

**The Application of the Family of Participation-Related Constructs (fPRC)  
Framework to AAC Intervention Outcomes in Children with Complex Communication  
Needs: A Scoping Review**

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**Abstract**

Participation is a fundamental human right, and being able to communicate is an essential component of participation in various life situations, such as at school, with peers, and in the community. Augmentative and alternative communication (AAC) interventions aim to facilitate communication and social interaction, independence, and participation in all aspects of life. The purpose of this study was to summarize and map the AAC intervention outcomes for children with complex communication needs onto the Family of Participation-related Constructs (fPRC) framework. The scoping review identified 270 studies for inclusion, and the data gathered was extracted and mapped onto the fPRC framework. The results indicate that although many studies have reported on participation-related constructs such as activity competence and context, there is still insufficient focus on attendance and involvement, sense of self, and environment constructs. Hence, future research in the field of AAC is needed on the various constructs of participation proposed by the fPRC framework.

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

Participation can be viewed as the ultimate goal for both children with disabilities and their families (Light & McNaughton, 2015) due to its positive influence on health and well-being (United Nations, 2006; World Health Organization [WHO], 2001, 2007). Participation is commonly described in the literature as being “involved in life situations” (WHO, 2007, p. 10). Similarly, communicative participation, which is measured within a social context, is a commonly used term in augmentative and alternative communication (AAC). Communicative participation is defined as “taking part in life situations where knowledge, information, ideas, or feelings are exchanged” (Eadie et al., 2006, p. 309). It is also defined as “understanding and being understood in a social context by applying verbal and non-verbal communication skills” (Singer et al., 2020, p. 1793).

The field of AAC has highlighted participation as an outcome of intervention for several decades, following the introduction of the participation model for AAC (Rosenberg & Beukelman, 1987). Since then, the participation model has been used as a tool for AAC assessment and intervention in the field of AAC (Beukelman & Light, 2020). The model captures many key factors within an ecological system of development, health, and functioning (Light & McNaughton, 2015). The participation model considers the factors specific to the individual’s communication competence (e.g., efficiently, and effectively transmitting messages) and the environmental support needed, for example, moving a child using an AAC system closer to the teacher (Beukelman & Mirenda, 2013). It also considers 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). The participation model further includes determining the type and degree of an individual's access barriers relating to their resources, attitudes, and capabilities (Beukelman

& Mirenda, 2013). Yet, there is limited evidence of its effective implementation (Light & McNaughton, 2015) and scant information on how to apply the model in a clinical context (Lund et al., 2016). Moreover, the participation model is most frequently applied using a participation inventory (Beukelman & Light, 2020). The latter may increase the focus on capability and performance and may neglect the focus on some of the participation and participation-related constructs such as involvement and sense of self as described by Imms et al. (2017) and Imms and Green (2020).

Communication and participation are both complex and multifaceted constructs that can be viewed as a process and an outcome. A consensus on both the definitions and operationalization of communicative participation and participation was necessary (Singer et al., 2020; Granlund, 2013). Therefore, a Delphi study by Singer and colleagues (2020) 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). Hence, communicative participation was defined as "understanding and being understood in a social context, by applying verbal and non-verbal communication skills" (Singer et al., 2020, p. 1793).

Similarly, participation is a multidimensional construct that can be viewed as both a process and an outcome (Granlund, 2013; Imms et al., 2017). The international classification of functioning, disability, and health (ICF) and the ICF-child and youth version (ICF-CY) conceptualize performance as the qualifier for participation (WHO, 2001, 2007). Participation is operationalized as attending to or doing a specific activity in a life situation as rated with the performance qualifier (Granlund, 2013). Discussions in the literature indicate that performance in terms of attendance is only one dimension of participation, and additional subjective qualifiers may be required to produce a comprehensive view of participation (Granlund et al., 2012). The

lack of a well-defined conceptualization of participation has led to several different definitions and allowed for participation to be operationalized in different ways (Granlund, 2013).

Therefore, researchers argued that consensus and clarity were needed on the definition of the construct of participation to enable meaningful interpretation of intervention outcomes (Rainey et al., 2014).

A series of systematic reviews were conducted to provide conceptual clarity and consistency in the definition of language specifically for children and youth with childhood-onset disabilities (Adair et al., 2015, 2018; Imms et al., 2016). Based on the data from these reviews, the family of participation-related constructs (fPRC) framework was proposed (Imms et al., 2017). The fPRC framework incorporates the ICF framework as a foundation for understanding the body structure and function of children 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 the 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 activities attended (Imms et al., 2017, p. 18). It can be measured either through time-use devices, diaries, and surveys or by observation, self-report, or proxy report (Imms et al., 2016; Imms & Green, 2020). For example, a child who uses AAC attends a range of activities during a school camp. Involvement, or the subjective experience of participation, is defined as “the experience of participation while attending” and may include elements of engagement, motivation, persistence, social connection, and affect (Imms et al., 2017, p. 18). Involvement is more subjective and thus more complex to measure, and it may be either not observable or wrongly observed (Adair et al., 2018; Imms et

al., 2016; Imms & Green, 2020). An example of involvement may include the reported motivation of a child who uses AAC to play with a peer at a school camp.

Although involvement and engagement have been used interchangeably to describe participation experiences, the fPRC framework proposes that involvement is a superordinate construct. Engagement is one aspect of involvement and is a linking construct expressed at multiple levels of human functioning (Imms et al., 2017). On an individual level, engagement may be reported as the focus of attention during various activities during or after the intervention. Additionally, engagement includes not only an internal state expressed through behavior but also enables direction toward external people, things, and events (Bright et al., 2015; Imms et al., 2017). Thus, two children 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 personalized AAC system such as a communication board during snack time at school. Engagement can also be used as a term when describing the interaction between professionals and childcare providers in the intervention process. Children's engagement in the steps of the process is related to the effect size of interventions (Pittman, 2003).

The fPRC framework proposes 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. Traditionally, many AAC interventions are based on the idea that skills training is an instrumental goal that will lead to an implicit participation goal (Adair et al., 2015). For example, by teaching children in symbol use in a clinic, they will participate more in classroom discussions in their mainstream

classroom. In this example, participation is not explicitly addressed in the intervention. If using participation explicitly in an intervention, it can be either an independent variable to reach a skill goal or an explicit outcome of the intervention. An example of using participation as a means or independent variable may include enhancing a child's active involvement in classroom discussions with any means through which the child's social communication skills using graphic symbols may be enhanced. When participation is the goal of an AAC intervention, the goal can be reached both by supporting the child's use of symbols or by training communicative partners (peers and adults) on how to interact with the help of AAC strategies. Another case in point is participation in a classroom discussion using a communication board (participation as a process), which 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).

Participation, as further described by the fPRC framework, 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 affects the environment through their engagement in activities. Whether such environmental effects should be seen as intervention effects or implementation effects can be discussed. The fPRC framework emphasizes the implications of understanding that participation as a process and outcome of engaging in or being involved in activities affects the whole context and may change over time (Imms et al., 2017). The fPRC framework proposes participation-related constructs that include three intrinsic elements and two extrinsic elements that influence and are influenced by participation (Imms et al., 2016; 2017).

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 (internal effort of focus) may lead to 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 to use an AAC device to request food. 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 have meaning (Imms et al., 2016). They are established through interactions with people with similar beliefs and values, and past experiences of enjoyment and success, creating a positive association with certain experiences (Imms et al., 2017; Skille & Øterås, 2011). Therefore, preferences might be seen as a precursor to participation or because 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).

The fPRC framework further describes extrinsic environment-related elements by separating context and environment. An integrated model proposed by Batorowicz et al. (2016) distinguishes between 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 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). The broader environment considers the external physical and social environments in which people live (Batorowicz et al., 2016; Imms et al., 2017). According to Maxwell et al. (2012), the environment may relate to reporting on the availability, accessibility, affordability, accommodability, and acceptability of AAC. The fPRC framework further operationalizes participation separately from the activity and the life situation in which it occurs. Thus, the participation concept can be applied to children at any competence level and to any activity or setting (Adair et al., 2018).

