and siblings for successful communication may further restrict participation in a variety of activities and limit their participation to specific environments (Alant & Lloyd, 2005b; Raghavendra et al., 2011). Research in the field of AAC further indicates that children and adolescents who use aided communication may continue to experience limited opportunities to engage socially for example with their peers and even other individuals who are competent AAC users (Batorowicz et al., 2006, 2014; Beukelman & Mirenda, 2013).

It is important for children and especially adolescents using AAC to have opportunities to participate – in effective and socially appropriate ways – with peers in activities in order to develop their preferences, beliefs, opinions and friendships (Batorowicz et al., 2014; Raghavendra et al., 2012). The importance of peer relationships and social interaction is indicated by a study that concluded that adolescents specifically perceived peer relationships as more important than attending domestic life activities (Lygnegård et al., 2019). The study by Batorowicz et al. (2014) on social participation using aided communication identified the achievements and challenges experienced by young people who use aided communication. It showed that the activities of the children using aided communication were concrete and predictable and mainly involved conversations regarding food and daily routines, which may impact and restrict their long-term language and communication development (Batorowicz et al., 2014). In other words, young people who use aided communication may lead structured social lives and have limited social interaction opportunities with their peers. The limited content of their communication may reflect this lack of interaction (Batorowicz et al., 2014). The studies referred to above highlight the need to support children and youth's meaningful engagement and communicative participation in a variety of environments and social contexts. While the effective use of AAC is reported to enable children with CCN to communicate and participate in a wider range of environments and activities (Babb et al., 2019; Light & McNaughton, 2012; Von Tetzchner, 2018), there is very little research on the impact of AAC interventions on the

participation outcomes for children and youth who use AAC (Grace et al., 2019; Light & McNaughton, 2015)

Although the ICF/ICF-CY and (more recently) the fPRC have paid attention to defining and conceptualising the construct of participation, the field of AAC considered participation as outcomes of AAC intervention even before the publication of the ICF (Light, 1988; Light & McNaughton, 2014). The Participation Model for AAC, originally proposed by Rosenbaum and Beukelman (1987) and endorsed by ASHA in 2004, has for several decades been used as a tool for AAC assessment and intervention in the field of AAC (ASHA, 2004; Beukelman & Light, 2020; Beukelman & Mirenda, 2013). The model underwent numerous revisions and, as described by Beukelman and Mirenda (2013), it captures many key factors within an ecological system of development, health and functioning (Light & McNaughton, 2015). The participation model considers not only the intrinsic factors specific to the individual's communication competence (e.g. efficiently and effectively transmitting messages) and the environmental support needed (e.g. moving a child using an AAC system closer to the teacher) (Beukelman & Mirenda, 2013). It also considers the opportunity barriers, such as the inability of different communication partners to support an individual using an AAC system to participate at the desired level within a social system (Beukelman & Mirenda, 2013; Light & McNaughton, 2015).

Although the field of AAC has greatly accepted the participation model, there is limited evidence of its effective implementation (Light & McNaughton, 2015) and there is little information on how to apply the model to clinical context (Lund et al., 2016). In addition, the participation model includes a participation inventory (Beukelman & Light, 2020) which may increase focus on capability and performance in isolation and possibly neglect other constructs of participation such as involvement, preference, and sense of self (Imms, 2020; Imms et al., 2017; Imms & Green, 2020).

Similar to the fPRC, a recent Delphi study realised the need to gain consensus on the definition and operationalisation of communicative participation. Developing a definition aimed to facilitate the discussion between parents and professionals on children's communication needs in daily life and to steer the goal-setting process (Singer et al., 2020). Communicative participation was thus defined as "understanding and being understood in a social context, by applying verbal and non-verbal communication skills" (Singer et al., 2020, p. 1793).

Section 1: Problem statement and literature review

Since the construct of participation is complex and viewed as a mechanism for and the outcome of development and it can be investigated as both a process and an outcome of engaging in a range of activities across a multitude of life situations (Granlund, 2013; Imms et al., 2017). The current scoping review is proposed to identify how participation is represented in the outcomes of AAC interventions and to map this onto the fPRC framework. Through this process of mapping, the researcher planned to identify the gaps in the literature regarding participation outcomes of AAC interventions. The mapping consequently provided guidelines for planning future AAC and participation research.

SECTION 2: METHODOLODY

2.1 Research aims

2.1.1 Main aim

This scoping review aimed to describe the participation-related outcomes reported by interventions in the field of AAC and then to map these onto the fPRC framework. The research questions for the review were formulated using the Population, Intervention and Outcome (PIO) constructs and maintained a wide approach to ensure that breadth of coverage of the literature would be achieved (Arksey & O'Malley, 2005; Daudt et al., 2013; Richardson et al., 1995). The main question was formulated to read as follows: What are the fPRC framework outcomes (O) of AAC interventions (I) for children who use AAC (P) described by literature?

2.1.2 Sub-aims

The study further aimed to

- identify and map the outcomes of the intervention studies according to the fPRC framework;
- describe the AAC intervention studies that report on participation outcomes;
- describe and map the AAC intervention systems used onto the fPRC framework; and
- describe and map the AAC intervention strategies utilised onto the fPRC framework.

2.2 Research design

A scoping review design as adopted in this study is used to search the literature, especially if the specific topic includes a body of literature that is complex such as participation outcomes of AAC intervention studies (Peters et al., 2015). The aims of scoping reviews include identifying the nature and extent of research evidence, providing an overview of the current literature and mapping the key concepts within a broader research topic (Grant & Booth, 2009; Moher et al., 2015; Peters et al., 2015). Therefore, this scoping review was undertaken to summarise and disseminate findings regarding the reported participation and fPRC outcomes of AAC intervention studies and to identify gaps in existing literature so as to guide further research within the field of AAC (Arksey & O'Malley, 2005).

Although a scoping review may share characteristics with a systematic review, it differs from the latter in that it aims to determine what range of evidence is available on a specific topic and to provide an overview of existing evidence regardless of quality (Peters et al., 2015). This lack of quality assessment may be seen as one of the limitations of a scoping review as it may increase the potential for bias and reduce the ability of the review to provide research that in itself can be disseminated (Daudt et al., 2013; Grant & Booth, 2009).

A six-step methodological approach developed by Arksey and O'Malley (2005) and enhanced by Levac et al. (2010) was used as framework to guide this scoping review and is outlined in Table 1. In addition, the Preferred Reporting Items for Systematic Review and Meta-Analysis extension for Scoping Reviews PRISMA-(ScR) checklist was used as a guideline to ensure consistent reporting of the scoping review process (Tricco et al., 2018).

2.3 **Protocol**

An a-priori protocol in the form of a proposal was used to predefine objectives and methods and to allow for transparency, consistency and integrity of the process of this scoping review (Grant & Booth, 2009; Peters et al., 2015). According to Schlosser et al. (2007), the use of a protocol reduces the probability of selection bias and increases the replicability and transparency of the review process. The proposal was reviewed by an international expert in AAC as well as by an international expert in participation-related research and AAC.

Section 2: Methodology

Table 1

Overview of the six-step methodological framework

	Framework stage	Description (combination of Arksey & O'Malley, 2005; Levac et al., 2010)
1	Identifying the research questions	The research question and aims guided the scope of the inquiry. The target population, intervention and outcome constructs clarified the focus of the scoping study and guided an effective search strategy. A rationale for conducting a scoping study was considered.
2	Identifying the relevant studies	The search terms were developed over time with input from the subject librarians and experts in the AAC field. Furthermore, identifying relevant studies included a team knowledgeable in search strategies and familiar with the search terms. An initial database search was piloted to test whether the search terms included relevant studies and to test the applicability of the study selection checklist, the inclusion and exclusion criteria and the data extraction template.
3	Study selection	This stage of the process included searching the literature, refining the search strategy, and reviewing articles for the study. Predefined and agreed-upon inclusion and exclusion criteria were developed. Search results were emailed in a Research Information System (RIS) format and imported to Covidence, an online systematic review software program (Veritas Health Innovation, n.d.). Next, two independent reviewers screened the studies at title and abstract level, as well as at full-text level of the citation to determine which studies would be further analysed. All potentially relevant articles were investigated at full-text level. A study selection checklist was developed and utilised to ensure reliability between the reviewers.
4	Charting the data	A data extraction template was developed and piloted to determine the variables and to ensure the research question was answered. Charting was a continuous process whereby data was extracted and updated on the data extraction template in Covidence.
5	Collating, summarising, and reporting the data	The data analyses included descriptive numerical summary analysis regarding the study characteristics, participant characteristics, intervention outcomes relating to the fPRC, AAC strategies and AAC systems. A discussion of the findings as related to study aims followed next (Colquhoun et al., 2014).
6	Consultation	Researchers in the field of participation and AAC will be consulted to ensure knowledge translation and to facilitate the dissemination of findings.

2.4 Ethical considerations

Ethical clearance for this study, which was obtained by the Faculty of Humanities as required from the University of Pretoria (UP), is included as Appendix C. Since a scoping review aims to review and summarise literature, it does not include any participants and hence, no informed consent was necessary for this study (Arksey & O'Malley, 2005). However, ethical considerations applied in terms of reducing bias and ensuring reliability regarding the identification of information and synthesis of relevant literature (McMillan & Schumacher, 2014).

The plagiarism policy of the University of Pretoria (UP) was upheld. Using the referencing techniques of the American Psychological Association (APA) also ensured accurate scholarly and scientific knowledge and ensured the protection of intellectual property rights (APA, 2019).

The scoping review protocol was registered on Open Science Framework, an open international platform that aims to increase the openness, integrity and reproducibility of scientific research (Center for Open Science, 2020). Registering the scoping review on this framework further ensured the reduction of reporting bias as the completed review could be compared to the planned protocol (Peters et al., 2020). The Open Science Framework registration for this review is DOI 10.17605/OSF.IO/3Z8UM.

2.5 Pilot search

A pilot search was conducted to determine the feasibility of the review question, to refine the search terms, study selection checklist, inclusion and exclusion criteria and the data extraction template, and to ensure that the reviewers apply them uniformly (Montori et al., 2003; Peters et al., 2015; Schlosser et al., 2007). The Cumulative Nursing and Allied Health Literature (CINAHL) database was searched via the EBSCOhost platform. Appendices A and B illustrate the progression of the search terms and the pilot search results. The results were imported and screened as described in the main study. The aims, materials, procedures, and results of the main study are outlined in Table 2, followed by the recommendations of the pilot study.

Section 2: Methodology

Table 2

Pilot searches: Aims, materials, procedures, results and recommendations

Aim	Materials	Procedures	Results	Recommendations
To determine whether the search terms were appropriate.	Proposed databases were searched.	Searches in the various databases were conducted.	Many irrelevant studies were found.	Appendix A indicates the progression of the search terms. The final pilot indicated that the search terms were found to be appropriate.
To determine whether the inclusion and exclusion criteria were applicable.	CINAHL was searched and the results were imported into Covidence. Covidence was used to screen the studies at title and abstract level, and thereafter at full-text level.	The inclusion and exclusion criteria were continuously updated as the title and abstracts of articles were reviewed to ensure consistency and consensus between the reviewers.	The inclusion and exclusion criteria were relevant and comprehensive.	<u>Added to population exclusion criteria</u>: • Persons with typical development • Persons with a hearing impairment and no other concomitant disabilities • Bilingual persons without concomitant disabilities • Persons with visual impairments and no other concomitant disabilities • Persons with specific language impairment, learning difficulties, dyslexia or developmental language delay • Persons with reading difficulties and those with delayed speech and language <u>Added to intervention exclusion criteria:</u> • Assessment using different batteries • Studies that use gaze fixation or looking at the symbol/object/photograph as an indication of comprehension • Comparison to typical development without AAC intervention <u>Added to outcomes exclusion:</u> "Outcomes focusing on child skills or abilities and child capability" were added to the outcomes exclusion criteria.

Section 2: Methodology

Aim	Materials	Procedures	Results	Recommendations
To determine whether the studies selection checklist was easy to apply when screening the title and abstract.	A study selection checklist was developed in Excel.	The study selection checklist was piloted by both reviewers to determine whether it was easy to apply.	The study selection checklist was found to be applicable.	The question: "Does the citation report the AAC intervention with communication outcomes?" was added to the study selection checklist.
To determine whether the data extraction document is comprehensive and suitable to answer the research questions.	A data extraction template was developed in Excel and updated continuously.	The data extraction template was piloted and revised to ensure the research questions could be answered.	Data extraction was revised to include more definitions of terms and to include AAC-related constructs and definitions.	To include outcomes in terms of the AAC and fPRC definitions (Imms et al., 2017; World Health Organization, 2001b) .

2.6 Search strategy

Published peer-reviewed studies were identified using electronic databases (Peters et al., 2015). To reduce sources selection bias and ensure a comprehensive search, six databases in the field of AAC were searched (Schlosser et al., 2005, 2007). The information specialists guided the appropriate selection of the databases and each database was individually searched (Schlosser et al., 2005) during November 2020. The databases included: Academic Search Complete, Cumulative Nursing and Allied Health Literature (CINAHL), Educational Resources Information Centre (ERIC), PsycINFO and Academic Search Complete and MEDLINE via EBSCOhost platform, as well as Linguistics and Language Behaviour Abstracts (LLBA) via the ProQuest platform. The results of the searches were emailed via an RIS link format and imported and organised in Covidence, a web-based software platform. The search strategy was an iterative process whereby additional search terms and the choice of databases were reviewed as the process progressed (Peters et al., 2015).

2.7 Search terms

Information specialists and experts in the field of AAC were consulted to determine the Medical Subject Heading (MeSH) and non-MESH search terms according to the PIO constructs (Adair et al., 2015; Imms et al., 2016). A list of search terms and Boolean operators in relation to the PIO format are described in Table 3.

2.8 Selection of records

Table 4 presents the inclusion and exclusion criteria according to the PIO construct used to identify the articles. The results of the articles identified through the search (using the agreed-upon search terms that conformed to the PIO and limiters set) were imported via RIS format into the Covidence systematic review managing software (Veritas Health Innovation, n.d.; Couban, 2016). Two reviewers independently screened the articles at title and abstract level against the inclusion and exclusion criteria (Table 4). A study selection checklist was developed to ensure reliability between reviewers (Appendix D). All potentially relevant articles were investigated at full-text level. Articles in which disagreement occurred were reviewed at full-text level and discrepancies were rectified by discussion until consensus was reached.

Section 2: Methodology

Table 3

Search terms

PIO constructs	Field	Search terms and Boolean operators
Population	Abstract	Child* OR infan* OR toddler* OR preschool* OR adolescen* OR teenage* OR youth* OR pediatric OR paediatric AND Disab* OR Autism OR ASD OR "developmental delay" OR "developmental disab*" OR "Cerebral palsy" OR CP OR nonverbal OR "little or no functional speech" OR "complex communication needs"
Intervention	All text	"augmentative and alternative communication" OR "augmentative & alternative communication" OR AAC OR "communication aid*" OR "communication system*" OR "speech generating device*" OR SGD OR "voice output communication aid*" OR gesture* OR "finger spell*" OR "manual sign*" OR "simultaneous communication" OR symbol OR "graphic symbol" OR "total communication" OR "social media" OR "peer mentoring" OR PECS OR makaton OR "video modelling" OR "communication partner training" OR "augmented input" OR "aided language" OR "system for augmenting language" OR "AAC modelling" OR "augmented communication-input" OR "augmented communication-output" OR "*scene display" OR VSD AND Intervention* OR therap* OR treatment
Outcomes	All text	Comprehension OR "receptive language" OR understand* OR interpret* OR "receptive vocabulary" OR "expressive language" OR communicat* OR "social communication" OR interact* OR participation* OR engagement OR attendance OR involvement OR "everyday functioning" OR "ADL" OR "activities of daily living" OR "everyday life situations"

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Table 4

Inclusion and exclusion criteria

Criteria	Inclusion criteria	Exclusion criteria	Justification
Population	Age of population Children and youth who use AAC (0-18 years) Population characteristics • Persons who are candidates for AAC based on the presence of a disability, and who may have complex communication needs. • Persons who would benefit from AAC input for communication or participation. • Studies that include communication partner training; however, the outcomes were measured for persons who were AAC users.	Age of population • Persons older than 18 years Population characteristics • Persons who typically are not candidates for/do not use AAC, this may include: • Persons with peripheral sensory (e.g. hearing or vision) impairments and no other concomitant disabilities • Bilingual persons without concomitant disabilities • Persons with dyslexia, poor readers or persons with delayed speech and language development	The fPRC framework was designed for children and youth with disabilities (Imms et al., 2017). Included population typically comprises users of AAC or candidates for AAC (Beukelman & Mirenda, 2013). Excluded population typically does not require AAC to support communication (ASHA, n.d.).
AAC interventions	Interventions that directly or indirectly implemented an AAC system, which augmented or provided alternative receptive and/or expressive language communication for the participants.	• Studies that did not include AAC in the intervention • Studies in which the AAC intervention outcomes did not relate directly to communication or participation, e.g. ease of symbol identification using colour vs black and white. • Studies excluding intervention, e.g. descriptive reports or assessment without	The overall goal of AAC interventions is to enhance communication competence and effectiveness, and to increase social interaction, quality of life, independence and participation in everyday life (Beukelman & Light, 2020; Beukelman & Mirenda, 2013).

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Criteria	Inclusion criteria	Exclusion criteria	Justification
		intervention • Studies making use of Sign Language with deaf participants, or relating to the deaf community • Pseudoscientific interventions such as Facilitated Communication training, Rapid Prompting Method, and Spelling to Communicate (Hemsley et al., 2018; Schlosser et al., 2014, 2019)	
Outcomes	Including participation or related outcomes as defined in the fPRC: • Attendance and involvement constructs, for example outcomes reporting on an increased frequency or duration of attendance and the experience of participation while attending (this may include elements of engagement or motivation during involvement in activities). • Intrinsic or personal constructs relating to the following: ∗ Activity competence – the ability to execute an activity measured by capacity, capability and performance ∗ Preference for items, activities or systems – e.g. toy preference or type of communication preference ∗ Sense of self – intrapersonal factors related to	Outcomes focusing on factors that may impact activity competence (participant skills or abilities and participant capability) but without communication and participation outcomes, e.g. determining the ability of a participant to use a switch but with no communication or related participation aims	These include studies that focus on communication and participation outcomes and how these outcomes map onto the fPRC framework (Imms et al., 2017).

Criteria	Inclusion criteria	Exclusion criteria	Justification
	confidence, satisfaction, self-esteem and self-determination, e.g. reporting on participants' increased confidence when communicating with novel communication partners ∗ Self-regulation – executive processes that enable the individual to direct and monitor their thinking, emotions, actions, and interactions, e.g. participants with sensory integration difficulties requesting to participate in an activity that includes vestibular input such as swinging • Extrinsic constructs relating to the following: ∗ Context – the setting for participation such as activity, object, place and time (Batorowicz et al., 2016), e.g. the participant is communicating with an increased number of peers during informal outside play time ∗ Environment – broader structures we live in (Maxwell et al., 2012), thus outcomes relating to having increased access, opportunities and the means to participate in life activities		
Type of sources	Databases Peer-reviewed journal articles	• Conference abstracts • Hand-searched articles	• Inclusion criteria: To keep the search comprehensive (Schlosser et al., 2007) • Exclusion criteria: To include a level of validity to the study (Daudt

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Criteria	Inclusion criteria	Exclusion criteria	Justification
			et al., 2013)
Research design	• Experimental • Quantitative • Qualitative • Mixed methods • Case study	• Literature reviews/systematic reviews • Editorials • Commentaries/opinions • Political reviews	Research methodologies mostly used in the field of AAC (Kent-Walsh & Binger, 2018)
Dates	1998 – 2020	Prior to 1998	Publication of the Participation model in the field of AAC (Beukelman & Mirenda, 2013)
Languages	English	Non-English	The reviewers are English

2.9 Charting the data

A descriptive analytical method was used to extract data from each study that related to the study aims (Colquhoun et al., 2014). A data extraction template (see Appendix E) was developed in the Covidence systematic review software system (Veritas Health Innovation, n.d.) to determine which variables to extract to answer the research question. The data was extracted from each of the included studies according to general study characteristics (Covidence number, title, number of studies, study design and year ranges), participant characteristics (number of participants, participant diagnosis and ages and number of control group participants). Information was also mined on the independent variable AAC interventions (AAC systems and AAC strategies), dependent variables, study outcomes reported, communication outcomes and fPRC outcomes. Data was further extracted by noting how participation was described and measured, based on the description of the type of activity. A few key concepts of the fPRC framework (relating to AAC constructs) guided the process and definitions are provided in Table 5 (Adair et al., 2018; Imms et al., 2017).

2.10 Data extraction and analysis

The primary extracted data analysis involved mapping the reported outcomes of AAC intervention studies onto the fPRC. The key definitions of concepts in the fPRC framework and AAC constructs (Table 5) were continually referenced when reviewing the outcomes during each step of the process (Adair et al., 2018; Imms et al., 2017). The extracted data was exported to Microsoft Excel using a comma-separated value format, after which it was exported to SPSS for data analysis.

Tables and figures were used to determine and graphically present the descriptive data on the study characteristics, participant characteristics, intervention outcomes relating to the fPRC, AAC strategies and AAC systems (Colquhoun et al., 2014).

Table 5

Definitions of key concepts

Concepts	Definition and application to AAC intervention outcomes
Participation	Attending and being involved in life situations (WHO, 2007, p. 10).
Attendance	The objective 'being-there' experience of participation that is measured as the frequency of attending, and/or the range or diversity of activities in which an individual takes part. For example, a child who uses AAC attending a range of activities during school camp.
Involvement	The 'in-the-moment' experience of participation while attending that may include elements of engagement, motivation, persistence, social connection, and affect. Involvement may be reported by the individual who uses AAC or by proxy report; however, involvement is subjective and may be either not observable or wrongly observed (Imms, 2020). An example of involvement may include the reported motivation of the participant during participation in a certain activity as a result of the intervention.
Engagement	Engagement, which is seen as a unifying construct across ecological levels, can be defined depending on the ecological level in which it is examined: (1) the person level – the internal state of individuals involving focus or effort; (2) between system levels – an active involvement in interactions between systems; (3) at the macro level – active involvement in a democratic society. Engagement may be reported as the focus of attention during various activities during or after the intervention.
Preference	The interests or activities that hold meaning or are valued and that may be considered a component of intervention or educational goal setting (Imms, 2020). Preference may relate to stimuli preference, activity preference, enjoyment and success and it may include preferences for items, activities or systems. For instance, indicating a type of communication preference such as a communication board or a speech-generating device.
Activity competence	The ability to execute the activity being undertaken according to an expected standard, which involves cognitive, physical, and affective skills and abilities. Activity competence can be measured as capacity, capability, or performed skill.

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Concepts	Definition and application to AAC intervention outcomes
Capacity	Best ability of the child within a structured environment such as that created for test taking. Capacity may for example include facilitating a child in a therapy session to discriminate what animal is shown on a page in a book about "Old MacDonald's farm" from the available options using the Picture Exchange Communication System (PECS).
Capability	Skills and abilities that the child can use in a daily environment. For example, a child may be prompted to use PECS to request their preferred animal to be included in the "Old MacDonald's Farm" song during the daily morning song and dance activity.
Performance	Skills and abilities the child uses in everyday settings. Performance may be illustrated by a child selecting an animal from an available array in class and using this to indicate that they saw this animal during an outing on the weekend.
Sense of self	Intrapersonal factors relate to confidence, self-esteem, self-determination and satisfaction with participation. It is related to the development of the person's perception of self. Sense of self may for instance be reported as a participant's increased confidence when communicating with novel communication partners. In addition, autonomy, relatedness and competence are important conditions to develop self-determination (Ryan & Deci, 2000).
Context	Activity setting for participation that includes people, place, activity, objects, and time (Batorowicz et al., 2016). For example, the participant is communicating with an increased number of peers during informal outside play time.
Environment	The broad, objective, social and physical structures in which we live (Batorowicz et al., 2016). According to Maxwell et al. (2012), environment may relate to reporting on the availability, accessibility, affordability, accommodability and acceptability of AAC; thus, outcomes relating to having increased access, opportunities, and the means to participate in life activities.

Adapted from Imms et al. (2017, p. 20)

2.11 Materials, equipment and software

The materials used in this study comprised of a set of predefined inclusion and exclusion criteria (Table 4), a study selection checklist (Appendix D) and a data extraction form (Appendix E).

- **Personal computer**. MacBook Pro 13 using MacOS High Sierra.
- **Covidence licence**. Covidence systematic review software is a web-based software platform used in the production of reviews. It assists in managing the screening of citations and full text, and assessing the risk of bias and data extraction (Veritas Health Innovation, n.d).
- **Microsoft Excel**. The data was analysed using Microsoft Excel.
- **IBM® SPSS® Statistics for Mac (version 27.0).** Predicative analytic software was also used for statistical analysis.

2.12 Reliability

In order to reduce bias and ensure reliability, screening of studies at title, abstract and full-text level was conducted by three independent reviewers (researcher, supervisor and co-supervisor) using Covidence. Studies had to meet the predefined inclusion criteria listed in Appendix C. All potentially relevant articles were investigated based on the full text. Any disagreement at title and abstract level advanced the study to full-text level review. Screening disagreements were resolved by discussion until consensus was reached. Furthermore, transparent and consistent reporting was ensured by using the PRISMA-(ScR) checklist (Tricco et al., 2018).

The researcher extracted 85% of the data independently and the remaining 15% of the records were extracted by the two research assistants independently. A second and third reviewer (supervisor and co-supervisor) checked a total of 25% of the data extraction to ensure data reliability (McMillan & Schumacher, 2014; Schlosser, 2003). All discrepancies were discussed until 100% agreement was reached.

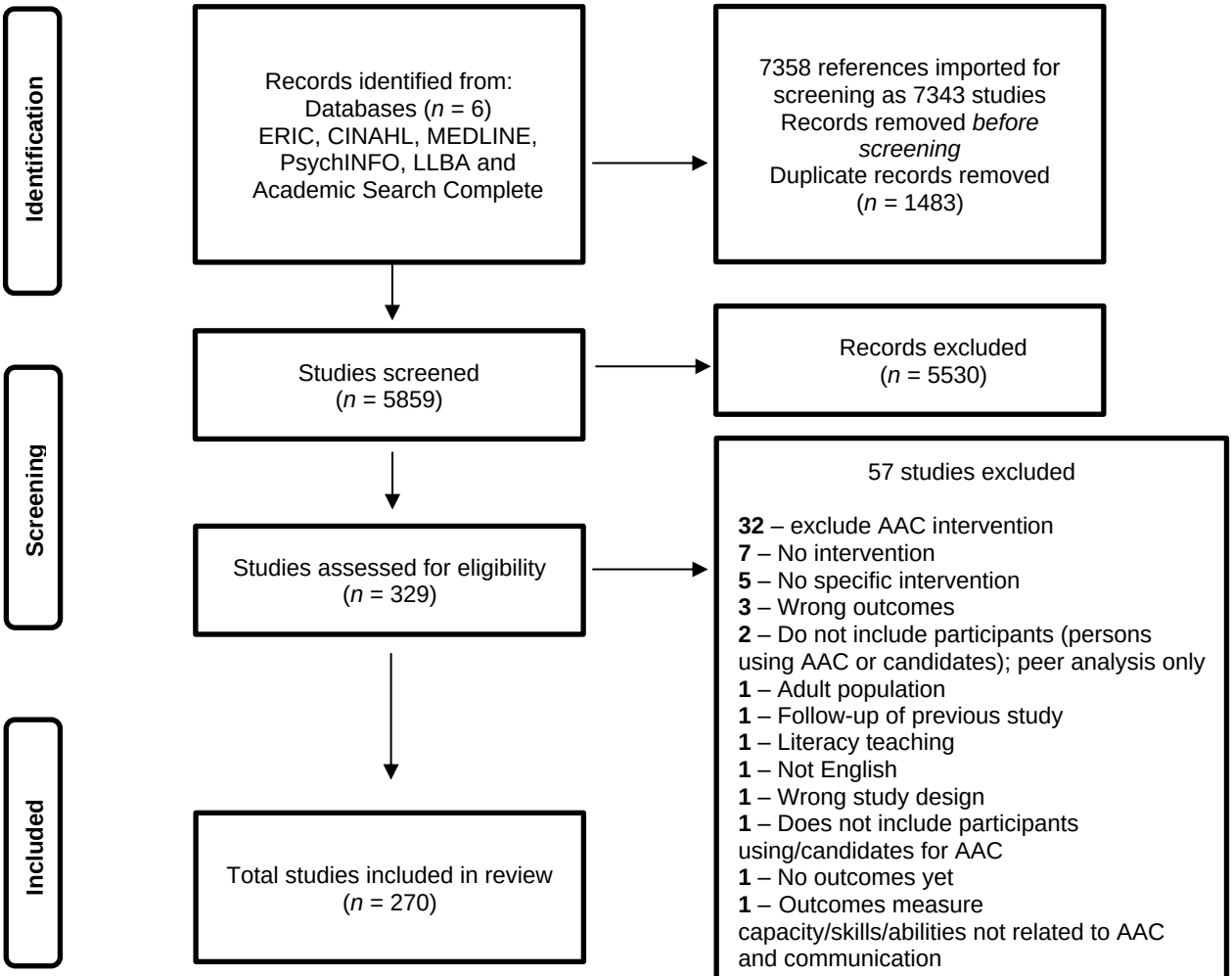
SECTION 3: RESULTS

3.1 Inclusion of studies

A total number of 7358 articles were identified for screening. Duplicates were removed and the process yielded 5859 articles included for abstract screening. Altogether 270 AAC intervention studies were eligible for inclusion in the study (see Appendix F). The PRISMA four-phase flow diagram in Figure 2 presents the flow of information through the different phases in respect of the articles identified for inclusion (Page et al., 2021).

Figure 2

PRISMA flow diagram of selection process (Page et al., 2021)



3.2 Study characteristics

An overview of the characteristics of the included studies is illustrated in Table 6. The majority of the studies (83%) included a single subject design (*n* = 212), whereas 42 (17%) studies utilised a group study design. As indicated in Table 6, a steady increase has been noted in the number of published studies, as the smallest number of publications appeared between 1998 and 2002 (*n* = 24, 9%). A number of studies were published for the year ranges 2003–2007 (*n* = 42, 16%), 2008–2012 (*n* = 63, 23%) and 2018–2020 (*n* = 52, 19%). The majority of the studies were published between 2013 and 2017 (*n* = 89, 33%).

Table 6

Characteristics of included studies

Characteristics	Description	Frequency (*n*)	Percentage (%)
Included studies	Total AAC intervention studies	270	-
Study design	Single subject design	212	83%
	Group design	42	17%
	Not reported	16	6%
Year range	2013–2017	89	33%
	2008–2012	63	23%
	2018–2020	52	19%
	2003–2007	42	16%
	1998–2002	24	9%

3.3 Participant characteristics

A total number of 2408 participants (*n* = 2408) were involved in the studies. The participants' characteristics listed in Table 7 show that most studies focused on children of elementary school age (47%) (*n* = 126, 47%), followed by children of preschool age (*n* = 108; 41%), and adolescents and youth (*n* = 32, 12%). The majority of the studies (61%) focused on participants with autism spectrum disorder (ASD), while others reported on participants with Down syndrome (DS) (11%), multiple disabilities (9%), cerebral palsy (CP) (9%), diagnosis reported as other (4%), and childhood apraxia of speech (CAS) (3%). Two per cent of the studies had no or an unknown diagnosis.