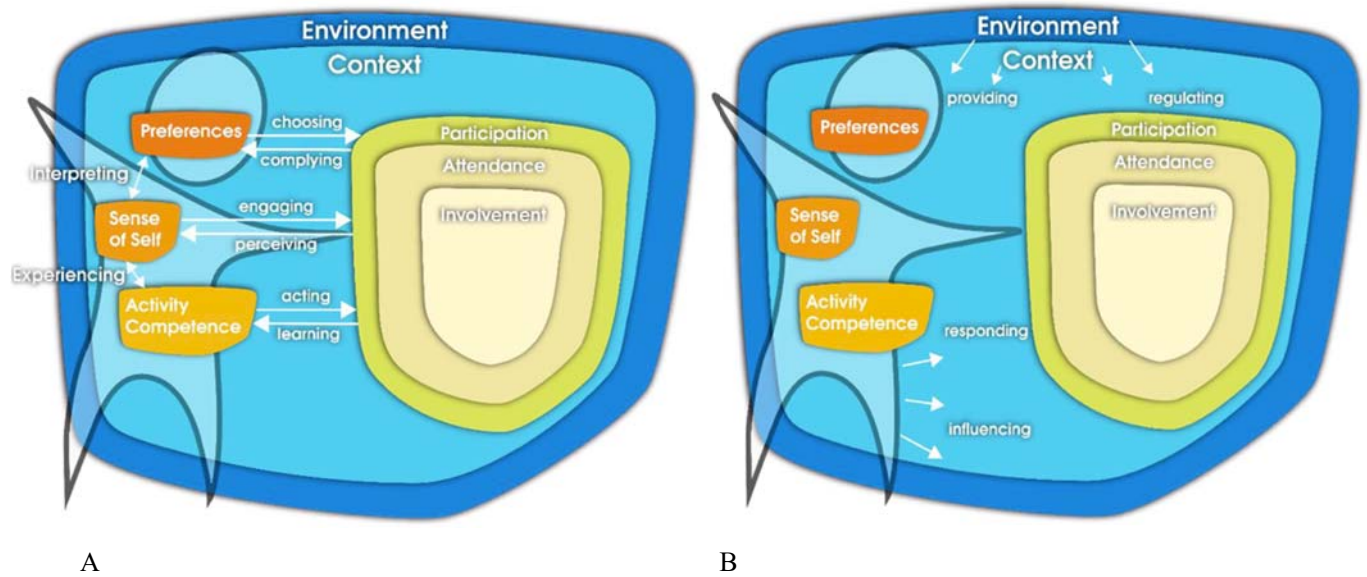
The fPRC framework, therefore, provides an extensively nuanced and inclusive framework to consider AAC intervention outcomes. In addition, a clear understanding and knowledge of how current AAC research has addressed participation as described in the fPRC framework were needed to propose future research and practice implications. To address this, the purpose of the scoping review was to summarize and map the outcomes of AAC intervention studies with children on the fPRC framework and to identify gaps in the literature to further guide research within the field of AAC (Arksey & O'Malley, 2005). The following research question was asked: How do AAC intervention outcomes for children with complex communication needs map onto the fPRC framework? This question was formulated using the population, intervention, and outcome (PIO) constructs (Arksey & O'Malley, 2005), and the researchers maintained a wide approach to ensure that the breadth of coverage of the literature would be achieved (Arksey & O'Malley, 2005; Daudt et al., 2013).

## Method

### Research Design

A scoping review design was used for this study because it is useful for 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 (Peters et al., 2020). 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 (Munn et al., 2018; Peters et al., 2020). 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 can be disseminated (Daudt et al., 2013; Grant & Booth, 2009).

A six-step scoping review approach developed by Arksey and O'Malley (2005) and enhanced by Levac et al. (2010) was used. In addition, the preferred reporting items for systematic review and meta-analysis extension for scoping reviews (PRISMA-ScR) were used as a guideline to ensure consistent reporting of the scoping review process (Page et al., 2021). The process of mapping the information from the included studies onto the fPRC framework was guided by fPRC framework as illustrated by Figure 1 and the application of AAC interventions to the fPRC framework (Table 1). Figure 1 presents the fPRC framework and its hypothetical interchangeable processes. The bi-directional arrows and associated verbs symbolize the transactions between the constructs (Imms et al., 2017). Figure 1A presents the relationship between participation and intrinsic factors (Imms et al., 2017). Figure 1B, shows how the context and environment can provide and regulate participation (Imms et al., 2017). Table 1 provides



**Figure 1.** Family of Participation-related Constructs (Imms et al., 2017, p. 19) .

Panel A displays the person-focused processes; Panel B displays the environment-focused processes (Imms et al., 2017, p. 19).

**Table 1.** *Definitions of Key Concepts of the Family of Participation-Related Constructs Framework that Relate to AAC*

Concepts	Definition	Application to AAC intervention outcomes
Participation	Participation refers to “being involved in life situations” (WHO, 2007, p. 10).	Participation may include a child participating in a classroom discussion using a communication board.
Attendance	Attendance refers to the objective experience of “being there” measured in an objective way (e.g., the frequency of attending, the range and/or diversity of activities in which an individual takes part).	Attendance may include a child who uses AAC attending a range of different activities during a school camp.
Involvement	Involvement refers to the subjective experience of participation while attending. This may include elements of engagement (focus of attention), motivation, persistence, social connection, sense of belonging, and affect. Involvement may be reported either by the individual who uses AAC or by a proxy report; however, involvement is subjective and may be not observable or wrongly observed (Imms, 2020).	Involvement may include the reported motivation of a child who uses AAC to play with a peer at a school camp.
Engagement	Engagement may be reported as the focus of attention and behavior during various activities during or after the intervention. Engagement and involvement have been used as interchangeable terms to describe the participation experiences. Engagement is one aspect of involvement that is a linking construct expressed at multiple levels of human functioning (Imms et al., 2017). Furthermore, it does not only include an internal state expressed through behavior, but also enables direction 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.	Engagement may include one child requesting more food while another child comments on the taste of the food using a personalized AAC system such as a communication board during snack time at school camp.
Preference	Preference refers to the interests or activities that are preferred, hold meaning, or are valued and that may be considered a component of an intervention or educational goal setting (Imms, 2020). Preference may relate to stimulus preference, activity preference, enjoyment, or success.	Preference may include a preference for items, activities, or systems; for instance, by indicating a type of communication preference such as a communication board or a speech-generating device.

Running head: APPLICATION OF THE FPRC TO AAC INTERVENTIONS

Activity competence	Activity competence is the ability to execute the activity being undertaken which involves cognitive, physical, and affective skills and abilities. It can be measured as capacity, capability, or performed skill.	Activity competence can relate to the ability of a child to use an AAC device to request to play outside.
Capacity	Capacity is the ability to execute the activity being undertaken according to an expected standard, which involves cognitive, physical, and affective skills and abilities. It refers to the best ability of the child within a structured environment, such as that created for test-taking.	Capacity may, for example, include using a Picture Exchange Communication System (PECS; Bondy & Frost, 2002) to assist a child in a therapy session to discriminate from the available options of animals shown on a page in a book about "Old MacDonald's Farm."
Capability	Capability refers to the skills and abilities that the child can use in a daily environment that constitute their capability. Is usually operationalized as the level of support needed to execute the action.	Capability may include a child being prompted to use PECS to request their preferred animal to be included in the "Old MacDonald's Farm" song during the daily morning ring activity.
Performance	Performance refers to the 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	Sense of self refers to the intrapersonal factors that relate to the confidence, self-esteem, self-determination, and satisfaction resulting from participation and promote the development of the person's perception of self. In addition, autonomy, relatedness, and competence are important conditions for developing self-determination (Ryan & Deci, 2000).	A sense of self may, for instance, be reported as a child's increased confidence when communicating with novel communication partners at school camp.

Context	Context relates to the child’s experience within an activity setting and includes elements of people, place, activity, objects, and time (Batorowicz et al., 2016). People involve the individuals with whom the child using AAC interacts (Batorowicz et al., 2016). Together the child and others involved “construct” the context.	An example of context includes; a child who is communicating with an increased number of peers during recess or break time. <i>Place</i> may relate to the child’s typical activity setting where the child spends time, such as the computer room at school. <i>Activity</i> refers to contextual activities or tasks, constructed by the child or others (Batorowicz et al., 2016). <i>Objects</i> refer to the artifacts children interact with, such as toys or educational tools (Batorowicz et al., 2016).
Environment	The broader environment involves the external physical and social environments in which people live (Batorowicz et al., 2016; Imms et al., 2017) and exists even if the person is not attending or present. According to Maxwell et al. (2012), the 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	<i>Availability</i> refers to the objective provision of resources, such as the availability of a central communication board on the playground (Maxwell et al. 2012). <i>Accessibility</i> refers to whether a child can or perceives having access to context for participation (Maxwell et al. 2012). <i>Affordability</i> is determined by the ability to be engaged, given the available resources, as well as whether the effort, which includes time and energy, will be worthwhile (Maxwell et al. 2012). An example of considering the affordability of recommending that a child use a speech-generating device while the family may have financial constraints. <i>Accommodability</i> refers to a situation that can be adapted (Maxwell et al. 2012). For instance, adapting the instructions given by the camp leader to build an obstacle course at summer camp by modeling the use of a central communication board. <i>Acceptability</i> refers to a child’s acceptance of the physical and social environment or the acceptance of other people’s acceptance of a person’s presence (Maxwell et al. 2012). This may relate to a child accepting his communication device or a peer accepting the presence of a child using a communication device to attend the activity at school camp (Maxwell et al. 2012).

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

definitions of participation and participation-related constructs (Imms et al. 2017) and their application to the field of AAC.

## **Search Strategy**

### ***Pilot Search***

A pilot search was conducted to determine the feasibility of the review question and refine the search terms, study selection checklist, eligibility criteria, and data extraction template (Peters et al., 2020; Schlosser et al., 2007). Published peer-reviewed studies were identified using electronic databases (Peters et al., 2020). A total of six databases in the field of AAC were identified (Schlosser et al., 2005, 2007). Each database was individually searched during November 2020. The databases included Academic Search Complete, Cumulative Nursing and Allied Health Literature (CINAHL), Educational Resources Information Centre (ERIC), PsycINFO, Academic Search Complete, and MEDLINE via the EBSCOhost platform, as well as Linguistics and Language Behavior Abstracts (LLBA) via the ProQuest platform. A list of search terms and Boolean operators in relation to the PIO format was developed in consultation with the information specialists and outlined in Table 2. The search results were imported via a RIS link format into Covidence (Version 2), a systematic review management software platform (Veritas Health Innovation, 2020).

### **Inclusion Criteria**

The included studies needed to meet the following criteria to be included in the review:

- (a) Participants who were children, aged 0 -18 years, with complex communication needs (Beukelman & Mirenda, 2013).
- (b) Interventions, as indicated by the independent variable, included directly or indirectly implemented AAC systems to augment or support alternative receptive and/or expressive language and communication for the participants.
- (c) The reported

**Table 2.** *Search Terms*

Platform	Databases	Search terms and Boolean operators
EBSCOhost	CINAHL, ERIC, MEDLINE, PsycINFO, and Academic Search Complete	(“[tiab] Child*”) OR (“[tiab] infan*”) OR (“[tiab] “toddler*”) OR (“[tiab] preschool*”) OR (“[tiab] adolescen*”) OR (“[tiab] teenage*”) OR (“[tiab] youth*”) OR (“[tiab] pediatric”) OR (“[tiab] paediatric”)AND (“[tiab] Disab*”) OR (“[tiab] Autism”) OR (“[tiab] ASD”) OR (“[tiab]developmental delay”) OR (“[tiab] developmental disab*”) OR (“[tiab] Cerebral palsy”) OR (“[tiab] CP”) OR (“[tiab] nonverbal”) OR (“[tiab] little”) OR (“[tiab] no functional speech”) OR (“[tiab] complex communication needs”)AND “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” AND “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”



ProQuest	LLBA	<p>“Child” OR “infant” OR “toddler” OR “preschool” OR “adolescent” 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” AND “augmentative and alternative communication” OR “augmentative &amp; 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” OR “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 “therapy” OR “treatment” AND “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”</p>
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*Note.* [tiab] = free text in abstract; \* = truncation (i.e., words that contain “child” as a root can have various endings such as “children”)

outcomes or dependant variables related to participation or related constructs as defined in the fPRC framework (see Table 1). (d) Results published between 1998 to 2020, in a peer-reviewed journal in English were included. The year 1998 was chosen as it was the year the participation model in the field of AAC was first published (Beukelman & Mirenda, 2013). Research methodologies mostly used in the field of AAC, such as experimental, quantitative, qualitative, mixed methods, and case study research designs, were included (Kent-Walsh & Binger, 2018). Editorials, commentaries, opinions, political reviews, scoping reviews, rapid reviews, and meta-analyses were all excluded. Dissertations and books were also excluded (Daudt et al., 2013).

### ***Initial Screening***

The first three authors (PP, SD, KB) independently screened the articles at the title, abstract level. The degree of agreement between the title and abstract level on Covidence was calculated using Cohen's Kappa ( $k = 0.67$ ), indicating substantial agreement (McHugh, 2012). Discrepancies were rectified by discussion between the three reviewers until a consensus was reached. If a consensus could not be reached, the fourth and fifth author were consulted.

### ***Full-text Screening***

The first three authors (PP, SD, KB) independently screened the articles at the full-text level. The degree of agreement was calculated using Cohen's Kappa ( $k = 0.65$ ), indicating substantial agreement (McHugh, 2012). Discrepancies were rectified by discussion between the authors until a consensus was reached (Daudt et al., 2013).

### **Data Extraction**

A data extraction template was developed in the Covidence (Version 2) systematic review software system. The data was extracted and coded from each of the included studies according to general study characteristics (Covidence number, title, number of studies, study

design, and year ranges) and participant characteristics (number of participants, participant diagnosis, ages, and number of control group participants). Data was further extracted by noting how participation was described, measured, and related to the fPRC framework as defined in the literature review section and further illustrated in Table 1. Data extraction was completed primarily by the first author ( $n = 203$ ) and two research assistants (qualified speech therapists), who extracted data on the remaining papers ( $n = 51$ ) and ( $n = 16$ ), respectively. The second and third authors (SD and KB) checked the data extraction for a total of 62 % of the included studies. Inter-rater agreement was calculated by dividing the total number of agreements by the number of agreements plus disagreements, multiplied by 100, which resulted in 95.7% agreement (McMillan & Schumacher, 2014). Disagreements on data extraction were discussed by the first three authors (PP, SD, KB) until a consensus was reached and when needed the final two authors (PR, MG) were consulted (Daudt et al., 2013).

### **Data Analysis**

The extracted data was exported to Microsoft Excel using a comma-separated value format, after which it was exported to SPSS for data analysis. A descriptive-analytical method was used to extract and analyze data from each study that related to this study's aims (Colquhoun et al., 2014). Tables and figures were used to determine and graphically present the coded and descriptive data on the study characteristics and participant characteristics (Colquhoun et al., 2014). Intervention outcomes were analyzed using a deductive content analysis approach, which included predetermined categories based on the fPRC framework (Elo & Kyngäs, 2008).