Table 7

Participant characteristics

Characteristics	Description	Number (*n*)	Percentage (%)
Participants	Total number of participants	2408	-
Age ranges	Preschool (0–5 years)	108	40%
	Elementary (6–11 years)	126	47%
	Adolescent and youth (12–18 years)	32	12%
Participant diagnosis	Autism spectrum disorder (ASD)	166	61%
	Multiple	31	11%
	Cerebral palsy (CP)	24	9%
	Other	23	9%
	Down syndrome (DS)	12	4%
	Childhood apraxia of speech (CAS)	9	3%
	Not reported	5	2%

3.4 Mapping of included studies on the fPRC

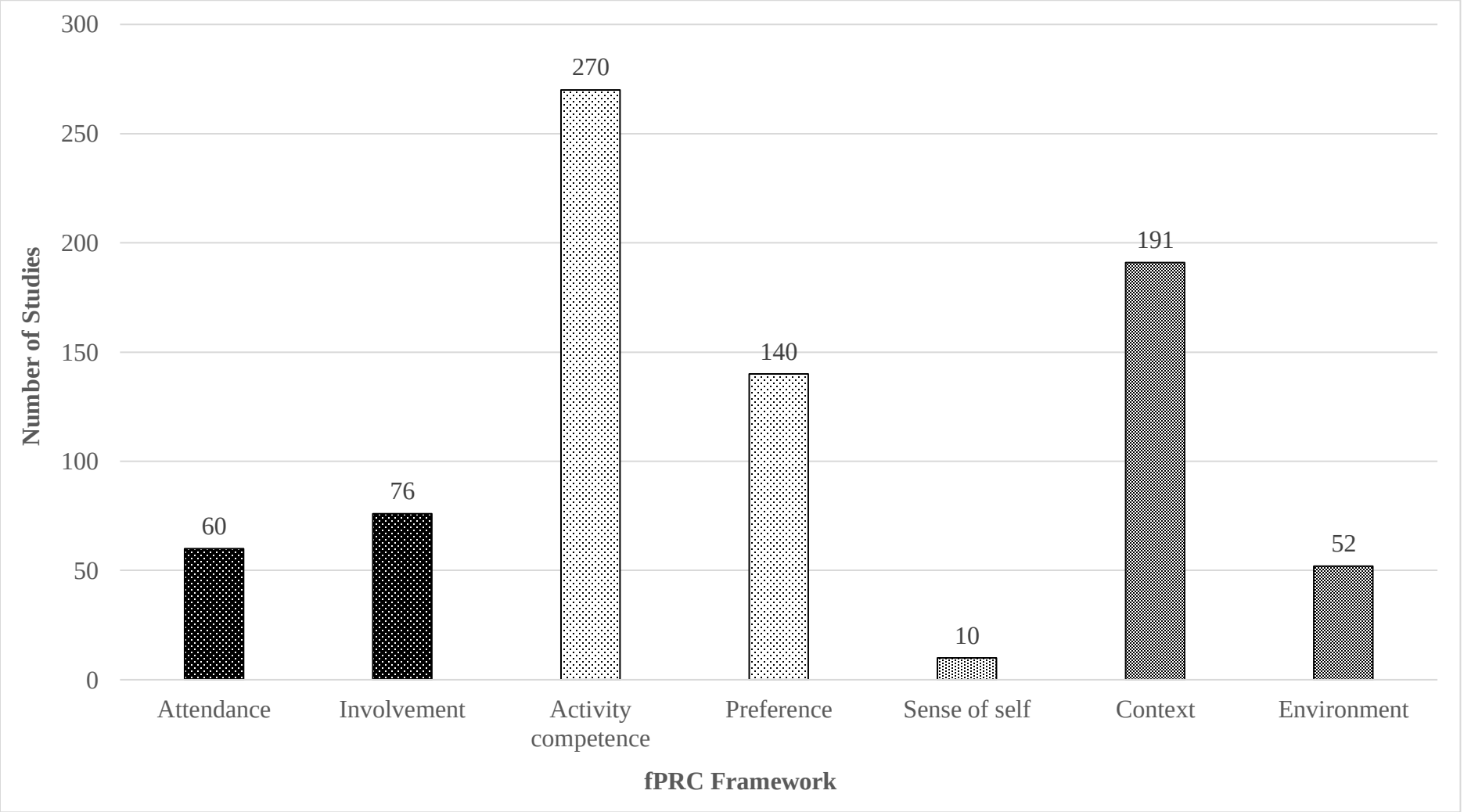
The mapping of the participation outcomes of the total number of AAC intervention studies (*n* = 270) on the fPRC framework is illustrated in Figure 3. The figure also shows that the AAC intervention studies reported on both participation and participation-related constructs. The personal constructs of activity competence (*n* = 270, 100%) and preference (*n* = 140, 52%) were widely reported outcomes. Many studies reported on the environmental constructs of context (*n* = 191, 71%) and environment (*n* = 52, 19%). A total of 49% (*n* = 134) of studies reported directly on participation involvement (*n* = 76, 28%) and on attendance (*n* = 58, 21%) outcomes. Only ten (4%) studies reported on the personal outcomes relating to sense of self.

3.4.1 Description of the AAC intervention studies reporting on participation outcomes

The details of all the included intervention studies (*n* = 270) mapped onto the fPRC framework are included in Appendix F, while Appendix G contains a summary of the specific components of the fPRC reported on in the AAC intervention studies.

Figure 3

Mapping of the AAC intervention participation outcomes on the fPRC



3.4.1.1 Attendance

The results indicate that many studies (*n* = 212, 79%) did not report on attendance. A small number of studies reported on the frequency (*n* = 39, 14%), duration (*n* = 10), diversity (*n* = 8) and the range (*n* = 3*)* of attending an activity.

3.4.1.2 Involvement

The majority of the studies (*n* = 194, 72%) did not report on the involvement construct either. Those studies that actually reported on involvement, reported the unifying construct of engagement (*n* = 67, 25%) as an outcome. Only six studies reported on the experience of motivation and three reported on social connectedness when being involved in an activity. A common theme of increase in opportunities for involvement was derived from the qualitative data extracted.

3.4.1.3 Activity competence

All of the studies (*n* = 270, 100%) reported on activity competence as an outcome. Interestingly, many studies (*n* = 108, 40%) indicated activity competence as performance – some as capacity (*n* = 95, 35%) and some as capability (*n* = 67, 25%).

3.4.1.4 Preference

The preference construct was not reported on by many studies (*n* = 130, 48%). Nevertheless, stimuli preference (*n* = 86, 32%) and activity preference (*n* = 28) were indicated in some of the outcomes of the AAC intervention studies. The results indicate that some studies (*n* = 21) reported on participants' experiences of success regarding their communication and a few studies (*n* = 5*)* reported on their enjoyment of activities.

3.4.1.5 Sense of self

This was the least reported-on construct as the results indicate that 96% of the studies (*n* = 260*)* did not report on the sense of self. The studies that did report on this construct reported on improved confidence (*n* = 4), satisfaction (*n* = 3), improved self-determination (*n* = 2) and increased self-esteem (*n* = 1) as outcomes of the intervention.

3.4.1.6 Context

Context relates to how the participants interacted with a specific context. The results indicate that participating in activities (*n* = 120) was reported as the most common outcome. Altogether 79 studies did not report on context, while 46 studies reported on using objects such as toys for

interaction and a few studies (*n* = 25) indicated interaction with people such as peers. None of the studies reported on the time construct.

3.4.1.7 Environment

Most of the studies (*n* = 218, 81%) did not report on the environment factor as an outcome. Some studies reported on increased availability (*n* = 34) and another few studies reported on the acceptability (*n* = 8), accessibility (*n* = 6), accommodability (*n* = 3) and affordability (*n* = 1) of AAC as an intervention outcome.

3.5 Description of AAC interventions

*3.5.1 **AAC systems***

ASHA refers to AAC systems as an integrated group of components that are used to enhance communication. “These components include forms of AAC (for example aided or unaided), symbols, selection techniques, and strategies” (ASHA, n.d, practice portal, AAC, para. 4). Table 8 gives an account of the AAC systems outcomes in relation to the fPRC framework. Several intervention studies reported on implementing more than one system, and all possible systems reported were extracted. The results indicate that the most frequently used AAC systems that reported on fPRC outcomes included SGD/VOCA (n= 423), Picture Exchange Communication Systems (PECS) or Picture Exchange (PE) systems (*n* = 208), total communication (*n* = 103) and graphic symbols (*n* = 94).

Section 3: Results

Table 8

AAC systems used mapped onto the fPRC

	Attendance	**Involvement**	**Activity competence**	**Preference**	**Sense of self**	**Context**	**Environment**	**Combined total**	
Unaided systems	**n**								**%**
Total communication	14	6	26	17	0	22	18	103	4%
Manual signs	3	2	16	10	0	13	3	47	2%
Gestures	2	3	17	7	0	9	2	40	2%
Keyword signing	3	0	3	3	0	3	1	13	1%
Aided systems	**n**								**%**
SGD/VOCA	35	37	140	78	6	95	32	423	18%
PECS or PE	14	16	67	52	0	50	9	208	9%
Graphic symbols	8	11	29	12	3	23	8	94	4%
Communication board	5	8	20	8	1	16	4	62	3%
Visual scene display	1	7	12	5	0	11	2	38	2%
Tangible symbols	2	2	6	5	0	5	2	22	1%
Visual schedules	1	2	4	2	0	4	1	14	1%

*SGD: Speech-generating device; VOCA: Voice output communication aids; PECS: Picture Exchange Communication System; PE: Picture Exchange

*3.5.2 **AAC intervention strategies***

The different types of instructional techniques and intervention strategies utilised by the studies are depicted in Figure 4. Several studies reported on more than one intervention strategy, and all possible strategies were extracted. The various AAC intervention strategies reported were categorised and coded according to four main classifications. The categories included augmented input, augmented output, prompting and communication partner training. A trend was noticed during data extraction, namely that the term 'prompting' was predominantly used as a strategy reported by the studies. Thus, 'augmented output' (Romski et al., 2010) and 'prompting' (Chazin et al., 2021; Mirenda, 2001) were differentiated. These categories were validated by an interrater (the researcher's co-supervisor).

The different variations of augmented input strategies (Chazin et al., 2021) such as Aided Language Stimulation (AiLgS) (Goossens, 1989), the System for Augmenting Language (SAL), (Romski & Sevcik, 1996), Natural Aided Language (Cafiero, 2001), Aided Language Modelling (ALM), (Drager et al., 2006) and Aided AAC Modelling (Binger & Light, 2007) were included under the augmented input category code.

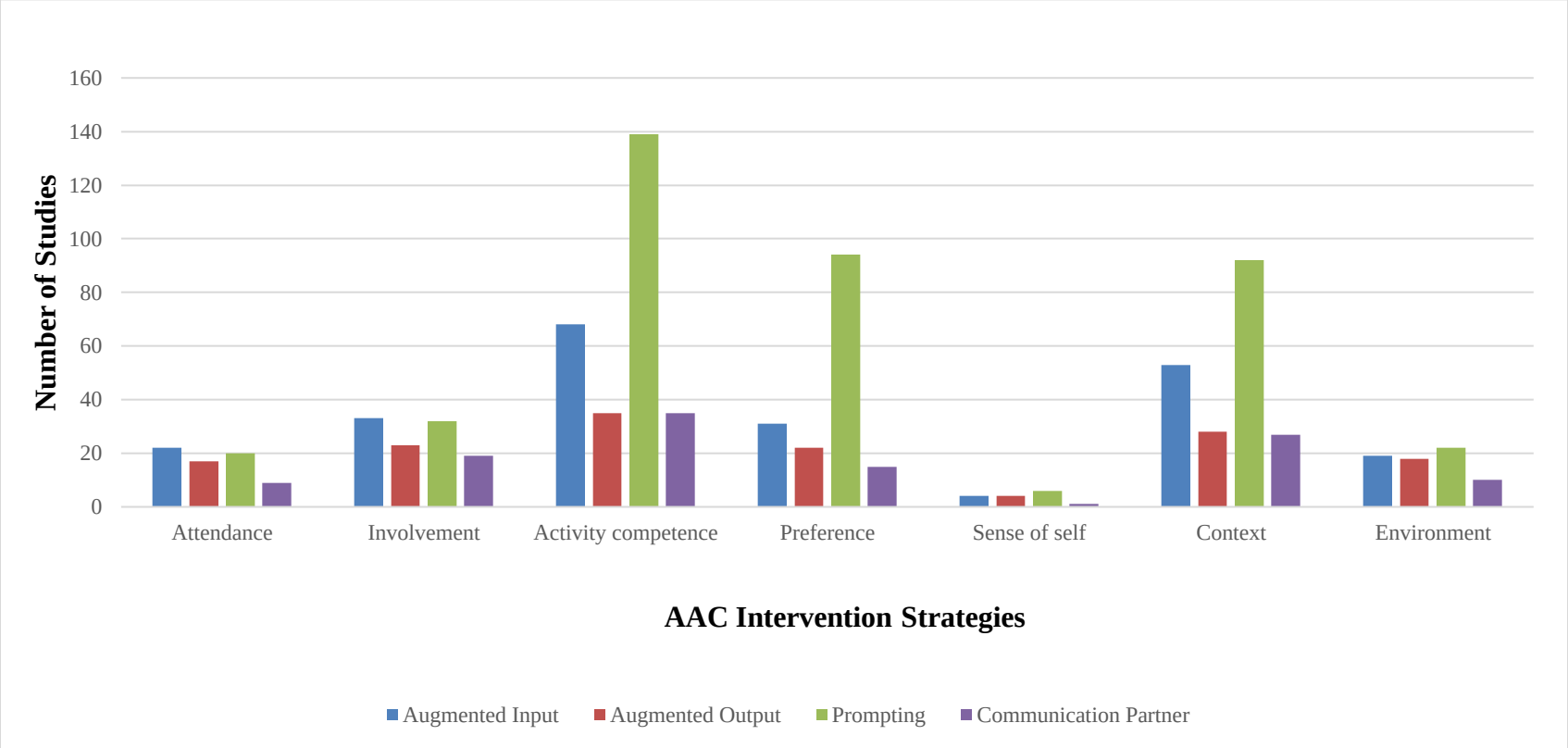
The augmented output category involved information sent to a communication partner by a variety of strategies using an SGD, photographs, video clips, print, gestures, manual signs, and nonelectronic aided symbols (Beukelman & Light, 2020; Mirenda, 2001; Romski et al., 2010).

The prompting code included systematic prompting (Chazin et al., 2021), PECS (Bondy & Frost, 2002; Mirenda, 2001), structured behavioural intervention strategies and applied behaviour analysis (ABA) strategies such as backward chaining, discrete trial training and differential reinforcement.

The communication partner training code included peer mentoring intervention, peer-mediated intervention strategies, educational staff training, and family members training (Kent-Walsh et al., 2015; Shire & Jones, 2015).

Figure 4

AAC intervention strategies mapped on the fPRC framework as an outcome



The results of the various AAC intervention strategies reported for the fPRC framework are illustrated in Figure 4. Prompting was the highest used strategy for most of the outcomes (activity competence preference, sense of self, context and environment). Augmented input strategies were the highest reported strategies for attendance (n = 2) and involvement (n = 33) outcomes. The results further indicated that augmented output and prompting were reported as frequently used strategies used for attendance, involvement and environment outcome.

SECTION 4: DISCUSSION

4.1 Participation constructs

This scoping review aimed to describe the participation-related outcomes reported by AAC intervention studies and how these map onto the fPRC framework. Although the review attempted to map the AAC intervention outcomes separately on the individual constructs of participation and related constructs, it should be noted that participation is a complex and multifactorial concept (Imms & Green, 2020). Therefore, in the discussion of each of the reported outcomes relating to the fPRC, they should not be viewed as isolated constructs, but rather as holistic participation by a child in any life situation.

The research on participation suggests that attendance in life situations for children and youth with disabilities is quite restricted (Imms, 2020). The results indicate that attendance relating to the "being-there" aspect of participation was not widely reported on as an outcome for many AAC intervention studies. The studies that reported of attendance mostly reported on frequency (n= 39, 25%) of attendance, while a few considered duration and diversity of attendance. To illustrate – frequency and duration of attendance were reported in a study by Lerna et al. (2012) that dealt with the effects of PECS on the social–communicative skills of children with autism. Preschool children were assigned to two intervention approaches, namely PECS and Conventional Language Therapy. The study (Lerna et al., 2012) reported that the between-group comparison of social–communicative measures coded during free play illustrated a significantly higher frequency of joint attention, requests/initiation and duration of cooperative play during free play in the PECS than in the Conventional Language Therapy group. Dyches et al. (2002), for instance, reported on diversity of activities by including a log of the participant using different AAC devices to make requests in novel community settings (such as restaurants). McCarthy and Light (2001) analysed the instructional effectiveness of a two-week inclusive theatre arts programme that involved two children who use AAC and three typically developing peers. The study reported that having access to AAC systems allowed these two participants to be equally highly engaged in a range of theatre activities. Furthermore, a study by Jurgens et al. (2009) reported that increased duration of play activities was an outcome of their intervention. This study implemented a PECS training programme to evaluate concomitant changes in spoken

language, social–communicative behaviours, and functional play for a child with autism. They also reported communication gains (such as increases in spoken vocabulary and in the length of comprehensible spoken utterances in free play) and gains in time spent in developmentally appropriate play (Jurgens et al., 2009).

Furthermore, it was significant to note that the studies that reported on attendance as an outcome implemented SGD systems (n= 35) and utilised augmented input strategies such as aided language modelling. One of these studies designed a language and literacy programme for children with CCN. All shareholders, including parents, educators and intervention staff constantly modelled the use of AAC in a variety of settings (Meyers 2007). In addition, PECS and total communication systems were used in some of the studies that reported on attendance outcomes.

Involvement as a construct of participation that relates to the 'experience of participation while attending' (Imms et al., 2017) is a highly subjective and complex construct. The clarity of the meaning of 'being involved' versus 'how to observe involvement' is still being considered (Imms, 2020). The fPRC includes engagement as a linking construct at personal level (effort of focus), between systems (engaged in an activity), or at macro-level (e.g. in society) (Imms et al., 2017). The findings that emerged from the current study indicate that some studies (n=76) considered involvement as an outcome – particularly engagement (n= 67). However, very little focus was placed on motivation and social connectedness. Most of the studies that reported on motivation used measures of direct observation or by proxy report from the participants' caretakers, educators, or research staff. To illustrate, Adams and Cook (2016) reported on motivation as an outcome by indicating that the participant's enthusiasm and sustained interest indicated that she was motivated. However, recent evidence indicates that children and caregivers' perspectives on participation differ (Samuels et al., 2020). Thus, by including the perspectives of both caregiver and child, this approach to children's participation may perhaps be broadened (Dada et al., 2020).

A common theme of increased communication opportunities for engagement emerged during data extraction. Sixteen studies (6%) reported on communication opportunities as an outcome. This could perhaps be linked to the field of AAC utilising the participation model as an approach towards AAC assessment and interventions. The participation model considers opportunity barriers and opportunity interventions as components of such an approach

(Beukelman & Mirenda, 2020). Additionally, the data (see Figure 4) indicates that communication partner training was mostly indicated for involvement outcomes. Studies that utilised communication partner training strategies included for instance the training of peers as communication partners by using SGD devices or PECS in a variety of environments (Chung & Carter, 2013; McCarthy & Light, 2001; Thiemann-Bourque et al., 2016, 2017, 2018). This addresses the need highlighted in literature, namely that children and youth have restricted social interactions, especially in respect of engagement with their peers (Batorowicz et al., 2014; Lygnegård et al., 2019).

4.2 Intrinsic personal-related constructs

The results in Figure 3 indicate that personal-related constructs such as activity competence and preference were predominantly reported as outcomes of the intervention studies. All the intervention studies (n = 270) reported on an aspect of activity competence, measured either as capacity, capability, or performance. This correlates with the findings in the literature that most intervention studies report on personal-related outcomes rather than on the subjective experience of participation (Adair et al., 2018; Granlund, 2013; Imms et al., 2017). The fPRC also refers to activity competence as being measured by capacity, capability, and performance. However, as previously mentioned in the literature review, the ICF conceptualises 'Activities and Participation' as one domain in the classification system. Due to the lack of clarity on the approach to participation, performance could be the only qualifier of participation, while capacity and capability are the qualifiers for activity (Imms & Green, 2020; WHO, 2007) Interestingly, the results indicate that 40% of the studies reported on performance (n= 108) and possibly aimed to report on participation as an outcome. Studies that reported on performance aimed to improve the participants' skills or abilities used in everyday settings, for instance spontaneous production of PECS (Phase IV) throughout the school day (McDonald et al., 2015).

The majority (60%) of the studies reported on capacity (35%) and capability (25%) as an outcome. Many studies aimed to develop and measure the increased capacity and capability of specific skills, such as requesting for a preferred stimulus/reinforcer or activity. However, these skills were mostly reinforced by a researcher prompting the participants in an experimental setting. The data indicated that systems such as PECS (Phases I-III) implemented by prompting strategies were used to a considerable extent during the intervention studies. The studies reported

on requesting for a preferred stimulus or activities as outcomes within a controlled experimental environment.

Preference outcomes are related to activities that hold meaning as positive experiences of enjoyment, while success creates a positive association with certain experiences (Skille & Øterås, 2011). Providing children and especially adolescents who use AAC with opportunities to participate in activities with peers may develop their preferences and boost their internal motivation (Batorowicz et al., 2014; Imms et al., 2016; Raghavendra et al., 2012). The results shown in Figure 4 illustrate that the studies that reported on preference outcomes mostly utilised prompting strategies. It was noted that many studies utilised the least-to-most prompting procedure based on the PECS training protocol of Bondy and Frost (2002). Similarly, the findings mostly indicated stimuli preferences (n= 86) such as food items (i.e., sweets and drinks), auditory stimuli (i.e., song or music) or tactile stimuli (i.e., vibrators or sensory spinners), as well as activity preferences (n= 28) such as playing with playdough or bubbles. Although it was noted that many of the studies that incorporated PECS conducted a reinforcement/stimuli sampling process prior to the intervention phase, they also provided the stimulus or activity (object) for a short duration of time and restricted access to the controlled experimental environment. In addition, some studies reported that the participants were able to request for a preferred item or snack in a controlled environment. Such findings support and confirm the finding reached by Batorowicz et al. (2014), namely that the content and activities of children using aided communication were concrete and predictable, and mainly involved conversations about food and daily routines.

The current scoping review further indicates that several studies included AAC system preference assessments. A few studies including those by Couper et al. (2014), Lorah et al. (2013), McLay et al. (2015), van der Meer et al. (2012) and Dyches et al. (2002) – to name a few – conducted preference assessments between systems such as SGD, manual signs, picture exchange options or communication boards. Success (n= 21) was mostly reported on by observation or by proxy reports. However, some studies administered child questionnaires and asked the participants' opinions on success, satisfaction and enjoyment. For instance, Bedrosian et al. (2003) used a student questionnaire in which the participants indicated that their writing and communication skills had improved and expressed their enjoyment of writing stories

together. Another example is a study by Adams and Cook (2016, p. 440) that probed the participant about the activity and she responded, “This is fun”.

Importantly, the child’s perception of activity competence for performing an activity and their preference may shape their sense of self (Imms et al., 2017). The theme of sense of self was derived from the value of participation and can shape and motivate the child’s participation (Imms et al., 2016; Imms & Green, 2020). The results illustrate that sense of self (n =10) was the least reported-on construct. The studies that commented on sense of self either reported by direct observation, by a researcher observing what they noted, or by proxy report. For instance, Stasolla et al. (2013) utilised a happiness index and continually recorded mood changes by observing smiling, laughing and excited body movements throughout the intervention. According to a study by Bornman et al. (2001), an increase in self-confidence was informally observed by the occupational therapist involved. Sigafoos et al. (2005) suggested that self-determination be promoted by assessing children’s preference for using AAC devices. Perhaps one approach to reduce barriers would be to include the children’s perspectives on their sense of self. Self-report measures such as Picture my Participation (PmP) (Arvidsson et al., 2019) may be considered as part of intervention (Dada et al., 2020; Kramer & Schwartz, 2017).

4.3 **Extrinsic environmental-related constructs**

Context is personal when viewed from the perspective of the person participating and it relates to people, place, activity objects and time in which the participation is situated (Batorowicz et al., 2016; Imms & Green, 2020). It is worth noting that the definition of social context – as conceptualised by Batorowich et al. (2016) and promoted by the fPRC – suggests that an individual can participate in an activity by themselves or with other people. The current results indicate that most of the studies (n = 120) reported on activity as an outcome. Activity refers to what the child does and what has happened around the child. Activity is important as it provides a developmental context (Batorowicz et al., 2016) and also provide opportunities for social interaction (King, Batorowicz, Rigby, Pinto et al., 2014).

To demonstrate, Dada and Alant (2009) described the effects that an aided language stimulation intervention has on the vocabulary acquisition of children with CCN. The aided language stimulation programme included three activities, namely food preparation, arts and crafts, and story time activities in a group format. The study concluded that the comprehension of symbols was sufficiently facilitated in four participants (Dada & Alant, 2009). Objects may be

considered as cognitive artifacts through which children interact with their environment (Batorowicz et al., 2016). Some of the studies reported on objects (n = 46) such as toys or educational tools. Many of the studies utilising PECS (Bondy & Frost, 2002) conducted a reinforcement/stimulus sampling protocol of objects to be requested during the intervention phase. The other studies reported on the people (n = 25) aspect. One case in point is a study by Grace et al. (2014) that reported on the effectiveness of an intervention aimed to increase the social participation and communication of youth with CCN. Additionally, support and training were effective in increasing internet use for connecting with others, and an increase in number of online communication partners following the intervention was reported. The results in Figure 4 also report that the strategies used for context outcomes indicated that prompting and augmented input were mostly utilised to facilitate the use of a variety of systems such as SGD/VOCA, PECS or PE, graphic symbols, total communication, and manual signs.

Environment refers to the broader (physical and social) context in which participation takes place. A large and growing body of evidence describes how environmental factors influence a child's participation (Imms & Green, 2020). It explains that the environment affects the child directly or indirectly and that the person affects the environment through their engagement in activities in specific places (Imms et al., 2017). Surprisingly, only a few studies (n = 52) reported on aspects of the environment and those that did report on environment outcomes mostly reported on availability (n = 34) to participate when using AAC. Maxwell et al. (2012, p. 65) describe availability as the "objective possibility to engagement in a situation". The data in Figure 4 further illustrates that augmented input, augmented output and prompting were utilised almost equally as strategies in the studies that reported on environment as an outcome.

Communication partner training was also considered more frequently by the studies reporting on environmental outcomes. To illustrate, a study by Drager et al. (2019) investigated the effectiveness of 'just-in-time (JIT)' AAC technology to increase the number of intentional and intelligible symbolic communicative turns expressed. The intervention integrated the JIT programming into ongoing shared context activities. New visual scene displays (VSD) and vocabulary relevant to the ongoing activities were quickly available and thus allowed the participants to remain engaged in the activities. Finally, an inspiring study by Bunning et al. (2014) tailored their intervention approach to each individual, based on Nakajima's (1985) three maxims cited by Alant and Lloyd (2005a). The intervention needed to be amendable to caregiver

implementation in the home context, as well as feasible and culturally and socially acceptable. The outcomes of their study revealed not only significant positive parent perceptions regarding the children's communication, but also indicated some expansion of the children's social activities (Bunning et al., 2014).

SECTION 5: CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary of main findings

Literature indicates that the field of AAC considers participation to be the ultimate goal of AAC interventions for children with CCN (Beukelman & Light, 2020; Granlund et al., 2008; Light & McNaughton, 2015. The scoping review in hand aimed to provide an overview of the participation constructs reported by AAC intervention studies for children and youth with CCN. It is evident from the results of this study that the field of AAC has considered areas of participation and related constructs. However, there is a paucity of intervention studies focusing on essential participation constructs such as attendance, involvement, sense of self and environment. Most of the studies focused on activity competence, especially capacity and capability, and although these are valuable aspects of participation, they do not fully attend to the holistic and multidimensional nature of participation.

The scoping review further illustrated that SGD and PECS are the most frequently implemented AAC systems, while prompting strategies constitute the most-used intervention strategy to facilitate communication development for children and youth using various AAC systems. It was interesting to note that augmented input, augmented output and communication partner training strategies were largely utilised by the studies reporting on attendance, involvement, sense of self and environment outcomes.

Seeing that participation is complex and multifaceted, it may be valuable to consider the fPRC framework in the field of AAC to provide conceptual clarity and consistency in language-for-participation outcomes for children and youth with CCN who use AAC. Furthermore, this scoping review highlighted important constructs of participation that should be considered to facilitate opportunities for participation. In turn, these constructs could also ensure positive health and wellbeing outcomes for children and especially for adolescents using AAC.

5.2 Implications for practice

Facilitating participation across activities allows individuals with CCN to build communication competence and to participate fully in all aspects of life (Beukelman & Mirenda, 2013; Light & McNaughton, 2014). Several authors indicated that participation is the end goal

for AAC intervention (Beukelman & Light, 2020; Granlund et al., 2008; Light & McNaughton, 2015). The fPRC framework can be a valuable framework to adjust restricted goal setting that focuses on isolated constructs such as capacity. It may further facilitate the consideration of participation as the motivating process and end goal for every child with CCN using a variety of AAC systems. Thus, interventionists need to consider participation in all of its complexity as the primary focus of intervention so as to develop comprehensive participatory goals together with all stakeholders. This may truly enhance the long-term wellbeing of children and youth using AAC.

5.3 Critical evaluation of the study

*5.3.1 **Strengths***

This study aimed to provide a comprehensive overview of the AAC interventions and how their outcomes map onto the fPRC. Using broad search terms and searching six databases yielded many articles for consideration. Furthermore, by ensuring that the inclusion criteria were extensive in terms of year ranges, participation constructs and intervention outcomes led to the inclusion of a large number of studies (n = 270). The fact that 47 possible variables were extracted from each study, thus yielding a very large data set, can be considering a strength of this scoping review, as it added quantitative value to the qualitative data set.

In addition, the scoping review mapped onto most of the fPRC constructs, except for one (self-esteem). This allowed for a comprehensive overview of participation outcomes of the AAC intervention studies.

*5.3.2 **Limitations***

A few limitations to this scoping review should be considered when interpreting the results. Since the review included only peer-reviewed journal articles, publication bias cannot be ruled out. In addition, due to the authors' linguistic restrictions only English articles were considered, which may have caused linguistic bias (Schlosser et al., 2007). The fPRC considers the construct of self-regulation as the executive process that creates a level of cohesion between preferences, activity competence and sense of self (Imms et al., 2017). However, self-regulation was not included in this scoping review as it is a broadly used term in the field of occupational therapy and would possibly have expanded the number of studies to an unmanageable quantity (Ayres & Robbins, 2005). Moreover, due to the complexity and volume of data, this scoping

review included only the reported participation outcomes and did not report on participation as a process.

5.4 **Recommendations for further studies**

Seeing that participation is a multifaceted and complex construct, it is important to understand how to set objectives in order to fully incorporate participation as an end goal of AAC interventions. Thus, focusing on studies reporting on a variety of participatory constructs as outcomes may lead to improved (understanding) of how to develop further research studies and set proper goals for clinicians. Furthermore, it is recommended that measures of participation be included in AAC intervention studies to effectively evaluate the impact of intervention on participation for children with CCN. It may also be valuable to delve deeper into participation as a process to determine accessible ways to positively influence the development of children and especially youth who use AAC. Since a paucity of intervention studies focussing on participation outcomes for adolescents who use AAC were indicated by this review.

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* References of the included studies.