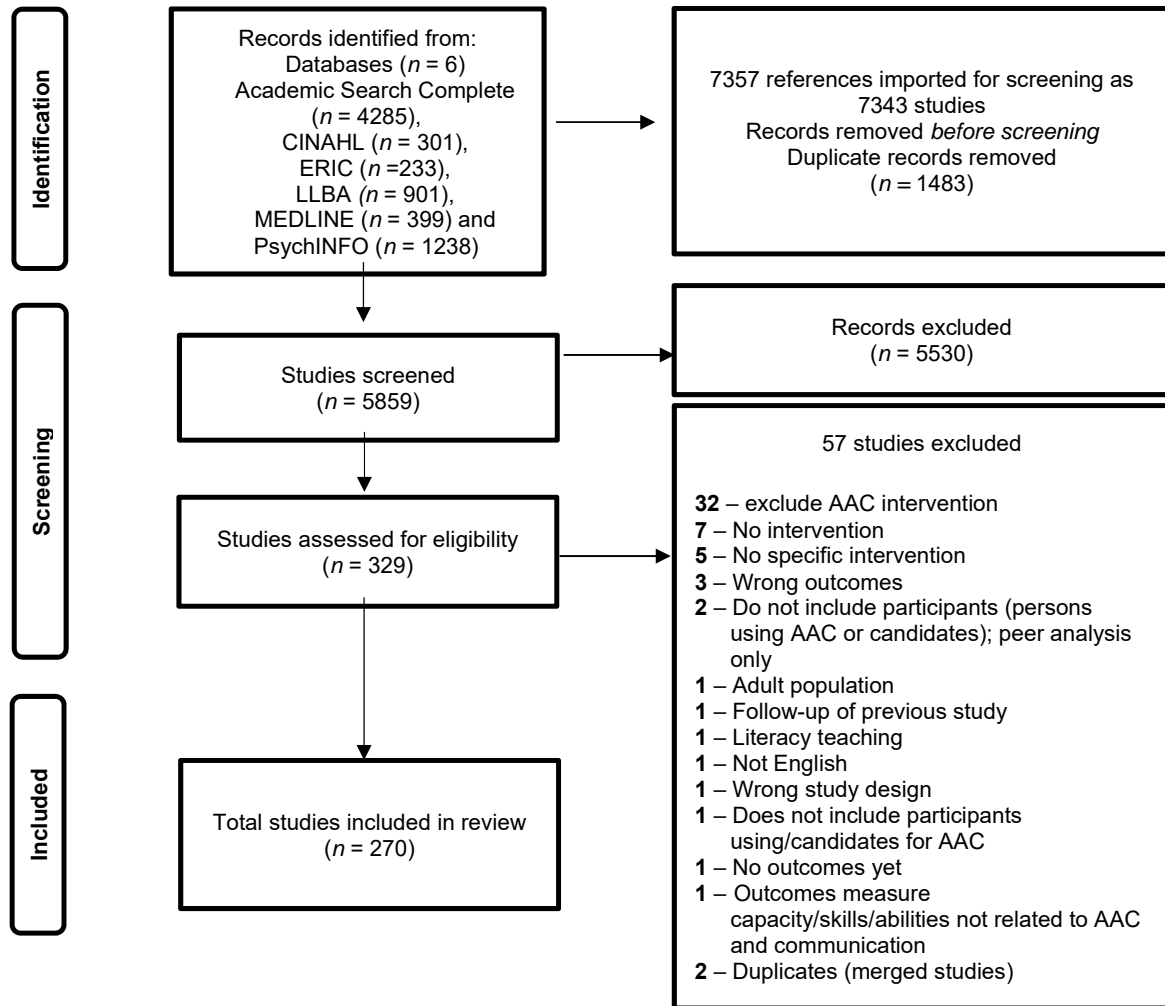


Figure 2. PRISMA Flow Diagram of Selection Process (Page et al., 2021)

## Results

Altogether, 270 AAC intervention studies were identified for inclusion in the review. The PRISMA four-phase flow diagram in Figure 2 illustrates the study identification process (Page et al., 2021).

### General Study Characteristics

Many studies (83%) included a single-subject design, whereas 17% utilized a group study design. A steady increase has been noted in the number of published studies, as the smallest number of publications appeared between 1998 and 2002 (9%). Several studies were published between 2003 and 2007 (16%), 2008 and 2012 (23%), and 2018 and 2020 (19%). Most studies were published between 2013 and 2017 (33%).

### Participant Characteristics

A total of 2408 participants were involved in the studies. Participants' characteristics show that most of the studies focused on elementary school age children (47%), followed by preschool age children (41%), and adolescents and youth (12%). Most of the studies (61%) focused on participants with autism spectrum disorder, while others reported on participants with Down syndrome (11%), multiple disabilities (9%), cerebral palsy (9%), other diagnoses (4%), and childhood apraxia of speech (3%). Two percent of the studies had no diagnosis or an unknown diagnosis.

### Mapping of Included Studies on the fPRC Framework

Supplemental Table 1 (Supplemental file) lists all ( $N = 270$ ) the included papers and how the studies map to each of the components of the fPRC framework. Table 3 provides a summary of the specific components of the fPRC framework as reported by the AAC intervention studies.

**Table 3.** Summary of AAC Intervention Studies Mapped onto the Family of Participation-Related*Construct Framework*

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

### ***Attendance***

The results indicate that many studies (79%) did not report on attendance. A small number of studies reported on the frequency (14%), duration (3%), diversity (3%), and range (1%) of attending an activity. To illustrate, the frequency and duration of attendance were reported in a study by Lerna et al. (2012). The study reported the effects of the picture exchange communication system (PECS) by Bondy and Frost (2002) on the social-communicative skills of children with autism spectrum disorder. Preschool children were grouped and assigned to two intervention approaches, namely PECS and conventional language therapy. The study by Lerna et al. reported that the between-group comparison of social-communicative measures coded during free play illustrated a significantly higher frequency of joint attention, and duration of cooperative play during free play in the groups that used PECS than in the conventional language therapy group.

### ***Involvement***

Involvement is a complex subconstruct of participation that relates to the subjective experience of participation while attending (Imms et al., 2017). The findings that emerged from the current study indicate that most of the studies (72%) did not report on the involvement construct. Some studies (28%) considered involvement as an outcome, particularly engagement (25%). Furthermore, very little focus was placed on motivation and social connectedness. Only 2% of the studies reported on the experience of motivation, and three reported on social connectedness when being involved in an activity. 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.

### ***Activity Competence***

All of the intervention studies ( $n = 270$ ) reported on an aspect of activity competence, measured either as capacity, capability, or performance. Interestingly, the results indicate that 40% of the studies reported on performance 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, the spontaneous production of PECS (Phase IV) throughout the school day (McDonald et al., 2015). The majority (60%) of the studies reported capacity (35%) and capability (25%) as outcomes.

### ***Preference***

Preference refers to expressions of interest or other indicators of involvement in an activity that holds meaning or is valued. Preferences may be related to stimuli preferences, activity preferences, enjoyment, and success. Preference as a construct was reported in approximately half of the studies (48%). These studies reported on choices or expressions of preferences made during the interventions, such as stimuli preference (32%), food items (i.e., sweets and drinks), auditory stimuli (i.e., song or music), tactile stimuli (i.e., vibrators or sensory spinners), and activity preference (10%), such as playing with playdough or bubbles. The results further indicated that some studies (8%) reported on participants' experiences of success regarding their communication, and a few studies (2%) reported on their enjoyment of activities.

### ***Sense of Self***

The theme "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 was the least reported construct. Only 4% of studies reported an improvement or increase in confidence (1%), satisfaction (1%), and self-determination (1%). Only one study



reported self-esteem as an outcome of the intervention. The studies that commented on the construct of sense of self either reported by direct observation, by a researcher observing what they noted, or by proxy reports. For instance, Stasolla et al. (2013) utilized a happiness index and continually recorded mood changes by observing smiling, laughing, and excited body movements throughout the intervention.

### ***Context***

Context is personal when viewed from the perspective of the person participating and relates to people, places, activity objects, and times in which the participation is situated (Batorowicz et al., 2016; Imms & Green, 2020). It is worth noting that a child can participate in an activity by themselves or with other people within a social context (Batorowicz et al., 2016; Imms et al., 2017). The results indicate that attending the constructed activities (44%) was reported as the most common contextual outcome. A total of 29% of the studies did not report on context, 17% reported on using objects such as toys for interaction, and a few studies (9%) indicated interaction with people such as peers. None of the studies reported on the time construct.

### ***Environment***

Environment refers to the broader (physical and social) context in which participation takes place. Most of the studies (81%) did not report on the environment as an outcome. Those studies that did report on the environment highlighted increased availability (13%), acceptability (3%), accessibility (2%), and accommodability (1%); only one study reported on the affordability of AAC as an intervention outcome. For instance, availability was reported by Franco et al. (2009), who investigated the generalizability of functional communication training

interventions by making phrases available on speech-generated devices across generalization settings.

## **Discussion**

### **Participation Constructs**

This scoping review aimed to describe the participation-related outcomes reported by AAC intervention studies and how these studies 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 framework, they should not be viewed as isolated constructs but rather as holistic participation by a child in any life situation.