APPENDIX A

Search term progression

Searches via EBSCOhost

Appendices

	Preliminary search 1 07/09/2020	Preliminary search 2 20/10/2020 : Search terms include P; abstract and I; all text AND "intervention*"..	Preliminary search 3 20/10/2020 Search terms all text include AND intervention*..	Preliminary search 4 30/10/2020	Piot search CINAHL via EBSCOhost (334 studies, 6 duplicates removed) 06/11/2020	Final search 26/11/2020
Search Concept 1	Child* OR infant* OR toddler* OR paediatric* OR peadiatric* OR adolescent* OR teen* OR youth* OR juvenile OR teenage*	Child* OR infant* OR toddler* OR preschool* OR adolescent* OR teen* OR youth* OR peer* OR student*	Child* OR infant* OR toddler* OR preschool* OR adolescent* OR teen* OR youth* OR peer* OR student*	Child* OR infan* OR toddler* OR preschool* OR adolescen* OR teenage* OR youth* OR pediatric OR paediatric	Child* OR infan* OR toddler* OR preschool* OR adolescen* OR teenage* OR youth* OR pediatric OR paediatric	Child* OR infan* OR toddler* OR preschool* OR adolescen* OR teenage* OR youth* OR pediatric OR paediatric
Search Concept 2	Disab* OR Autism OR "Autistic disorder" OR "Developmental delay" OR "Cerebral palsy" OR CP OR "communication disorder" OR nonverbal OR "little or no functional speech" OR "complex communication needs	Disab* OR Autism OR ASD OR "developmental delay" OR "developmental disab*" OR "Cerebral palsy" OR CP OR nonverbal OR "little or no functional speech" OR "complex communication needs"	Disab* OR Autism OR ASD OR "developmental delay" OR "developmental disab*" OR "Cerebral palsy" OR CP OR nonverbal OR "little or no functional speech" OR "complex communication needs"	Disab* OR Autism OR ASD OR "developmental delay" OR "developmental disab*" OR "Cerebral palsy" OR CP OR nonverbal OR "little or no functional speech" OR "complex communication needs"	Disab* OR Autism OR ASD OR "developmental delay" OR "developmental disab*" OR "Cerebral palsy" OR CP OR nonverbal OR "little or no functional speech" OR "complex communication needs"	Disab* OR Autism OR ASD OR "developmental delay" OR "developmental disab*" OR "Cerebral palsy" OR CP OR nonverbal OR "little or no functional speech" OR "complex communication needs"

	Preliminary search 1 07/09/2020	Preliminary search 2 20/10/2020 : Search terms include P; abstract and I; all text AND "intervention*"..	Preliminary search 3 20/10/2020 Search terms all text include AND intervention*..	Preliminary search 4 30/10/2020	Piot search CINAHL via EBSCOhost (334 studies, 6 duplicates removed) 06/11/2020	Final search 26/11/2020
Search Concept 3	"Augmentative and alternative communication" OR AAC OR "communication aid*" OR "communication system*" OR "speech generating device*" OR "SGD" OR "voice output communication aid*" OR gesture* OR "finger spell*" OR "manual sign*" OR "simultaneous communication" OR symbol OR "graphic symbol" OR "total communication"	"augmentative and alternative communication" OR "augmentative & alternative communication" OR AAC OR "communication aid*" OR "communication system*" OR "speech generating device*" OR SGD OR "voice output communication aid*" OR gesture* OR "finger spell*" OR "manual sign*" OR "simultaneous communication" OR symbol OR "graphic symbol" OR "total communication" OR "social media" OR "peer mentoring" OR PECS OR makaton OR "video modelling" OR "communication partner training" OR "augmented input" OR "aided language" OR "system for augmenting language" OR "AAC modelling" OR "augmented communication-input" OR "augmented communication-output" OR "*scene display" OR VSD	"augmentative and alternative communication" OR "augmentative & alternative communication" OR AAC OR "communication aid*" OR "communication system*" OR "speech generating device*" OR SGD OR "voice output communication aid*" OR gesture* OR "finger spell*" OR "manual sign*" OR "simultaneous communication" OR symbol OR "graphic symbol" OR "total communication" OR "social media" OR "peer mentoring" OR PECS OR makaton OR "video modelling" OR "communication partner training" OR "augmented input" OR "aided language" OR "system for augmenting language" OR "AAC modelling" OR "augmented communication-input" OR "augmented communication-output" OR "*scene display" OR VSD	"augmentative and alternative communication" OR "augmentative & alternative communication" OR AAC OR "communication aid*" OR "communication system*" OR "speech generating device*" OR SGD OR "voice output communication aid*" OR gesture* OR "finger spell*" OR "manual sign*" OR "simultaneous communication" OR symbol OR "graphic symbol" OR "total communication" OR "social media" OR "peer mentoring" OR PECS OR makaton OR "video modelling" OR "communication partner training" OR "augmented input" OR "aided language" OR "system for augmenting language" OR "AAC modelling" OR "augmented communication-input" OR "augmented communication-output" OR "*scene display" OR VSD	"augmentative and alternative communication" OR "augmentative & alternative communication" OR AAC OR "communication aid*" OR "communication system*" OR "speech generating device*" OR SGD OR "voice output communication aid*" OR gesture* OR "finger spell*" OR "manual sign*" OR "simultaneous communication" OR symbol OR "graphic symbol" OR "total communication" OR "social media" OR "peer mentoring" OR PECS OR makaton OR "video modelling" OR "communication partner training" OR "augmented input" OR "aided language" OR "system for augmenting language" OR "AAC modelling" OR "augmented communication-input" OR "augmented communication-output" OR "*scene display" OR VSD	"augmentative and alternative communication" OR "augmentative & alternative communication" OR AAC OR "communication aid*" OR "communication system*" OR "speech generating device*" OR SGD OR "voice output communication aid*" OR gesture* OR "finger spell*" OR "manual sign*" OR "simultaneous communication" OR symbol OR "graphic symbol" OR "total communication" OR "social media" OR "peer mentoring" OR PECS OR makaton OR "video modelling" OR "communication partner training" OR "augmented input" OR "aided language" OR "system for augmenting language" OR "AAC modelling" OR "augmented communication-input" OR "augmented communication-output" OR "*scene display" OR VSD

Appendices

	Preliminary search 1 07/09/2020	Preliminary search 2 20/10/2020 : Search terms include P; abstract and I; all text AND "intervention*"..	Preliminary search 3 20/10/2020 Search terms all text include AND intervention*..	Preliminary search 4 30/10/2020	Piot search CINAHL via EBSCOhost (334 studies, 6 duplicates removed) 06/11/2020	Final search 26/11/2020
Search Concept 4	Comprehension OR "receptive language" OR understand* OR interpret* OR "receptive vocabulary" OR "expressive language" OR communication OR "social participation" OR "social communication" OR interaction* OR "interaction opportunity*" OR "communication access"	Intervention* OR treatment OR therap*	Intervention* OR treatment OR therap*	Intervention* OR therap* OR treatment	Intervention* OR therap* OR treatment	Intervention* OR therap* OR treatment
Search Concept 5	engagement OR participation OR attendance OR involvement OR "activity* competence" OR preference OR "sense of self" OR "Self-regulation" OR "social context" OR environment	No Outcome Term	No Outcome Term	Comprehension OR "receptive language" OR understand* OR interpret* OR "receptive vocabulary" OR "expressive language" OR communicat* OR "social communication" OR interact* OR participation* OR engagement OR attendance OR involvement OR "everyday functioning" OR "ADL" OR "activities of daily living" OR "everyday life situations"	Comprehension OR "receptive language" OR understand* OR interpret* OR "receptive vocabulary" OR "expressive language" OR communicat* OR "social communication" OR interact* OR participation* OR engagement OR attendance OR involvement OR "everyday functioning" OR "ADL" OR "activities of daily living" OR "everyday life situations"	Comprehension OR "receptive language" OR understand* OR interpret* OR "receptive vocabulary" OR "expressive language" OR communicat* OR "social communication" OR interact* OR participation* OR engagement OR attendance OR involvement OR "everyday functioning" OR "ADL" OR "activities of daily living" OR "everyday life situations"

Progression of search terms

LLBA via ProQuest

Appendices

LLBA via ProQuest	Preliminary search 1 07/09/2020	Preliminary search 6 20/10/2020 Search terms all text include AND intervention*	Preliminary search 7 30/10/2020	Final search 26/11/2020
Search concept 1	early childhood OR infants AND toddlers OR preschool OR teen OR adolescent OR youth	Child* OR infant* OR toddler* OR preschool* OR adolescent* OR teen* OR youth* OR ~~peer* OR student* Or scholar*~~	Child OR infant OR toddler OR preschool OR adolescent OR teenage OR youth OR pediatric OR paediatric	Child OR infant OR toddler OR preschool OR adolescent OR teenage OR youth OR pediatric OR paediatric
Search concept 2	developmental delay disorders OR cerebral palsy OR CP OR nonverbal OR little OR no functioning speech OR complex communication needs	Disab* OR Autism OR ASD OR "Developmental delay" OR "developmental disab*" OR "Cerebral palsy" OR CP OR nonverbal OR "little or no functional speech" OR "complex communication needs	Disab OR Autism OR ASD OR developmental delay OR developmental disab OR Cerebral palsy OR CP OR nonverbal OR little or no functional speech OR complex communication needs	Disab OR Autism OR ASD OR developmental delay OR developmental disab OR Cerebral palsy OR CP OR nonverbal OR little or no functional speech OR complex communication needs
Search concept 3	augmentative and alternative communication OR Augmentative & alternative communication OR AAC OR communication aid* OR communication system* OR speech generating device* OR SGD OR voice output communication aid* OR gesture* OR finger spell* OR manual sign* OR simultaneous communication OR symbol OR graphic symbol OR total communication OR social media OR peer mentoring OR PECS OR Makaton OR video based modelling OR communication partner training OR integrated video modelling OR intervention* OR augmented input OR Aided Language OR System for augmenting language OR AAC modelling OR augmented communication-input OR augmented communication-output	"augmentative and alternative communication" OR "Augmentative & alternative communication" OR AAC OR "communication aid*" OR "communication system*" OR "speech generating device*" OR SGD OR "voice output communication aid*" OR gesture* OR "finger spell*" OR "manual sign*" OR "simultaneous communication" OR symbol OR "graphic symbol" OR "total communication" OR "social media" OR "peer mentoring" OR PECS OR Makaton OR "video based modelling" OR "communication partner training" OR "integrated video modelling" OR intervention* OR "augmented input" OR "Aided Language" OR "System for augmenting language" OR "AAC	augmentative and alternative communication OR augmentative & alternative communication OR AAC OR communication aid OR communication system OR speech generating device OR SGD OR voice output communication aid OR gesture OR finger spell OR manual sign OR simultaneous communication OR symbol OR graphic symbol OR total communication OR social media OR peer mentoring OR PECS OR makaton OR video modelling OR communication partner training OR OR augmented input OR aided language OR system for augmenting language OR AAC modelling OR augmented communication-input OR augmented communication-output OR scene display OR VSD	augmentative and alternative communication OR augmentative & alternative communication OR AAC OR communication aid OR communication system OR speech generating device OR SGD OR voice output communication aid OR gesture OR finger spell OR manual sign OR simultaneous communication OR symbol OR graphic symbol OR total communication OR social media OR peer mentoring OR PECS OR makaton OR video modelling OR communication partner training OR augmented input OR aided language OR system for augmenting language OR AAC modelling OR augmented communication-input OR augmented communication-output OR scene display OR VSD

Appendices

LLBA via ProQuest	Preliminary search 1 07/09/2020	Preliminary search 6 20/10/2020 Search terms all text include AND intervention*	Preliminary search 7 30/10/2020	Final search 26/11/2020
		modelling" OR "augmented communication-input" OR "augmented communication-output"		
Search concept 4		Intervention OR therapy OR treatment	Intervention OR therapy OR treatment	Intervention OR therapy OR treatment
Search concept 5		no outcome terms	Comprehension OR receptive language OR understand OR interpret OR receptive vocabulary OR expressive language OR communicate OR social communication OR interact OR participation OR engagement OR attendance OR involvement OR everyday functioning OR ADL OR activities of daily living OR everyday life situations	Comprehension OR receptive language OR understand OR interpret OR receptive vocabulary OR expressive language OR communicate OR social communication OR interact OR participation OR engagement OR attendance OR involvement OR everyday functioning OR ADL OR activities of daily living OR everyday life situations

APPENDIX B

Results of each preliminary search

Appendices

Databases	Preliminary search 1	Preliminary search 2	Preliminary search 3	Preliminary search 4	Pilot search	Final search
Academic search complete	15612	5181	52610	4299		4285
CINAHL	220	547	4113	438	334	301
ERIC	230	308	1554	314		233
LLBA via ProQuest	1180	1451	23875	891		901
Medline	232	522	2269	505		399
PsycINFO	482	1222	30956	1302		1238
Total	2359612	9231	115377	7749	334	7357

APPENDIX C

Ethical Clearance

Appendices

Faculty of Humanities
Fakulteit Geesteswetenskappe
Lefapha la Bomotho

6 October 2020

Dear Mrs P Prinsloo

Project Title:	Impact of AAC interventions on participation outcomes in children with complex communication needs: Scoping review
Researcher:	Mrs P Prinsloo
Supervisor(s):	Prof. S Dada Dr KG Bastable
Department:	CAAC
Reference number:	24026566 (HUM012/0920)
Degree:	Master's

Thank you for the application that was submitted for ethical consideration.

The Research Ethics Committee notes that this is a literature-based study, and no human subjects are involved.

The application has been **approved** on 1 October 2020 with the assumption that the document(s) are in the public domain. Data collection may therefore commence along these guidelines.

Please note that this approval is based on the assumption that the research will be carried out along the lines laid out in the proposal. However, should the actual research depart significantly from the proposed research, a new research proposal and application for ethical clearance will have to be submitted for approval.

We wish you success with the project.
Sincerely,

Prof Innocent Pikirayi

Deputy Dean: Postgraduate Studies and Research Ethics

Faculty of Humanities, UNIVERSITY OF PRETORIA

APPENDIX D

Study Selection Checklist

Appendices

Study selection checklist

Title of article	
Authors	
Year	
Name of reviewer	
Current date	

1. Does the citation report on **children** (younger than 18) who use AAC or who are candidates for AAC?
    - Yes
    - No
    - Maybe/ inconclusive

2. Does the citation describe an empirical research study using primary data, published as a journal article in English? (no reviews, opinion pieces, conference proceedings, policy reviews, etc.)
    - Yes
    - No
    - Maybe/ inconclusive

3. Does the citation report on AAC intervention?
    - Yes
    - No
    - Maybe/ inconclusive

4. Does the citation report the AAC intervention with the concept of **participation OR any of the family of participation-related constructs** as a process or outcomes?
    - Yes
    - No
    - Maybe/ inconclusive

Reviewer decision:
The following will be incorporated into the electronic screening (refer to Table 3 for Inclusion and Exclusion Criteria):

- 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 inconclusive or maybe to any or all of the questions, the article will be included for full-text screening.