The available research on participation suggests that attendance in life situations for children with disabilities is quite restricted (Imms, 2020). Moreover, the results of this review indicate that attendance, which relates to the experience of participation that is measured objectively (Imms et al., 2017), was not widely reported as an outcome for many AAC intervention studies. This can be attributed to the fact that many of the interventions took place in a clinical room or in a quiet corner of a classroom. The studies that reported attendance mostly reported on frequency (25%) of attendance, while a few considered duration and diversity of attendance. To illustrate, Dyches et al. (2002) reported on the 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) analyzed the instructional effectiveness of a two-week inclusive theater arts program that involved two children who use AAC and three typically developing peers. Their study reported that having access to AAC

systems allowed these two participants to be equally engaged in a range of theater activities. Furthermore, a study by Jurgens et al. (2009) reported an increased duration of play activities as an outcome of their intervention. The latter study implemented a PECS training program to evaluate concomitant changes in spoken language, social-communicative behaviors, and functional play for a child with autism. They also reported communication gains (e.g., increases in spoken vocabulary and the length of comprehensible spoken utterances in free play) and gains in time spent in developmentally appropriate play (Jurgens et al., 2009). Furthermore, most studies used language to describe increased participation regarding the quality of the execution of tasks as activity competence, such as performance, capability, or capacity. This correlates with the results from the systematic review conducted by Imms and colleagues (2016).

Involvement relates to the complex and highly subjective construct of participation while attending (Imms et al., 2017). A clear understanding of the difference between being involved and how to observe involvement is still being considered (Imms, 2020). The fPRC framework includes engagement as a linking construct at the personal level (effort of focus), between systems (engaged in an activity), or at the macro level, for example, in society (Imms et al., 2017). Involvement may also include elements of motivation, persistence, social connection, and level of affect (Imms et al., 2017). Most of the studies that reported on motivation used measures of direct observation or by-proxy reporting from the participants' caretakers, educators, or research staff. However, recent evidence indicates that children's and caregivers' perspectives on participation differ (Samuels et al., 2020). Therefore, intervention studies could consider including the perspectives of both the caregiver and child to broaden the approach to children's participation (Dada et al., 2020).

It is worth noting that several studies that reported on involvement included communication partner instruction as an AAC strategy such as teaching peers to be communication partners by using speech output technologies or PECS in a variety of environments (Chung & Carter, 2013; McCarthy & Light, 2001; Thiemann-Bourque et al., 2016, 2017, 2018). This teaching addresses the need that was highlighted in the literature, that is, that children have restricted social interactions, especially regarding engagement with their peers (Batorowicz et al., 2014; Lygnegård et al., 2019).

### **Intrinsic Personal-Related Constructs**

The results obtained from the mapping of the included studies onto the fPRC framework indicate that intrinsic constructs of the fPRC, such as activity competence and preference, were predominantly reported as outcomes of the intervention studies. This correlates with the findings in the literature that most intervention studies report on personal-related outcomes, such as frequency of use of symbols, rather than on the subjective experience of participation (Adair et al., 2018; Granlund, 2013; Imms et al., 2017). The fPRC framework also refers to activity competence as being measured by capacity, capability, and performance. However, as previously mentioned in the literature review, the ICF conceptualizes “activities and participation” as one component in the classification system (WHO, 2001, 2007, p. 12). Due to the lack of clarity on the approach to participation, performance could be the only qualifier for participation but also for performing communicative behaviors, while capacity and capability are the sole qualifiers for activity (Imms & Green, 2020; WHO, 2007).

Preference outcomes were found to be 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). It was noted that many of the studies incorporated PECS, whereby the researchers conducted a reinforcement/stimulus sampling process prior to the intervention phase. The researchers provided the stimulus, activity, and object for a short duration of time and restricted access within the controlled experimental environment. Some studies also reported that the participants were able to request 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 used, and activities performed by children using aided communication were concrete, predictable, and mainly involved conversations about food and daily routines. The requirement for control in experimental studies can also make it more difficult to enhance social interaction in unstructured activities.

The current scoping review further indicates that several studies included AAC system preference assessments. Some 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 speech output technologies, manual signs, picture exchange options, or communication boards. Success (8%) was mostly reported 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 they expressed their enjoyment of writing stories together. Another example comes from a study by Adams and Cook (2016, p. 440), who probed the participant about the activity, and she responded, "This is fun."

Importantly, the child's perception of competence in performing an activity and their activity preference may shape their sense of self (Imms et al., 2017). This was the least reported on construct, and it was also reported by observation or by proxy reports. To illustrate, a study by Bornman et al. (2001) indicated that an increase in self-confidence was informally observed by the occupational therapist involved in the study. Sigafos et al. (2005) suggested that self-determination could be promoted by assessing children's preferences for using AAC devices. Perhaps one approach to reducing barriers would be to include the children's perspectives on their sense of self. Self-report measures of participation, attendance, and involvement, such as Picture My Participation (Arvidsson et al., 2020), may also be considered as part of the interventions used (Dada et al., 2020; Kramer & Schwartz, 2017).

### **Extrinsic Environmental-Related Constructs**

Context, when viewed from the perspective of the person participating, is personal and relates to people, places, activities, objects, and the time in which the participation is situated (Batorowicz et al., 2016; Imms & Green, 2020). The current results indicate that most of the studies ( $n = 120$ ) reported 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) as well as opportunities for social interaction (King et al., 2014). The activities a child participates in may be solitary or group-based and can be constructed by the child or by others (Batorowicz et al., 2016). Dada and Alant (2009) described the effects that an aided language stimulation intervention has on the vocabulary acquisition of children with complex communication needs. The program includes three activities, namely food preparation, arts and crafts, and story time activities in a group format. These separate activities formed part of a collaborative group project where the participants collectively assembled a picture of a

sheep or a bowl of pudding. Thus, the context differed for each activity (Dada & Alant, 2009). Their study concluded that the intervention was sufficient to facilitate the comprehension of symbols for all four participants (Dada & Alant, 2009). Some other studies reported on objects (17%) such as toys or educational tools and suggested that these objects may be seen as cognitive artifacts through which children interact with their environment (Batorowicz et al., 2016). Many of the studies that used PECS as an intervention conducted a reinforcement/stimulus sampling protocol of objects to be requested during the intervention phase. Only a few studies (9%) reported on the people aspect with whom a child interacts (Batorowicz et al., 2016). One case in point is a study by Grace et al. (2014) that reported on the effectiveness of an intervention that aimed to increase the social participation and communication of youth with complex communication needs. Additionally, support and training were effective in increasing internet use for connecting with others, and after the intervention, an increase was reported in the number of online communication partners.

A large and growing body of evidence describes how environmental factors influence a child's participation (Imms & Green, 2020). While the environment affects the child directly or indirectly, the individual in turn affects the environment through their engagement in activities in specific places (Imms et al., 2017). According to Maxwell et al. (2012, p. 65), availability is the "objective possibility to engage in a situation." Surprisingly, only a few studies (19%) reported on environmental outcomes. The few that did, mostly reported their availability to participate when using AAC (13%). To illustrate, a study by Drager et al. (2019) investigated the effectiveness of "just-in-time" AAC technology to increase the number of intentional and intelligible symbolic communicative turns expressed. The intervention integrated "just-in-time" programming with ongoing shared context activities. New visual scene displays and vocabulary

relevant to the ongoing activities were quickly available, which allowed the participants to remain engaged in the activities (Drager et al. 2019). A final example is an inspiring study by Bunning et al. (2014), tailored their intervention approach to each child. The intervention had to be feasible, culturally, and socially acceptable, and amendable to be implemented by the caregiver in the home context. The outcomes of their study revealed some expansion of the children's social activities (Bunning et al., 2014).

In addition, Bunning et al. (2014) reported a significant increase in positive parent perceptions regarding their children's communication. This parental outcome is not a child participation outcome but can be seen as an implementation outcome (Proctor et al., 2011). Maybe the distinction between evaluating intervention outcomes and evaluating implementation outcomes is partly artificial when evaluating the participation outcomes of AAC interventions. An effective AAC intervention probably requires that not only the child change their use of communicative behaviors but also that communicative partners are affected by what they perceive as a more communicatively skilled child. Thus, more studies need to report on changes in behaviors and perceptions of communicative partners when evaluating intervention outcomes.

### **Clinical Implications**

Enhancing and increasing participation across activities allows children with complex communication needs to build communication competence and participate fully in all aspects of life (Beukelman & Light, 2020). Several authors argue that participation is the end goal of AAC intervention (Beukelman & Light, 2020; Granlund et al., 2008; Light & McNaughton, 2015). The fPRC framework incorporates the ICF framework as the foundation for understanding the body, structure, and function of children. Therefore, the fPRC framework can be a valuable comprehensive framework to extend restricted goal setting that focuses on a child's capacity or



performance of communicative skills to also include attending and being involved in everyday activities that include the use of AAC. It may further facilitate the consideration of participation as both the motivating process and the end goal for every child with complex communication needs using a variety of AAC systems. Thus, interventionists need to consider participation - in all its complexity - as the primary focus of intervention to develop comprehensive participatory goals together with all stakeholders. This may truly enhance the communicative participation of children using AAC.

### **Limitations and Future Directions**

Admittedly, certain limitations to this scoping review should be considered when interpreting the results. Because the review included only peer-reviewed journal articles, publication bias cannot be ruled out. In addition, due to the authors' linguistic constraints, only English articles were considered, which may also have caused linguistic bias (Schlosser et al., 2007). Although the fPRC framework 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), self-regulation was not included in this scoping review. This is because it is a broadly used term in the fields of occupational therapy and psychology 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 not participation as a process. The included search terms were broad enough to provide a comprehensive overview of the participation outcomes of AAC intervention studies; however, the search term "aided communication" was omitted. The search was conducted in 2020 and as such this review may have missed the latest AAC intervention studies.

Importantly, future studies should aim to understand how to set objectives to fully incorporate participation as an end goal of AAC interventions. Thus, focusing on studies that report on a variety of participatory constructs as outcomes may lead to an 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 an intervention on participation for children with complex communication needs. Future intervention studies should also carefully consider differentiating intervention outcomes from implementation outcomes, as these types of outcomes are measured differently (Proctor et al., 2011). Since this review indicated a paucity of intervention studies focusing on participation outcomes for adolescents who use AAC, it may also be valuable to delve deeper into participation as a process to determine accessible ways of positively influencing the development of children who use AAC.

## **Conclusion**

The literature studied indicates that the field of AAC considers effective communication and participation in daily life to be the goal of AAC interventions for children with complex communication needs (Beukelman & Light, 2020; Granlund et al., 2008). This scoping review aimed to provide an overview of the participation constructs reported by AAC intervention studies for children and youth with complex communication needs. It is evident from the results of this study that the field of AAC has carefully considered areas of participation and related constructs. However, this review indicated that intervention studies should focus on essential participation constructs such as attendance, involvement, sense of self, and environment. Most of the available studies focused on activity competence, especially capacity, and capability, and

although these are valuable aspects of participation, they do not fully address the holistic and multidimensional nature of participation.

Because 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 with complex communication needs who use AAC. This scoping review highlighted important constructs of participation that should be considered to facilitate opportunities for participation. Focusing on these constructs could further support communicative participation outcomes for children and especially adolescents using AAC in a variety of social contexts and environments. In turn, children using AAC may be supported in developing their preferences, beliefs, opinions, and friendships. This scoping review provided opportunities for understanding the current status of participation and its related constructs in AAC research, with clear areas to be addressed in future research.

## References

\* Included studies

For complete list of 270 included studies see the supplementary materials.

Adair, B., Ullenhag, A., Keen, D., Granlund, M., & Imms, C. (2015). The effect of interventions aimed at improving participation outcomes for children with disabilities: a systematic review. *Developmental Medicine & Child Neurology*, *57*(12), 1093–1104.  
[doi.org/10.1111/dmcn.12809](https://doi.org/10.1111/dmcn.12809)

Adair, B., Ullenhag, A., Rosenbaum, P., Granlund, M., Keen, D., & Imms, C. (2018). Measures used to quantify participation in childhood disability and their alignment with the family of participation-related constructs: a systematic review. *Developmental Medicine and Child*

*Neurology*, 60(11), 1101–1116. doi.org/10.1111/dmcn.13959

\* Adams, K., & Cook, A. (2016). Using robots in “hands-on” academic activities: A case study examining speech-generating device use and required skills. *Disability and Rehabilitation: Assistive Technology*, 11(5), 433–443. doi.org/10.3109/17483107.2014.986224

Arksey, H., & O’Malley, L. (2005). Scoping studies: Towards a methodological framework. *International Journal of Social Research Methodology: Theory and Practice*, 8(1), 19–32. doi.org/10.1080/1364557032000119616

Arvidsson, P., Dada, S., Granlund, M., Imms, C., Bornman, J., Elliott, C., & Huus, K. (2020). Content validity and usefulness of Picture My Participation for measuring participation in children with and without intellectual disability in South Africa and Sweden. *Scandinavian Journal of Occupational Therapy*, 27(5), 336–348. doi.org/10.1080/11038128.2019.1645878

Ayres, A. J., & Robbins, J. (2005). *Sensory Integration and the Child: Understanding Hidden Sensory Challenges* (25th ed.). WPS.

Batorowicz, B., Campbell, F., Von Tetzchner, S., King, G., & Missiuna, C. (2014). Social participation of school-aged children who use communication aids: The views of children and parents. *AAC: Augmentative and Alternative Communication*, 30(3), 237–251. doi.org/10.3109/07434618.2014.940464

Batorowicz, B., King, G., Mishra, L., & Missiuna, C. (2016). An integrated model of social environment and social context for pediatric rehabilitation. *Disability and Rehabilitation*, 38(12), 1204–1215. doi.org/10.3109/09638288.2015.1076070

\* Bedrosian, J., Lasker, J., Speidel, K., & Politsch, A. (2003). Enhancing the Written Narrative Skills of an AAC Student with Autism. *Topics in Language Disorders, 23*(4), 305–324.  
[doi.org/10.1097/00011363-200310000-00006](https://doi.org/10.1097/00011363-200310000-00006)

Beukelman, D. R., & Mirenda, P. (2013). Augmentative and alternative communication. Supporting children and adults with complex communication needs. In *Augmentative and Alternative Communication: Supporting Children and Adults with Complex Communication Needs* (Fourth, pp. 3–15). Paul H. Brookes Publishing Co.

Beukelman, D. R., & Light, J. (2020). *Augmentative & Alternative Communication: Supporting Children and Adults with Complex Communication Needs* (5th ed.). Brookes Publishing.

Bondy, A., & Frost, L. (2002). The picture exchange communication systems: training manual. In *Newark: Pyramid Educational* (2nd ed.). Pyramid Educational.

\* Bornman, J., Alant, E., & Meiring, E. (2001). The use of a digital voice output device to facilitate language development in a child with developmental apraxia of speech: A case study. *Disability and Rehabilitation, 23*(14), 623–634.

Bright, F. A. S., Kayes, N. M., Worrall, L., & McPherson, K. M. (2015). A conceptual review of engagement in healthcare and rehabilitation. *Disability and Rehabilitation, 37*(8), 643–654.  
[doi.org/10.3109/09638288.2014.933899](https://doi.org/10.3109/09638288.2014.933899)

\* Bunning, K., Gona, J. K., Newton, C. R., & Hartley, S. (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. *Augmentative and Alternative Communication, 30*(4), 344–356.  
[doi.org/10.3109/07434618.2014.970294](https://doi.org/10.3109/07434618.2014.970294)

Center for Open Science. (2020). *Center for Open Science Mission*. Business Plan.

[www.cos.io/about/mission](http://www.cos.io/about/mission)

- \* Chung, Y.-C., & Carter, E. W. (2013). Promoting peer interactions in inclusive classrooms for students who use speech-generating devices. *Research and Practice for Persons with Severe Disabilities, 38*(2), 94–109.
- Colquhoun, H. L., Levac, D., O'Brien, K. K., Straus, S., Tricco, A. C., Perrier, L., Kastner, M., & Moher, D. (2014). Scoping reviews: Time for clarity in definition, methods, and reporting. In *Journal of Clinical Epidemiology* (Vol. 67, Issue 12, pp. 1291–1294). Elsevier USA. [doi.org/10.1016/j.jclinepi.2014.03.013](https://doi.org/10.1016/j.jclinepi.2014.03.013)
- \* Couper, L., van der Meer, L., Schäfer, M. C. M., McKenzie, E., McLay, L., O'Reilly, M. F., Lancioni, G. E., Marschik, P. B., Sigafoos, J., & Sutherland, D. (2014). Comparing acquisition of and preference for manual signs, picture exchange, and speech-generating devices in nine children with autism spectrum disorder. Retrieved from *Developmental Neurorehabilitation, 17*(2), 99–109. [doi.org/10.3109/17518423.2013.870244](https://doi.org/10.3109/17518423.2013.870244)
- \* Dada, S., & Alant, E. (2009). The effect of aided language stimulation on vocabulary acquisition in children with little or no functional speech. *American Journal of Speech-Language Pathology, 18*(1), 50–64. [doi.org/10.1044/1058-0360\(2008/07-0018\)](https://doi.org/10.1044/1058-0360(2008/07-0018))
- Dada, S., Bastable, K., Schlebusch, L., & Halder, S. (2020). The participation of children with intellectual disabilities: Including the voices of children and their caregivers in India and South Africa. *International Journal of Environmental Research and Public Health, 17*(18), 1–13. [doi.org/10.3390/ijerph17186706](https://doi.org/10.3390/ijerph17186706)
- Daudt, H. M., van Mossel, C., & Scott, S. J. (2013). Enhancing the scoping study methodology: a large, inter-professional team's experience with Arksey and O'Malley's framework. *BMC Medical Research Methodology, 13*(48), 1–9. [doi.org/10.1186/1471-2288-13-48](https://doi.org/10.1186/1471-2288-13-48)