APPENDIX E

Data Extraction Template

Appendices

Variable	Category	Reporting justification
Identification		
Identification number		None
Country		None
Title		None
Author		None
Date		None
Name of person extracted		None
Participants/Population		
Inclusion criteria (0-18 years)	Number of study participants and sample size	To determine number of participants in the scoping review
Age	Mean range	To determine the frequency of ages included in the studies
Disability AAC techniques are routinely used with people who experience developmental disabilities (Beukelman & Mirenda, 2013). Childhood onset disability is a complex field that includes a myriad of conditions arising in early life (Imms & Green, 2020)	•☐ Autism Spectrum Disorder •☐ Cerebral Palsy •☐ Down Syndrome •☐ Childhood Apraxia of Speech •☐ Developmental disabilities •☐ Multiple disabilities •☐ Other, specified	To determine the type of disability included in the studies
Control group	Number and disability of the control group	To determine whether the control group includes children with CCN or typically developing peers
Method		
Study designs	•☐ RCT •☐ Multiple baseline •☐ Alternating treatment design •☐ Case stud	To determine the frequency of the different types of study designs
Format of intervention	•☐ Single •☐ Group format	To determine the frequency of the format of intervention

Appendices

Dependent variable	State dependent variable	To describe the dependent variable reported
Dependent variable measured as	State how the dependent variable was measured	To determine the measures used
Outcomes reported	State outcomes reported	To describe a link to the reporting outcomes
Independent variable	State independent variable	To describe the independent variable reported
Intervention		
AAC interventions AAC involves attempts to study and when necessary compensate for temporary or permanent impairments, activity limitations, and participation restrictions of individuals with severe disorders of speech-language production and/or comprehension, including spoken and written modes of communication (ASHA, 2004). AAC interventions focuses on implementing AAC strategies and methods with the "overall goal of these interventions to increase quality of life and participation in everyday life of children who with complex communication needs and must augment their spoken needs with alternative means of communication" (Granlund et al., 2008, p. 207)	Unaided AAC intervention •☐ Total communication •☐ Simultaneous communication •☐ Finger spelling •☐ Gestures •☐ Keyword signing **Aided AAC intervention systems** •☐ SGD/VOCA •☐ PECS •☐ Communication board •☐ Graphic symbols •☐ Tangible symbols •☐ VSD •☐ Visual schedules •☐ Other **Aided AAC intervention strategies** •☐ Augmented communication input •☐Augmented communication output •☐ Aided AAC modelling •☐ Aided language modelling •☐ Aided language stimulation •☐ Natural aided language •☐ SAL •☐ Scene cues	To describe the types of intervention used to facilitate participation and indicate possible gaps in research regarding AAC interventions and participation

Appendices

	•☐ Communication partner training •☐ Peer mentoring •☐Adapted ABA methods •☐ DDT •☐ Prompting •☐Other	
Type of activity Activity is defined by ICF/ICF-CY as "the individual's ability to execute a task" (WHO, 2007, p. 13) Activities according to the CAPE 5 informal or formal activities(King et al., 2009, p. 120; Law et al., 2006)	•☐ Recreational •☐ Active physical activities •☐ Social activities •☐ Skill-based activities •☐ Self-improvement activities •☐ Educational •☐ Other, describe	To describe the trend of the type of activity involved in AAC interventions
<u>Outcomes of the studies</u>		
Communication- related outcomes: Dependent variable (DV) "An outcome can be defined as the effects of one or several events happening earlier in time; in this case, the effects of an AAC intervention (Granlund et al., 2008, p.208). Outcomes of AAC interventions may vary in specificity and generality and may be related to the ICF domains of Body function and Structure and factors Activity and Participation and Environmental (Granlund, Björck-Åkesson, et al., 2008; Raghavendra et al., 2007)	☐ Initiate interaction ☐ Requesting/ Manding ☐ Tacting/labelling ☐ Comprehension/receptive language ☐ Expressive language ☐ Literacy skills ☐ Social interaction ☐ Social communication ☐ Independent functional communication ☐ Other	To determine the trends of the communication skills targeted in AAC interventions
Participation as an outcome (dependent variable) To understand or change participation as an outcome such as increased attendance or involvement in activities (Adair et al., 2018; Granlund et al., 2008; Schlebusch et al., 2020). To allow individuals with CNN to build communication competence and to participate fully in all aspects of life (Beukelman & Mirenda, 2013; Light & McNaughton, 2014)	Participation in communication activities such as: •☐ expressing wants and needs •☐ exchanging information •☐ building social closeness •☐ participating in social etiquette routines •☐ engagement in social activities •☐ engagement in educational activities •☐ participation in social networks •☐ engagement in household tasks	To determine the trend of participation and participation-related constructs targeted during AAC intervention Number and frequency of the studies that include participation as an outcome

Appendices

	•☐ participation in society •☐ participation in the community •☐ Other	
Measurements of participation Observation and proxy ratings are methods used to quantify and understand involvement of assessing children with complex communication needs (Adair et al., 2018)	<u>Questionnaires</u> •☐ Interview format •☐ Parent questionnaire •☐ Child questionnaire •☐ Direct observation •☐ Interview •☐ Focus group •☐ Video recording •☐ Multiple data collection	To describe how participation was measured
<u>Conceptual elements:</u> <u>Outcome of AAC intervention on fPRC (relating to research question</u>)		
Attendance Attendance defined as "being there and measured as frequency of attending, and/or the range or diversity of activities" (Imms et al., 2017, p. 18)	<u>Measures as:</u> •☐ Frequency •☐ Range •☐ Duration •☐ Diversity of activity	To determine trends in the outcomes related to attendance within the fPRC framework
Involvement Involvement defined as the "experience of participation while attending" (Imms et al., 2017, p. 18).	<u>Includes elements of:</u> •☐ Engagement (focus of attention) •☐ Motivation •☐ Persistence •☐ Social connectedness •☐ Affect	To determine trends in the outcomes related to involvement within the fPRC framework
<u>Intrinsic elements of the person</u>		
Preference Preference defined as activities that hold meaning; antecedent and consequence of participation (Imms et al., 2017; Skille & Øterås, 2011)	•☐ Success •☐ Enjoyment •☐ Stimuli preference •☐ Activity preference	To determine trends in the outcomes related to preference within the fPRC framework
Activity competence Activity competence consistent with ICF can be defined as the extent to which an individual can perform an	•☐ Capability •☐ Capacity •☐ Performance	To determine trends in the outcomes related to activity competence within the fPRC

Appendices

activity/task and can be measured as capability, capacity and performance (Imms et al., 2017; Imms & Green, 2020; World Health Organization, 2007).		framework
Sense of self Sense relates to intrapersonal factors such as confidence, self-esteem, satisfaction, self-determination (Imms et al., 2017) *Self-determination* : internal and external regulation. Linked to relatedness, competence and autonomy (Imms & Green, 2020; Ryan & Deci, 2000).	•☐ Confidence •☐ Self-esteem •☐ Satisfaction •☐ Self-determination ◦☐ relatedness ◦☐ competence ◦☐ autonomy	To determine trends in the outcomes related to sense of self within the fPRC framework
<u>Extrinsic elements of the fPRC</u>		
Activity setting or context Context is defined as involving the people, place, activities and time in which participation is situated (Batorowicz et al., 2016)	•☐ Activity •☐ Object •☐ Place •☐ People •☐ Time	To determine trends in the outcomes related to the context
Environment The broader environment is considered the physical (climate, terrain, built environment) and social (community, cultural, institutional processes and practices) elements people live in (Imms & Green, 2020; Maxwell et al., 2012)	<u>Can be objective (observable perspective or subjective (perceived)</u> •☐ Availability •☐ Accessibility •☐ Affordability •☐ Accommodability •☐ Acceptability	To determine trends in the outcomes related to the broader environment

APPENDIX F

Intervention Outcomes Mapped onto the fPRC Framework

Appendix

First author and year	Title of article	Attendance	Involvement	Activity competence	Preference	Sense of self	Context	Environment
Kagohara 2012	Teaching picture naming to two adolescents with autism spectrum disorders using systematic instruction and speech-generating devices			capacity				
McLay 2017	Acquisition and preference and follow up comparison across three AAC modalities taught to two children with autism spectrum disorder			capacity	stimuli preference		activity	
Collette 2019	Proloquo2Go enhances classroom performance in children with autism spectrum disorder			performance			activity	
Couper 2014	Comparing acquisition of and preference for manual signs, picture exchange and speech-generating devices in nine children with autism spectrum disorder			capacity	stimuli preference		object	
Gregory 2009	The influence of matching and motor imitation abilities on rapid acquisition of manual signs and exchange-based communicative responses			capacity	stimuli preference		object	
Roche 2014	Comparing tangible symbols and picture exchange and a direct selection response for enabling two boys with developmental disabilities to access preferred stimuli			capacity	stimuli preference			
Wright 2013	Effects of a naturalistic sign intervention on expressive language of toddlers with Down syndrome			capability			activity	
So 2019	Who is a better teacher for children with autism? Comparison of learning outcomes between robot-based and human-based interventions in gestural production and recognition			capacity				
Carbone 2006	A comparison of two approaches for teaching VB functions: Total communication vs vocal-alone			capacity	stimuli preference			
Rudd 2007	Teaching productive sign modifications to children with intellectual disabilities			capability	stimuli preference			
Braddock 2016	Symbolic communication forms in young children with autism spectrum disorder			performance			activity	
Carbone 2010	Increasing the vocal responses of children with autism and developmental disabilities using manual sign mand training and prompt delay.			capacity	stimuli preference		object	
Lal 2010	Effect of alternative and augmentative communication on language and social behavior of children with autism			capacity				
Holyfield 2019	Preliminary investigation of the effects of a prelinguistic AAC intervention on social gaze behaviors from school age children with multiple disabilities		engagement (focus of attention)	capacity	activity preference		activity	

Appendices

First author and year	Title of article	Attendance	Involvement	Activity competence	Preference	Sense of self	Context	Environment
So 2016	Using robot animation to promote gestural skills in children with autism spectrum disorders			capability				
So 2018	Robot-based intervention may reduce delay in the production of intransitive gestures in Chinese-speaking preschoolers with autism spectrum disorder			capacity				
Kurt 2011	A comparison of discrete trial teaching with and without gestures or signs in teaching receptive language skills to children with autism			capacity				
Buffington 1998	Procedures for teaching appropriate gestural communication skills to children with autism			capability	stimuli preference		object	
Ingersoll 2007	Teaching the imitation and spontaneous use of descriptive gestures in young children with autism using a naturalistic behavioral intervention			capability			activity	
Moes 2002	Contextualized behavioral support in early intervention for children with autism and their families			performance	stimuli preference		activity	accessibility
So 2019	Robot-based play drama intervention may improve the narrative abilities of Chinese-speaking preschoolers with autism spectrum disorder		engagement (focus of attention)	capability			activity	
Al-Batayneh 2020	Effectiveness of a toothbrushing programme using the picture exchange communication system (PECS) on gingival health of children with autism spectrum disorders			performance			activity	
Calculator 2016	Description and evaluation of a home-based parent-administered program for teaching enhanced natural gestures to individuals with Angelman syndrome			performance			activity	
Charlop 2008	An application of the Picture Exchange Communication System with children with autism and a visually impaired therapist			capacity	stimuli preference		object	
Finke 2017	Effects of a least to most prompting procedure on multisymbol message production in children with autism spectrum disorder who use augmentative and alternative communication			capability			activity	
Gordon 2011	A communication-based intervention for nonverbal children with autism. What changes? Who benefits?			performance	stimuli preference		activity	
Jurgens 2019	Maintenance and generalization of skills acquired through Picture Exchange Communication System (PECS) training: A long-term follow-up			performance	stimuli preference		activity	availability

Appendices

First author and year	Title of article	Attendance	Involvement	Activity competence	Preference	Sense of self	Context	Environment
Lal 2007	Effect of visual strategies on development of communication skills in children with autism			capacity				
Schlosser 2007	Effects of synthetic speech output on requesting and natural speech production in children with autism: A preliminary study			capability	stimuli preference			
Sigafoos 2005	Supporting self-determination in AAC interventions by assessing preference for communication devices			performance	stimuli preference	self determination		
Travis 2010	The effectiveness of the picture exchange communication system (PECS) for children with autism spectrum disorder (ASD): A South African pilot study			performance	stimuli preference		activity	
Akers 2019	An evaluation of conditional manding using a four-component multiple schedule			capacity			object	
Wijkamp 2010	Sign-supported Dutch in children with severe speech and language impairments A multiple case study			capability			people	
Lancioni 2008	Three persons with multiple disabilities accessing environmental stimuli and asking for social contact through microswitch and VOCA technology			capacity	stimuli preference			
DiStefano 2016	Communication growth in minimally verbal children with ASD: The importance of interaction		engagement (focus of attention)	capability			activity	
Binger 2017	Early sentence productions of 5-year-old children who use augmentative and alternative communication			capacity				
Yun-Ching Chung 2013	Promoting peer interactions in inclusive classrooms for students who use speech-generating devices	duration		capability	success			availability
Taylor 2003	AAC and scripting activities to facilitate communication and play	duration		capacity	success		activity	
Yoder 2010	Brief report: Randomized test of the efficacy of Picture Exchange Communication System on highly generalized picture exchanges in children with ASD	duration	engagement (focus of attention)	capability	success			availability
Adams 2013	Programming and controlling robots using scanning on a speech-generating communication device A case study	duration	engagement (focus of attention)	performance			activity	
Pattison 2016	Simultaneous presentation of speech and sign prompts to increase MLU in children with intellectual disability	frequency	engagement (focus of attention)	capability	activity preference		people	availability
Toth 2009	Bridge of signs: Can sign language empower non deaf	Frequency		performance	success		people	accommodability

Appendices

First author and year	Title of article	Attendance	Involvement	Activity competence	Preference	Sense of self	Context	Environment
	children to triumph over their communication disabilities?							
Tan 2014	Acquisition and generalization of key word signing by three children with autism	frequency		capacity	success		activity	availability
Edmister 2015	Repeated reading and turn taking and augmentative and alternative communication (AAC)	frequency	engagement (focus of attention)	capability			activity	
Thomas-Stonell 2016	Communicative participation changes in preschool children receiving augmentative and alternative communication intervention	frequency		performance			people	availability
Achmadi 2014	Acquisition and preference and follow-up data on the use of three AAC options by four boys with developmental disability/delay			performance	stimuli preference		object	
Thirumanickam 2018	Effectiveness of video-based modelling to facilitate conversational turn taking of adolescents with autism spectrum disorder who use AAC			capability			activity	
Ganz 2015	Comparison between visual scene displays and exchange-based communication in augmentative and alternative communication for children with ASD			capacity	stimuli preference		activity	
Laubscher 2019	Effect of an application with video visual scene displays on communication during play pilot study of a child with autism spectrum disorder and a peer		engagement (focus of attention)	capability			activity	
Therrien 2016	Using the iPad to facilitate interaction between preschool children who use AAC and their peers		engagement (focus of attention)	capability			activity	
Drager 2019	AAC technologies with visual scene displays and just-in-time programming and symbolic communication turns expressed by students with severe disability		motivation	capability	enjoyment		activity	accessibility
Schlosser 2013	Implementing directives that invoke prepositions with children with autism: A comparison of spoken cues with two types of augmented input			capacity			object	
Therrien 2018	Promoting peer interaction for preschool children with complex communication needs and autism spectrum disorder		engagement (focus of attention)	capability			activity	acceptability
Holyfield 2019	Comparative effects of high-tech visual scene displays and low-tech isolated picture symbols on engagement from students with multiple disabilities		engagement (focus of attention)	capacity	activity preference		activity	

Appendices

First author and year	Title of article	Attendance	Involvement	Activity competence	Preference	Sense of self	Context	Environment
Daneshvar 2019	A treatment comparison study of a photo activity schedule and social stories for teaching social skills to children with Autism Spectrum Disorder: Brief report		engagement (focus of attention)	performance			people	
OBrien 2016	Brief report: Just-in-time visual supports to children with autism via the Apple Watch: A pilot feasibility study	duration	engagement (focus of attention)	capacity	success		object	availability
Plavnick 2012	A practical strategy for teaching a child with autism to attend to and imitate a portable video model			capacity	activity preference		activity	
Chang 2018	Applying secondary tier group-based video modeling to teach children with developmental disabilities to communicate using iPad			capability			object	
Smith 2014	Video feedforward for rapid learning of a picture-based communication system			performance	stimuli preference		object	
Copple 2015	An examination of the effectiveness of video modelling intervention using a speech-generating device in preschool children at risk for autism			capability	stimuli preference			
Babb 2020	Using AAC video visual scene displays to increase participation and communication within a volunteer activity for adolescents with complex communication needs	frequency	engagement (focus of attention)	capability			activity	
Wu 2010	Assessment and treatment of stereotypic vocalizations in a Taiwanese adolescent with autism: A case study		engagement (focus of attention)	performance	activity preference		object	
Rowland 2000	Tangible symbols and tangible outcomes			performance				
Trief 2013	A field study of a standardized tangible symbol system for learners who are visually impaired and have multiple disabilities		engagement (focus of attention)	performance	stimuli preference		activity	
Lund 2008	Teaching young people who are blind and have autism to make requests using a variation on the Picture Exchange Communication System with tactile symbols: A preliminary investigation			capability	stimuli preference		object	
Trief 2007	The use of tangible cues for children with multiple disabilities and visual impairment	frequency		capacity	success		people	availability
Alzrayer 2017	Teaching children with autism spectrum disorder and other developmental disabilities to perform multistep requesting using an iPad			capacity	stimuli preference		activity	
McLay 2015	Comparing acquisition and generalization and			capacity				