- \* Drager, K. D. R., Light, J., Currall, J., Muttiah, N., Smith, V., Kreis, D., Nilam-Hall, A., Parratt, D., Schuessler, K., Shermetta, K., & Wiscount, J. (2019). AAC technologies with visual scene displays and “just in time” programming and symbolic communication turns expressed by students with severe disability. *Journal of Intellectual & Developmental Disability, 44*(3), 321–336. doi.org/10.3109/13668250.2017.1326585
- \* Dyches, T. T., Davis, A., Lucido, B., & Young, J. R. (2002). Generalization of skills using pictographic and voice output communication devices. *AAC: Augmentative & Alternative Communication, 18*(2), 124–131. doi.org/10.1080/07434610212331281211
- Eadie, T. L., Yorkston, K. M., Klasner, E. R., Dudgeon, B. J., Deitz, J. C., Baylor, C. R., Miller, R. M., & Amtmann, D. (2006). Measuring communicative participation: A review of self-report instruments in speech-language pathology. *American Journal of Speech-Language Pathology, 15*(4), 307–320. doi.org/10.1044/1058-0360(2006/030)
- Elo, S., & Kyngäs, H. (2008). The qualitative content analysis process. *Journal of advanced nursing, 62*(1), 107–115. doi.org/10.1111/j.1365-2648.2007.04569.x
- Franco, J., Lang, R., O’Reilly, M. F., Chan, J. M., Sigafos, J., & Rispoli, M. (2009). Functional analysis and treatment of inappropriate vocalizations using a speech-generating device for a child with autism. *Focus on Autism & Other Developmental Disabilities, 24*(3), 146–155. doi.org/10.1177/1088357609338380
- \* Grace, E., Raghavendra, P., Newman, L., Wood, D., & Connell, T. (2014). Learning to use the Internet and online social media: What is the effectiveness of home-based intervention for youth with complex communication needs? *Child Language Teaching and Therapy, 30*(2), 141–157. doi.org/10.1177/0265659013518565
- Granlund, M. (2013). Participation - challenges in conceptualization, measurement and

intervention. *Child: Care, Health and Development*, 39(4), 470–473.

doi.org/10.1111/cch.12080

Granlund, M., Arvidsson, P., Niia, A., Björck-Åkesson, E., Simeonsson, R., Maxwell, G., Adolfsson, M., Eriksson-Augustine, L., & Pless, M. (2012). Differentiating activity and participation of children and youth with disability in Sweden. *American Journal of Physical Medicine & Rehabilitation*, 91(13), S84–S96. doi.org/10.1097/phm.0b013e31823d5376

Granlund, M., Björck-Åkesson, E., Wilder, J., & Ylvén, R. (2008). AAC interventions for children in a family environment: Implementing evidence in practice. *AAC: Augmentative and Alternative Communication*, 24(3), 207–219. doi.org/10.1080/08990220802387935

Grant, M. J., & Booth, A. (2009). A typology of reviews: an analysis of 14 review types and associated methodologies. *Health Information & Libraries Journal*, 26(2), 91–108.

doi.org/10.1111/j.1471-1842.2009.00848.x

Imms, C. (2020). Participation in diverse life situations for people with disability: a vision for the future. In *Developmental Medicine and Child Neurology* (Vol. 62, Issue 1, p. 5).

doi.org/10.1111/dmcn.14399

Imms, C., Adair, B., Keen, D., Ullenhag, A., Rosenbaum, P., & Granlund, M. (2016).

‘Participation’: A systematic review of language, definitions, and constructs used in intervention research with children with disabilities. *Developmental Medicine & Child Neurology*, 58(1), 29–38. doi.org/10.1111/dmcn.12932

Imms, C., Granlund, M., Wilson, P. H., Steenbergen, B., Rosenbaum, P. L., & Gordon, A. M.

(2017). Participation, both a means and an end: a conceptual analysis of processes and outcomes in childhood disability. *Developmental Medicine & Child Neurology*, 59(1), 16–25. doi.org/10.1111/dmcn.13237



Imms, C., & Green, D. (2020). Conceptual issues in participation. In *Participation: Optimising Outcomes in Childhood Onset Neurodisability* (pp. 2–11). Mac Keith Press.

\* Jurgens, A., Anderson, A., & Moore, D. W. (2009). The effect of teaching PECS to a child with autism on verbal behaviour, play, and social functioning. *Behaviour Change*, 26(1), 66–81. doi.org/10.1375/bech.26.1.66

Kent-Walsh, J., & Binger, C. (2018). Methodological advances, opportunities, and challenges in AAC research. *AAC: Augmentative and Alternative Communication*, 34(2), 93–103. https://doi.org/10.1080/07434618.2018.1456560

King, G., Gibson, B. E., Mistry, B., Pinto, M., Goh, F., Teachman, G., & Thompson, L. (2014). An integrated methods study of the experiences of youth with severe disabilities in leisure activity settings: the importance of belonging, fun, and control and choice. *Disability & Rehabilitation*, 36(19), 1626–1635. doi.org/10.3109/09638288.2013.863389

Kramer, J. M., & Schwartz, A. (2017). Reducing barriers to patient-reported outcome measures for people with cognitive impairments. *Archives of Physical Medicine and Rehabilitation*, 98(8), 1705–1715. doi.org/10.1016/j.apmr.2017.03.011

\* Lerna, A., Esposito, D., Conson, M., Russo, L., & Massagli, A. (2012). Social-communicative effects of the Picture Exchange Communication System (PECS) in Autism Spectrum Disorders. *International Journal of Language & Communication Disorders*, 47(5), 609–617. doi.org/10.1111/j.1460-6984.2012.00172.x

Levac, D., Colquhoun, H., & O'Brien, K. K. (2010). Scoping studies: Advancing the methodology. *Implementation Science*, 5(69), 1–9. doi.org/10.1186/1748-5908-5-69

Light, J., & McNaughton, D. (2015). Designing AAC research and intervention to improve outcomes for individuals with complex communication needs. *AAC: Augmentative and*

*Alternative Communication*, 31(2), 85–96. doi.org/10.3109/07434618.2015.1036458

\* Lorah, E. R., Tincani, M., Dodge, J., Gilroy, S., Hickey, A., & Hantula, D. (2013). Evaluating picture exchange and the iPad (TM) as a speech-generating device to teach communication to young children with autism. *Journal of Developmental and Physical Disabilities*, 25(6), 637–649.

Lund, S. K., Quach, W., Weissling, K., McKelvey, M., & Dietz, A. (2017). Assessment with children who need Augmentative and Alternative Communication (AAC): Clinical Decisions of AAC Specialists. *Language, speech, and hearing services in schools*, 48(1), 56–68. doi.org/10.1044/2016\_LSHSS-15-0086

Lyngnegård, F., Almqvist, L., Granlund, M., & Huus, K. (2019). Participation profiles in domestic life and peer relations as experienced by adolescents with and without impairments and long-term health conditions. *Developmental Neurorehabilitation*, 22(1), 27–38. doi.org/10.1080/17518423.2018.1424266

Maxwell, G., Alves, I., & Granlund, M. (2012). Participation and environmental aspects in education and the ICF and the ICF-CY: Findings from a systematic literature review. *Developmental Neurorehabilitation*, 15(1), 63–78. doi.org/10.3109/17518423.2011.633108

\* McCarthy, J., & Light, J. (2001). Instructional effectiveness of an integrated theater arts program for children using augmentative and alternative communication and their nondisabled peers: Preliminary study. *AAC: Augmentative and Alternative Communication*, 17(2), 88–98. doi.org/10.1080/714043371

\* McDonald, M. E., Battaglia, D., & Keane, M. (2015). Using fixed interval-based prompting to increase a student's initiation of the picture exchange communication system. *Behavioral Development Bulletin*, 20(2), 265–275. doi.org/10.1037/h0101315

McHugh M. L. (2012). Interrater reliability: the kappa statistic. *Biochemia Medica*, 22(3), 276–282.

\* McLay, L., van der Meer, L., Schäfer, M. C. M., Couper, L., McKenzie, E., O'Reilly, M. F., Lancioni, G. E., Marschik, P. B., Green, V. A., Sigafoos, J., & Sutherland, D. (2015). Comparing acquisition, generalization, maintenance, and preference across three AAC options in four children with autism spectrum disorder. *Journal of Developmental and Physical Disabilities*, 27(3), 323–339. doi.org/10.1007/s10882-014-9417-x

McMillan, J., & Schumacher, S. (2014). Research in Education. In *Research in Education Evidence-Based Inquiry* (7th ed.). Pearson Education Limited.

Munn, Z., Peters, M. D. J., Stern, C., Tufanaru, C., McArthur, A., & Aromataris, E. (2018). Systematic review or scoping review? Guidance for authors when choosing between a systematic or scoping review approach. *BMC Medical Research Methodology*, 18(1), 1–7. doi.org/10.1186/s12874-018-0611-x

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., ... Moher, D. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ*, 372. doi.org/10.1136/bmj.n71

Peters, M. D. J., Godfrey, C., McInerney, P., Munn, Z., Tricco, A., & Khalil, H. (2020). Chapter 11: Scoping reviews. In E. Aromataris & Z. Munn (Eds.), *JBIR Reviewer's Manual* (2020 ed.). JBI. doi.org/10.46658/jbirm-20-01

Pittman, K., Irby, M., Tolman, J., Yohalem, N., & Ferber, T. (2003). Preventing problems, promoting development, encouraging engagement: Competing priorities or inseparable

goals? *Forum for Youth Investment*.

- Proctor, E., Silmere, H., Raghavan, R., Hovmand, P., Aarons, G., Bunger, A., Griffey, R., & Hensley, M. (2011). Outcomes for implementation research: Conceptual distinctions, measurement challenges, and research agenda. *Administration and Policy in Mental Health and Mental Health Services Research, 38*(2), 65–76. doi.org/10.1007/s10488-010-0319-7
- Raghavendra, P., Olsson, C., Sampson, J., McInerney, R., & Connell, T. (2012). School participation and social networks of children with complex communication needs, physical disabilities, and typically developing peers. *AAC: Augmentative and Alternative Communication, 28*(1), 33–43. doi.org/10.3109/07434618.2011.653604
- Rainey, L., van Nispen, R., van der Zee, C., & van Rens, G. (2014). Measurement properties of questionnaires assessing participation in children and adolescents with a disability: a systematic review. *Quality of Life Research, 23*(10), 2793–2808. doi.org/10.1007/s11136-014-0743-3
- Rosenberg, S., & Beukelman, D. (1987). The participation model. *Proceedings of the national planners conference on assistive device service delivery* (pp. 159-161). Washington DC: RESNA, The Association for the Advancement of Rehabilitation Technology.
- Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist, 55*(1), 68–78. doi.org/10.1037/110003-066X.55.1.68
- Samuels, A., Dada, S., Van Niekerk, K., Arvidsson, P., & Huus, K. (2020). Children in South Africa with and without intellectual disabilities' rating of their frequency of participation in everyday activities. *International Journal of Environmental Research and Public Health, 17*(18), 1–12. doi.org/10.3390/ijerph17186702

Schlosser, R. W., Wendt, O., Angermeier, K. L., & Shetty, M. (2005). Searching for evidence in augmentative and alternative communication: Navigating a scattered literature. *AAC: Augmentative and Alternative Communication*, *21*(4), 233–255.

[doi.org/10.1080/07434610500194813](https://doi.org/10.1080/07434610500194813)

Schlosser, R. W., Wendt, O., & Sigafoos, J. (2007). Not all systematic reviews are created equal: Considerations for appraisal. *Evidence-Based Communication Assessment and Intervention*, *1*(3), 138–150. [doi.org/10.1080/17489530701560831](https://doi.org/10.1080/17489530701560831)

\* Sigafoos, J., O'Reilly, M., Ganz, J. B., Lancioni, G. E., & Schlosser, R.W. (2005). Supporting self-determination in AAC interventions by assessing preference for communication devices. *Technology & Disability*, *17*(3), 143–153. [doi.org/10.3233/tad-2005-17302](https://doi.org/10.3233/tad-2005-17302)

Singer, I., Klatte, I. S., Welbie, M., Cnossen, I. C., & Gerrits, E. (2020). A multidisciplinary Delphi consensus study of communicative participation in young children with language disorders. *Journal of Speech, Language, and Hearing Research*, *63*(6), 1793–1806. [doi.org/10.1044/2020\\_JSLHR-19-00326](https://doi.org/10.1044/2020_JSLHR-19-00326)

Skille, E., & Øterås, J. (2011). What does sport mean to you? Fun and other preferences for adolescents' sport participation. *Critical Public Health*, *21*(3), 359–372. [doi.org/10.1080/09581591003797111](https://doi.org/10.1080/09581591003797111)

\* Stasolla, F., Caffò, A. O., Picucci, L., & Bosco, A. (2013). Assistive technology for promoting choice behaviors in three children with cerebral palsy and severe communication impairments. *Research in Developmental Disabilities*, *34*(9), 2694–2700. [doi.org/10.1016/j.ridd.2013.05.029](https://doi.org/10.1016/j.ridd.2013.05.029)

\* Thiemann-Bourque, K., Brady, N., McGuff, S., Strump, K., & Naylor, A. (2016). Picture Exchange Communication System and Pals: A peer-mediated augmentative and alternative

communication intervention for minimally verbal preschoolers with autism. *Journal of Speech, Language, and Hearing Research*, 59(5), 1133–1145. doi.org/10.1044/2016\_jslhr-l-15-0313

\* Thiemann-Bourque, K., Feldmiller, S., Hoffman, L., & Johnner, S. (2018). Incorporating a peer-mediated approach into speech-generating device intervention: Effects on communication of preschoolers with autism spectrum disorder. *Journal of Speech, Language, and Hearing Research*, 61(8), 2045–2061. doi.org/10.1044/2018\_JSLHR-L-17-0424

\* Thiemann-Bourque, K., McGuff, S., & Goldstein, H. (2017). Training peer partners to use a speech-generating device with classmates with autism spectrum disorder: Exploring communication outcomes across preschool contexts. *Journal of Speech, Language & Hearing Research*, 60(9), 2648–2662. doi.org/10.1044/2017\_JSLHR-L-17-0049

United Nations. (2006). United Nations Convention on the Rights of Persons with Disabilities (CRPD). *International and European Labour Law*, December, 455–461. doi.org/10.5771/9783845266190-471

\* van der Meer, L., Didden, R., Sutherland, D., O'Reilly, M. F., Lancioni, G. E., & Sigafos, J. (2012). Comparing three augmentative and alternative communication modes for children with developmental disabilities. *Journal of Developmental and Physical Disabilities*, 24(5), 451–468. doi.org/10.1007/s10882-012-9283-3

Veritas Health Innovation, (2020). *Covidence systematic review software* (Version 2), Melbourne, Australia. Available at [www.covidence.org](http://www.covidence.org).

World Health Organization. (2001). *International Classification of Functioning, Disability and Health: ICF*. World Health Organization. [apps.who.int/iris/handle/10665/42407](https://apps.who.int/iris/handle/10665/42407)

World Health Organization. (2007). International classification of functioning, disability, and

health: Children & youth version: ICF-CY. In *Intergovernmental Panel on Climate Change* (Ed.), *NLM* (Issue 5). WHO Press. doi.org/10.1017/CBO9781107415324.004