Appendices

First author and year	Title of article	Attendance	Involvement	Activity competence	Preference	Sense of self	Context	Environment
	maintenance and preference across three AAC options in four children with autism spectrum disorder							
Ryan 2018	Responsiveness of a parent-reported outcome measure to evaluate AAC interventions for children and youth with complex communication needs			performance				
Sigafoos 2018	Teaching two children with autism spectrum disorder to use a speech-generating device			capacity	activity preference			
Almirall 2016	Longitudinal effects of adaptive interventions with a speech-generating device in minimally verbal children with ASD			performance				
Cook 2017	A simple intervention for stereotypical engagement with an augmentative alternative communicative device			performance	stimuli preference		object	acceptability
Lüke 2016	Impact of speech-generating devices on the language development of a child with childhood apraxia of speech: A case study			performance				
Barker 2019	Intervention focus moderates the association between initial receptive language and language outcomes for toddlers with developmental delay			capacity				
Romski 2010	Randomized comparison of augmented and non-augmented language interventions for toddlers with developmental delays and their parents			performance			activity	
Chazin 2018	Implementation and intervention practices to facilitate communication skills for a child with complex communication needs			capability			activity	
Waddington 2014	Three children with autism spectrum disorder learn to perform a three-step communication sequence using an iPad-based speech-generating device			capacity	stimuli preference			
Trembath 2009	Peer-mediated teaching and augmentative and alternative communication for preschool-aged children with autism		engagement (focus of attention)	capability			people	availability
Schlosser 2017	Repurposing everyday technologies to provide just-in-time visual supports to children with intellectual disability and autism a pilot feasibility study with the Apple Watch			capacity				
Gilroy 2018	A pilot community-based randomized comparison of speech-generating devices and the Picture Exchange Communication System for children diagnosed with			performance	activity preference		activity	

Appendices

First author and year	Title of article	Attendance	Involvement	Activity competence	Preference	Sense of self	Context	Environment
	autism spectrum disorder							
Bock 2005	Increasing functional communication in non-speaking preschool children: Comparison of PECS and VOCA			capacity	stimuli preference		object	
vanderMeer 2013	Teaching multi step requesting and social communication to two children with autism spectrum disorders with three AAC options			capability	stimuli preference			
vanderMeer 2012	A further comparison of manual signing and picture exchange and speech generating devices as communication modes for children with autism spectrum disorders			performance	stimuli preference		object	
Lorah 2016	Comparing teacher and student use and preference of two methods of augmentative and alternative communication: Picture exchange and a speech-generating device			performance	stimuli preference			
Lorah 2013	Evaluating picture exchange and the iPad as a speech-generating device to teach communication to young children with autism			capacity	stimuli preference			
Son 2006	Comparing two types of augmentative and alternative communication systems for children with autism			capability	stimuli preference		object	
Saturno 2015	An augmentative and alternative communication tool for children and adolescents with cerebral palsy			capacity				
Tönsing 2016	Supporting the production of graphic symbol combinations by children with limited speech: A comparison of two AAC systems		motivation	capability	stimuli preference		activity	
vanderMeer 2012	Speech-generating devices versus manual signing for children with developmental disabilities			capability	stimuli preference			
King 2013	Severe speech sound disorders: An integrated multimodal intervention			capability			object	
VanderSchuit 2010	Immersive communication intervention for speaking and non-speaking children with intellectual disabilities			performance			activity	availability
Davis 1998	Teaching children with severe disabilities to utilize non-obligatory conversational opportunities: An application of high probability requests		engagement (focus of attention)	performance			people	
Binger 2011	Using aided AAC models and recasts and contrastive targets to teach grammatical morphemes to children who use AAC			capacity	stimuli preference		activity	
Brady 2015	Investigating a multimodal intervention for children with			capacity				

Appendices

First author and year	Title of article	Attendance	Involvement	Activity competence	Preference	Sense of self	Context	Environment
	limited expressive vocabularies associated with autism							
Lorah 2016	Evaluating the Language Builder Application in the acquisition of listener responding in young children with autism			capacity				
Meeks 2017	Using an Apple iPad and communication application to increase communication in students with autism spectrum disorder			capacity	stimuli preference			
Navarro 2020	Using AAC to unlock communicative potential in late talking toddlers			capability				
Suberman 2020	Teaching caregivers to implement mand training using speech-generating devices			performance				
Hudson 2016	Teaching early numeracy skills using single switch voice output devices to students with severe multiple disabilities		engagement (focus of attention)	performance			activity	accessibility
Encarnação 2017	Using assistive robots to promote inclusive education		motivation	performance	activity preference		activity	
Grace 2014	Learning to use the internet and online social media: What is the effectiveness of home-based intervention for youth with complex communication needs?		social connectedness	performance	enjoyment	satisfaction	people	accessibility
Carnett 2020	Teaching children with autism spectrum disorder to ask 'where' questions using a speech-generating device			capability			activity	
Ferris 2009	Comparison of error correction procedures involving a speech-generating device to teach a child with autism new tacts			capacity	stimuli preference			
Genc-Tosun 2017	Teaching multi step requesting to children with autism spectrum disorder using systematic instruction and a speech-generating device			capacity	stimuli preference		object	
Gevarter 2019	A behavioral intervention package to increase vocalizations of individuals with autism during speech-generating device intervention			capacity	stimuli preference		object	
Alzrayer 2019	The effects of systematic instruction in teaching multistep social communication skills to children with autism spectrum disorder using an iPad		engagement (focus of attention)	capability				
Snodgrass 2018	A boy and his AAC team: Building instructional competence across team members		engagement (focus of attention)	performance			activity	availability
Binger 2010	Teaching educational assistants to facilitate the			capacity			activity	

Appendices

First author and year	Title of article	Attendance	Involvement	Activity competence	Preference	Sense of self	Context	Environment
	multisymbol message productions of young students who require augmentative and alternative communication							
Chang 2018	Symbolic play in school-aged minimally verbal children with autism spectrum disorder			capability			people	
Kent-Walsh 2015	Teaching children who use augmentative and alternative communication to ask inverted yes or no questions using aided modeling			capacity			activity	
Mathisen 2009	Using MINSPEAK: A case study of a preschool child with complex communication needs		engagement (focus of attention)	performance		confidence	activity	
Kunze 2019	Language preference of a multilingual individual with disabilities using a speech-generating device			capacity	stimuli preference			
Sonawane 2020	AVAZ application trial version – A voice for the nonverbal children with autism spectrum disorder: A pilot study			capacity	stimuli preference		object	
Sreekumar 2020	Advancement to higher communicative functions with transition to iPad app: A case report		motivation	capacity		confidence		acceptability
Hampton 2020	Multicomponent communication intervention for children with autism: A randomized controlled trial			performance			activity	
Kent-Walsh 2010	Effects of parent instruction on the symbolic communication of children using augmentative and alternative communication during storybook reading			performance			activity	
Koppenhaver 2001	Supporting communication of girls with Rett syndrome and their mothers in storybook reading			performance			activity	
Lorah 2019	Establishing peer manding in young children with autism using a speech-generating device			performance	stimuli preference		object	
Meinzen Derr 2017	Technology-assisted language intervention for children who are deaf or hard of hearing: Aa pilot study of augmentative and alternative communication for enhancing language development			performance				
Bourque 2020	Expanding communication modalities and functions for preschoolers with autism spectrum disorder: Secondary analysis of a peer partner speech-generating device intervention		engagement (focus of attention)	performance	activity preference		activity	
Kasari 2014	Communication interventions for minimally verbal children with autism: A sequential multiple assignment randomized trial		engagement (focus of attention)	performance	activity preference		activity	

Appendices

First author and year	Title of article	Attendance	Involvement	Activity competence	Preference	Sense of self	Context	Environment
Cosbey 2006	Using a single switch voice output communication aid to increase social access for children with severe disabilities in inclusive classrooms		engagement (focus of attention)	performance	stimuli preference		object	
Muharib 2019	Backward chaining and speech output technologies to enhance functional communication skills of children with autism spectrum disorder and developmental disabilities			capacity				
Olive 2007	The effects of enhanced milieu teaching and a voice output communication aid on the requesting of three children with autism			capability				
Hetzroni 2003	Effects of a positive support approach to enhance communicative behaviors of children with mental retardation who have challenging behaviors		engagement (focus of attention)	capability	success		activity	availability
King 2014	Evaluation of the iPad in the acquisition of requesting skills for children with autism spectrum disorder			capacity	stimuli preference		object	
Schepis 1998	Increasing communicative interactions of young children with autism using a voice output communication aid and naturalistic teaching			capability	stimuli preference			
Alzrayer 2020	Effects of a behavior intervention package on augmented and vocal mands by children with developmental disabilities			capability	stimuli preference		object	
Gevarter 2020	Teaching preschoolers with autism to use different speech-generating device display formats during play intervention and secondary factors			capability	activity preference		activity	
McCarthy 2001	Instructional effectiveness of an integrated theatre arts program for children using augmentative and alternative communication and their nondisabled peers: Preliminary study	range	engagement	performance	success		activity	
Bishop 2020	Further investigation of increasing vocalizations of children with autism with a speech-generating device			capacity	stimuli preference		object	
Brady 2000	Improved comprehension of object names following voice output communication aid use: Two case studies			capacity	activity preference		activity	
DiCarlo 2000	Using voice output devices to increase initiations of young children with disabilities			performance			activity	
Ganz 2015	Impact of PECS tablet computer app on receptive identification of pictures given a verbal stimulus			capacity	stimuli preference		object	
Gevarter 2014	Comparing acquisition of AAC-based mands in three			capacity	stimuli		object	

Appendices

First author and year	Title of article	Attendance	Involvement	Activity competence	Preference	Sense of self	Context	Environment
	young children with autism spectrum disorder using iPad applications with different display and design elements				preference			
Gevarter 2017	Assessing the acquisition of requesting a variety of preferred items using different speech-generating device formats for children with autism spectrum disorder			capacity	stimuli preference			
Gevarter 2018	Comparison of schematic and taxonomic speech-generating devices for children with ASD			capability	stimuli preference		object	
Greenberg 2012	Assessing generalization of the Picture Exchange Communication System in children with autism			capability	stimuli preference		object	
Kagohara 2010	Behavioral intervention promotes successful use of an iPod-based communication device by an adolescent with autism			capacity			object	
Lorah 2014	Within stimulus prompting to teach symbol discrimination using an iPad speech-generating device			capacity	stimuli preference			
Lorah 2015	The acquisition of intraverbal responding using a speech-generating device in school-aged children with autism			capacity				
Lorah 2017	Acquisition of tacting using a speech-generating device in group learning environments for preschoolers with autism			performance				
McDuffie 2012	Object interest in autism spectrum disorder: Aa treatment comparison			capacity			object	
Sankardas 2017	iPad efficacy of electronic devices to help children with autism spectrum disorder to communicate in the classroom			capacity				
Wendt 2019	Effects of an iPad-based speech-generating device infused into instruction with the Picture Exchange Communication System for adolescents and young adults with severe autism spectrum disorder			capability				acceptability
Thunberg 2007	Children with autistic spectrum disorders and speech-generating devices: Communication in different activities at home		engagement (focus of attention)	performance			activity	
Lancioni 2007	Enabling two adolescents with multiple disabilities to choose among environmental stimuli through different procedural and technological approaches			capacity	stimuli preference			
Myers 2007	“Please listen it’s my turn”. Instructional approaches curricula and contexts for supporting communication and increasing access to inclusion	diversity of activity		performance	success		activity	

Appendices

First author and year	Title of article	Attendance	Involvement	Activity competence	Preference	Sense of self	Context	Environment
Saunders 2013	Establishing a conditional signal for assistance in teenagers with blindness	diversity of activity	engagement (focus of attention)	performance	stimuli preference		activity	
Thiemann-Bourque 2018	Incorporating a peer-mediated approach into speech-generating device intervention effects on communication of preschoolers with autism spectrum disorder	diversity of activity	engagement (focus of attention)	performance				acceptability
Adams 2016	Using robots in hands-on academic activities: A case study examining speech-generating device use and required skills	diversity of activity	motivation	capacity	enjoyment		activity	
Adamson 2010	Augmented language intervention and the emergence of symbol-infused joint engagement	duration	engagement (focus of attention)	capability			people	
Shillingsburg 2019	Teaching children with autism spectrum disorder to report past behavior with the use of a speech-generating device	frequency		capability	success		people	availability
Sevcik 2004	Research directions in augmentative and alternative communication for preschool children	frequency		capability	success		activity	availability
Choi 2010	Teaching requesting and rejecting sequences to four children with developmental disabilities using augmentative and alternative communication	frequency		capacity	activity preference		object	availability
Sigafoos 2003	Effects of speech output on maintenance of requesting and frequency of vocalizations in three children with developmental disabilities	frequency		capacity	stimuli preference		activity	availability
vanderMeer 2012	Comparing three augmentative and alternative communication modes for children with developmental disabilities	frequency	engagement (focus of attention)	capacity	stimuli preference		people	
Roche 2014	An evaluation of speech production in two boys with neurodevelopmental disorders who received communication intervention with a speech-generating device	frequency	engagement (focus of attention)	capacity	stimuli preference		object	availability
Sennott 2016	AAC modeling with the iPad during shared storybook reading: Pilot study	frequency		capacity	success		activity	availability
Soto 2008	The effect of shared book reading on the acquisition of expressive vocabulary of a 7-year-old who uses AAC	frequency	engagement (focus of attention)	performance			activity	affordability
Nguyen 2008	An interfacing system that enables speech-generating device users to independently access and use a mobile	frequency		performance	success	satisfaction	people	

Appendices

First author and year	Title of article	Attendance	Involvement	Activity competence	Preference	Sense of self	Context	Environment
	phone							
Strasberger 2014	The effects of peer-assisted communication application training on the communicative and social behaviors of children with autism	frequency		capability	activity preference		people	availability
Thunberg 2009	Speech-generating devices used at home by children with autism spectrum disorders: A preliminary assessment	frequency	engagement (focus of attention)	performance			people	availability
Lee 2013	AAC intervention using a VOCA for deaf children with multiple disabilities who received cochlear implantation	frequency		performance			activity	
Franco 2009	Functional analysis and treatment of inappropriate vocalizations using a speech-generating device for a child with autism	frequency	engagement (focus of attention)	performance	activity preference		activity	availability
Severini 2019	Implementing “Stay Play Talk” with children who use AAC	frequency	engagement (focus of attention)	performance			activity	
Bornman 2001	The use of a digital voice output device to facilitate language development in a child with developmental apraxia of speech: A case study		engagement (focus of attention)	performance		confidence	activity	
Lancioni 2006	Teaching Yes and No responses to children with multiple disabilities through a program including microswitches linked to a vocal output device			capacity	stimuli preference			
Bedwani 2015	Augmentative and alternative communication for children with autism spectrum disorder: An evidence-based evaluation of the language acquisition through Motor Planning LAMP Programme		motivation	performance			activity	
Whitmore 2014	Early augmented language intervention for children with developmental delays: Potential secondary motor outcomes			capability			object	
Adams 2013	Access to hands-on mathematics measurement activities using robots controlled via speech-generating devices: Three case studies	range	engagement (focus of attention)	capacity	activity preference		activity	
Thiemann-Bourque 2016	Picture Exchange Communication System and Pals: A peer-mediated augmentative and alternative communication intervention for minimally verbal preschoolers with autism		engagement (focus of attention)	performance			activity	
Arroyo 2010	AAC interventions: Case study of in utero stroke			capability	activity preference		activity	

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First author and year	Title of article	Attendance	Involvement	Activity competence	Preference	Sense of self	Context	Environment
Beck 2008	Comparison of PECS and the use of a VOCA: A replication			performance			activity	
Greenberg 2014	Adapting the Picture Exchange Communication System to elicit vocalizations in children with autism			capability	stimuli preference		activity	
Ganz 2013	Effectiveness of the PECS Phase III app and choice between the app and traditional PECS among preschoolers with ASD			capacity	stimuli preference			
Ganz 2013	Impacts of a PECS instructional coaching intervention on practitioners and children with autism			capacity	stimuli preference			
Yoder 2006	Randomized comparison of two communication interventions for preschoolers with autism spectrum disorders			capability	success		activity	availability
Cornelius Habarad 2015	The power of the mand: Utilizing the mand repertoire to decrease problem behavior			capability	stimuli preference		activity	
Anderson 2007	Functional communication and other concomitant behavior change following PECS training: A case study			performance	activity preference		activity	
Carré 2009	Picture exchange communication (PECS) training for young children. Does training transfer at school and to home?			performance				
Carson 2012	The collateral effects of PECS training on speech development in children with autism			performance	stimuli preference		activity	
Liddle 2001	Implementing the Picture Exchange Communication System (PECS)			performance	stimuli preference		object	
Park 2011	Effects of mother-implemented Picture Exchange Communication System (PECS) training on independent communicative behaviors of young children with autism spectrum disorders			performance				
McDonald 2015	Using fixed interval-based prompting to increase a student initiation of the Picture Exchange Communication System			performance	activity preference		activity	
Chaabane 2009	The effects of parent-implemented PECS training on improvisation of mands by children with autism			capacity	stimuli preference			
Migiati 2003	A pilot evaluation study of the Picture Exchange Communication System (PECS) for children with autistic spectrum disorders			performance			activity	
Pereira 2020	Augmentative and alternative communication on autism spectrum disorder: Impacts on communication			performance			activity	

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First author and year	Title of article	Attendance	Involvement	Activity competence	Preference	Sense of self	Context	Environment
Boesch 2013	Comparative efficacy of the Picture Exchange Communication System (PECS) versus a speech-generating device: Effects on social-communicative skills and speech development			capacity	stimuli preference		object	
Carr 2007	The effects of PECS teaching to phase III on the communicative interactions between children with autism and their teachers			performance	activity preference		activity	
Charlop Christy 2002	Using the Picture Exchange Communication System (PECS) with children with autism assessment of PECS acquisition and speech and social communicative behavior and problem behavior			capacity				
Cihak 2012	The Use of video modeling with the Picture Exchange Communication System to increase independent communicative initiations in preschoolers with autism and developmental delays			capability	stimuli preference		object	
Ganz 2009	Impact of the Picture Exchange Communication System: Effects on communication and collateral effects on maladaptive behaviors			capacity	activity preference		activity	
Ganz 2010	Impact of AAC versus verbal modeling on verbal imitation AND picture discrimination and related speech: A pilot investigation			capability	stimuli preference			
Ganz 2010	Non responsiveness to intervention: Children with autism spectrum disorders who do not rapidly respond to communication interventions			capacity	stimuli preference			
Howlin 2007	The effectiveness of Picture Exchange Communication System (PECS) training for teachers of children with autism: A pragmatic and group randomised controlled trial			capability			activity	
Hu 2019	Effects of PECS on the emergence of vocal mands and the reduction of aggressive behavior across settings for a child with autism			performance	activity preference		object	
Ivy 2014	Using the Picture Exchange Communication System with students with visual impairment			capability	stimuli preference		object	
Ninci 2018	Transferring picture exchange requests to receptive identification for children with ASD			capacity				
Frea 2001	A demonstration of the effects of augmentative communication on the extreme aggressive behavior of a		engagement (focus of	performance	stimuli preference		activity	

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First author and year	Title of article	Attendance	Involvement	Activity competence	Preference	Sense of self	Context	Environment
	child with autism within an integrated preschool setting		attention)					
Kodak 2012	Training and generalization of peer-directed mands with non-vocal children with autism		engagement (focus of attention)	performance	stimuli preference		activity	
Hosseini 2016	Play therapy in augmented reality children with autism	diversity of activity	engagement (focus of attention)	capacity	success		object	availability
Stahmer 2004	Inclusive programming for toddlers with autism spectrum disorders: Outcomes from the Children's Toddler School	diversity of activity	engagement (focus of attention)	performance			activity	
Yoder 2006	A randomized comparison of the effect of two prelinguistic communication interventions on the acquisition of spoken communication in preschoolers with ASD	duration		capacity	success			availability
Jurgens 2009	The effect of teaching PECS to a child with autism on verbal behaviour AND play and social functioning	duration	engagement (focus of attention)	performance	stimuli preference		activity	
Agius 2016	A comparison of PECS and iPad to teach requesting to pre-schoolers with autistic spectrum disorders	frequency		capability	stimuli preference		object	
Schwartz 1998	The Picture Exchange Communication System: Communicative outcomes for young children with disabilities	frequency		performance	stimuli preference		people	availability
Temple 2007	A randomized comparison of the effect of two prelinguistic communication interventions on the acquisition of spoken communication in preschoolers with ASD	frequency	engagement (focus of attention)	capacity			activity	availability
Paden 2012	Teaching children with autism to engage in peer-directed mands using a Picture Exchange Communication System	frequency	engagement (focus of attention)	capacity	stimuli preference		people	availability
Lerna 2014	Long-term effects of PECS on social communicative skills of children with autism spectrum disorders: A follow-up study	frequency	Other engagement and joint attention	performance	stimuli preference		activity	
Lerna 2012	Social communicative effects of the Picture Exchange Communication System (PECS) in autism spectrum disorders	frequency and duration	Other engagement in joint attention and activity	performance			activity	

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First author and year	Title of article	Attendance	Involvement	Activity competence	Preference	Sense of self	Context	Environment
			with a therapist					
Ganz 2004	Effects on communicative requesting and speech development of the Picture Exchange Communication System in children with characteristics of autism			performance			activity	
Sigafoos 2009	A comparison of picture exchange and speech-generating devices: Acquisition, preference, and effects on social interaction		engagement (focus of attention)	capacity	stimuli preference		activity	
Simpson 2010	Teaching young children with autism graphic symbols embedded within an interactive song			capacity			activity	
Still 2015	Facilitating derived requesting skills with a touchscreen tablet computer for children with autism spectrum disorder			capacity				
Huist 2020	Using video to teach early language concepts and symbols to children with complex communication needs			capability				
Matter 2017	A comparison of existing and novel communication responses used during functional communication training			capacity	stimuli preference			
Winborn-Kemmerer 2010	Analysis of mand selection across different stimulus conditions			capability			activity	
Harding 2011	Implementing AAC with children with profound and multiple learning disabilities: A study in rationale underpinning intervention		engagement (focus of attention)	performance			activity	
Mohan 2019	Capitalizing on technology for developing communication skills in autism spectrum disorder: A single case study			performance				
McConkey 2010	Preschoolers with autism spectrum disorders: Evaluating the impact of a home-based intervention to promote their communication			performance				
Sainan An 2017	Development and evaluation of a speech-generating AAC mobile app for minimally verbal children with autism spectrum disorder in Mainland China			capacity				
Nigam 2006	Concomitant use of the matrix strategy and the mand-model procedure in teaching graphic symbol combinations			capacity				
Hetzroni 2000	Preschoolers with communication impairments play Shrinking Kim: An interactive computer storytelling intervention for teaching Blissymbols			capacity	success		activity	availability

Appendices

First author and year	Title of article	Attendance	Involvement	Activity competence	Preference	Sense of self	Context	Environment
Dyches 2002	Generalization of skills using pictographic and voice output communication devices	diversity of activity	engagement (focus of attention)	performance	success		people	
Yorke 2018	The effects of explicit instruction in academic vocabulary during shared book reading on the receptive vocabulary of children with complex communication needs	duration		capacity	success			
Stiebel 1999	Promoting augmentative communication during daily routines: A parent problem-solving intervention	frequency		performance	success		people	accommodability
Shillingsburg 2019	Teaching mands for information using speech-generating devices A replication and extension	frequency		capacity	activity preference		activity	availability
Aasen 2014	Enhancing activity by means of tactile symbols: A study of a heterogeneous group of pupils with congenital blindness intellectual disability and autism spectrum disorder	frequency	engagement (focus of attention) and motivation	performance	activity preference		activity	
SchaeferWhitby 2019	Teaching object exchange for communication to a young girl with autism spectrum disorder and visual impairment	frequency	engagement (focus of attention)	performance	activity preference	confidence	people	availability
Schreibman 2014	A randomized trial comparison of the effects of verbal and pictorial naturalistic communication strategies on spoken language for young children with autism	frequency		capability	success		activity	availability
Calculator 2002	Use of enhanced natural gestures to foster interactions between children with Angelman syndrome and their parents			performance				
Binger 2008	Teaching Latino parents to support the multisymbol message productions of their children who require AAC			capability			activity	
Barton-Hulsey 2017	Comparing the effects of speech-generating device display organization on symbol comprehension and use by three children with developmental delays			capacity	activity preference		activity	
Ganz 2014	Efficacy of handheld electronic visual supports to enhance vocabulary in children with ASD			capability	stimuli preference		activity	
Barton 2006	Exploring visual graphic symbol acquisition by preschool age children with developmental and language delays			capacity				
Von Tetzchner 2004	Acquisition of graphic communication by a young girl without comprehension of spoken language		engagement (focus of attention)	performance			activity	

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First author and year	Title of article	Attendance	Involvement	Activity competence	Preference	Sense of self	Context	Environment
Hetzroni 2003	A positive behaviour support: A preliminary evaluation of a school-wide plan for implementing AAC in a school for students with intellectual disabilities			performance			people	accessibility
Keen 2001	Replacing prelinguistic behaviors with functional communication			performance			activity	
Anderson 2016	Effects of functional communication training with and without delays to decrease aberrant behaviour in a child with autism spectrum disorder			capability	stimuli preference		object	
Harding 2009	Analysis of multiple manding topographies during functional communication training			performance	stimuli preference		object	
Leech 2011	Indirect facilitation of speech in a late talking child by prompted production of picture symbols or signs			performance			activity	
Simacek 2017	Communication intervention for young children with severe neurodevelopmental disabilities via telehealth			performance			activity	acceptability
Drager 2006	The effect of aided language modeling on symbol comprehension and production in 2 preschoolers with autism			capability			activity	
Hanser 2007	Integrated word identification and communication instruction for students with complex communication needs Preliminary results			capacity			activity	
Uliano 2010	Augmentative and alternative communication in adolescents with severe intellectual disability: A clinical experience			performance		self esteem		
Stasolla 2013	Assistive technology for promoting choice behaviors in three children with cerebral palsy and severe communication impairments		engagement (focus of attention)	capability	enjoyment	self determination		
Harris 2004	The impact of aided language stimulation on symbol comprehension and production in children with moderate cognitive disabilities			capability			activity	
Stephenson 2009	Picture book reading as an intervention to teach the use of line drawings for communication with students with severe intellectual disabilities		engagement (focus of attention)	performance			activity	
Chan 1999	The impact of leisure options on the frequency and spontaneous communication production of a young child with multiple disabilities	diversity of activity		performance	activity preference		activity	
Bedrosian 2003	Enhancing the written narrative skills of an AAC student with autism: Evidence-based research issues	frequency	social connectedness	performance	enjoyment	satisfaction	people	availability

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First author and year	Title of article	Attendance	Involvement	Activity competence	Preference	Sense of self	Context	Environment
Sigafoos 1998	Assessing conditional use of graphic mode requesting in a young boy with autism	frequency	engagement (focus of attention)	capacity	stimuli preference		object	availability
Solomon-Rice 2014	Facilitating vocabulary in toddlers using AAC: A preliminary study comparing focused stimulation and augmented input	frequency	engagement (focus of attention)	capability			activity	
Salminen 2004	Impact of computer-augmented communication on the daily lives of speech-impaired children. Part I: Daily communication and activities	frequency	engagement (focus of attention)	performance	success		activity	accommodability
Johnston 2003	Teaching functional communication skills using augmentative and alternative communication in inclusive settings	range	engagement (focus of attention)	performance			activity	acceptability
Cannella Malone 2009	An examination of preference for augmentative and alternative communication devices with two boys with significant intellectual disabilities			capacity	stimuli preference			
Bruno 2006	Use of aided language stimulation to improve syntactic performance during a weeklong intervention program			performance				
Nunes 2007	Enhancing the alternative and augmentative communication use of a child with autism through a parent implemented naturalistic intervention			capability			activity	availability
Cumley 1999	Augmentative and alternative communication options for children with developmental apraxia of speech: Three case studies		engagement (focus of attention)	performance			people	accessibility
Cafiero 2001	The effect of an augmentative communication intervention on the communication and behavior and academic program of an adolescent with autism			performance			activity	
Flores 2012	A comparison of communication using the Apple iPad and a picture-based system			performance	Stimuli preference		object	
Dada 2009	The effect of aided language stimulation on vocabulary acquisition in children with little or no functional speech		engagement (focus of attention)	performance			activity	
Dorney 2019	Transactions within a classroom-based AAC intervention, targeting preschool students with autism spectrum disorders: A mixed methods investigation		engagement (focus of attention)	performance			activity	
Lanter 2016	Incorporating AAC and general instructional strategies in requesting interventions: A case study in Down syndrome			capacity	Stimuli preference			

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First author and year	Title of article	Attendance	Involvement	Activity competence	Preference	Sense of self	Context	Environment
Tönsing 2014	Teaching graphic symbol combinations to children with limited speech during shared story reading			capacity			activity	
Trudeau 2003	Using augmentative and alternative communication approaches to promote participation of preschoolers during book reading a pilot study	frequency	engagement (focus of attention)	performance	Activity preference		activity	
Bunning 2014	Caregiver perceptions of children who have complex communication needs following a home-based intervention using augmentative and alternative communication in rural Kenya: An intervention note	frequency		performance			people	acceptability
Carter 1998	Promoting interaction with children using augmentative communication through a peer-directed intervention	frequency	social contact	performance			activity	
Dada 2007	A discussion of individual variability in activity-based interventions using the niche concept	participation	engagement (focus of attention)	performance			activity	
Thiemann-Bourque 2017	Training peer partners to use a speech-generating device with classmates with autism spectrum disorder: Exploring communication outcomes across preschool contexts	duration	engagement (focus of attention)	performance			activity	

APPENDIX G

Summary of the Specific Components of the fPRC Constructs Reported on by the AAC Intervention Studies

Appendices

	Description	Frequency (n)	Percentage (%)
1	**Attendance**	***n***	**%**
	No attendance reported	212	79%
	Frequency	39	14%
	Duration	10	3%
	Diversity of activity	8	3%
	Range	3	1%
2	**Involvement**	***n***	**%**
	No involvement reported	194	72%
	Engagement (focus of attention)	67	25%
	Motivation	6	2%
	Social connectedness	3	1%
	Persistence	0	0%
	Affect	0	0%
3	**Activity competence**	***n***	**%**
	Performance	108	40%
	Capacity	95	35%
	Capability	67	25%
4	**Preference**	***n***	**%**
	No preference	130	48%
	Stimuli preference	86	32%
	Activity preference	28	10%
	Success	21	8%
	Enjoyment	5	2%
5	**Sense of self**	***n***	**%**
	No sense of self reported	260	96%
	Confidence	4	1%
	Satisfaction	3	1%
	Self-determination	2	1%
	Self-esteem	1	0%
6	**Context**	***n***	**%**
	Activity	120	44%
	No context	79	29%
	Object	46	17%
	People	25	9%
	Time	0	0%
7	**Environment**	***n***	**%**
	No environment	218	81%
	Availability	34	13%
	Acceptability	8	3%
	Accessibility	6	2%
	Accommodability	3	1%
	Affordability	1	0%

APPENDIX H

Bibliography of All Included Studies

Appendices

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Appendices

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APPENDIX I

Declaration of Language Editor

Appendices

DECLARATION

I herewith declare that I,

Isabel M Claassen (APSTrans (SATI)),

full-time freelance translator, editor and language consultant

of
1367 Lawson Avenue, Waverley, Pretoria
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and
accredited member (No. 1000583) of the South African Translators' Institute (SATI)

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Impact of AAC interventions on participation outcomes in children with complex communication needs: A scoping review

submitted to me by

Mrs Pauline Prinsloo

Student Number U24026566

E-mail: paulinezwiegelaar7@gmail.com

in partial fulfilment of the requirements for the degree

Master's in Augmentative and Alternative Communication

Date completed: 13-08-2021

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APPENDIX J

Turnitin Report

Appendices

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