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**Factors Perceived by Rehabilitation Professionals to Influence the Provision
of Assistive Technology: A Systematic Review**

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Adherence to ethical standards

The ethical board of the University of Pretoria approved the study.

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Abstract

Background

The use of Assistive Technology (AT) by children with disabilities has been associated with significant development and improvement in outcomes within all spheres of life. However, AT is often underutilised. Appropriate selection of AT by rehabilitation professionals could improve the satisfaction of the user and their family with their AT.

Data sources

A systematic search identified six studies that investigate the factors that occupational therapists, physiotherapists, as well as speech and language pathologists perceive to influence their provision of AT to children.

Study appraisal

Two qualitative and four quantitative articles were identified. Both article types were appraised using the Mixed Methods Appraisal tool (Pluye, Robert, Cargo, & Bartlett, 2011).

Synthesis method

A process of deductive thematic analysis by using themes from the Assistive Technology Device Selection Framework (Scherer, Jutai, Fuhrer, Demers, & Deruyter, 2007), was followed by inductive thematic analysis to uncover subthemes. Data from all six articles are synthesised to provide a view of factors that are perceived to influence AT selection.

Implications of findings

Within a family-centered perspective, both family and child expectations and preferences should be considered. Professionals should consider the influence of their own preferences and knowledge on the AT they recommend.

Key words:

assistive technology, children with disabilities, rehabilitation professionals.

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The term Assistive Technology (AT) has been defined as "any item, piece of equipment or product system, whether acquired commercially off the shelf, modified, or customised, that is used to increase, maintain or improve the functional capabilities of a child with a disability" (*Individuals with Disabilities Education Act*, 2004). AT is often recommended by rehabilitation professionals after a process of carefully matching the abilities of a person, the capabilities of the AT as well as the characteristics of the environment (Cook & Polgar, 2008).

Children with disabilities experience a multitude of barriers to participation in activities. This may be due to barriers related to their disability, or those imposed by their environment (King et al., 2009; King, Shields, Imms, Black, & Ardern, 2013; Mihaylov, Jarvis, Colver, & Beresford, 2004; Raghavendra, Virgo, Olsson, Connell, & Lane, 2011). The resulting limited participation in, for example, education, play, and family life denies them of countless opportunities for learning and development and inhibits their integration into society.

The use of AT by children with disabilities has been associated with development and improvement (in the domains of motor, communication, social, cognitive, adaptive behaviour, literacy and engagement) in outcomes within all spheres of life (Dunst, Trivette, Hamby, & Simkus, 2013). It has been suggested that AT can be used to overcome some of the barriers that may be experienced by a child with a disability, thereby facilitating participation and learning (Henderson, Skelton, & Rosenbaum, 2008; Schoonover, Argabrite Grove, & Smith, 2013).

Despite the benefits documented, various authors have indicated that AT is underutilised by children with disability (Dugan, Campbell, & Wilcox, 2006; Kling, Campbell, & Wilcox, 2010). Various reasons have been suggested for this (Bailey, Parette, Stoner, Angell, & Carroll, 2006; Parette, Vanbiervliet, & Hourcade, 2000), including the perceived

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unwillingness of parents to use the devices in their homes, funding issues, as well as the abandonment of provided devices (Judge, 2002) by the child and family.

While abandonment of assistive technology devices (ATD) clearly contribute to the underutilisation of AT, eventual utilisation of AT can also be influenced by factors that occur before the AT is even procured. According to Scherer, Jutai, Fuhrer, Demers and Deruyter (2007) the process that occurs before the procurement of an ATD is the selection process.

Careful selection of appropriate AT is important in ensuring cost-effectiveness and efficacy in the process (Bernd, Van Der Pijl, & De Witte, 2009; Friederich, Bernd, & De Witte, 2010). Appropriate selection could ensure the satisfaction of the AT user and their family and could limit difficulties and disappointment with AT during the implementation process.

Despite the clear importance of the selection process, this aspect has not received adequate attention in the literature. Not much is known about the reasoning of professionals regarding their selection practices (Friederich et al., 2010) or factors that influence this process, particularly when selecting AT for children. This has clear implications for evidence-based practises in this field.

In a review by Bernd et al. (2009), three models were identified from the literature to be "specific to AT and suitable for selection process" (p. 154). These are the Human Activity Assistive Technology (HAAT) model (Cook & Polgar, 2008), the Matching Person and Technology Model (Scherer, 1998), as well as the ATD Selection framework (Scherer et al., 2007).

The HAAT model (Cook & Polgar, 2008) indicates that AT selection is influenced by four main components - these being the human using the AT, the activity where AT is required, the assistive technology, as well as contextual factors. The Matching Person and Technology Model (Scherer, 1998), is reportedly the most widely published model regarding

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selection of AT (Bernd et al., 2009) and focuses on matching the abilities and perspectives of the AT consumer with specific AT within the particular environment.

The ATD Selection Framework (Scherer et al., 2007) focuses particularly on aspects of AT provision that influence the process before the AT is procured. It is the only one of the three models that pertinently indicates the influence of the professional in the AT selection process. As professionals are typically intimately involved in AT selection, it could be expected that they would influence this process to a certain extent. This can be illustrated, for example by studies that call for the expansion and improvement of training for professionals regarding AT (Copley & Ziviani, 2004; Long & Perry, 2008; Long, Woolverton, Perry, & Thomas, 2007; Wilcox, Guimond, Campbell, & Weintraub Moore, 2006). Since the current study aimed to identify a broad array of factors from published literature that was reported to influence AT selection as perceived by professionals, the ATD Selection Framework was deemed as the most appropriate analysis framework for the current study.

According to the authors (Scherer et al., 2007), the ADT Selection Framework was conceptualised after reviewing available literature and utilises a consumer-centered approach, characterised by joint decision making between the consumer of the AT and the provider. Although the framework suggests that the consumer refers only to the single person using the AT, this understanding can be broadened when the framework is applied to children, to include both child and family. Family-centered intervention and specifically, family-centred AT decision making has been described as best practise (Judge, 2002; Parette & Brotherson, 2004; Parette et al., 2000) and therefore the family is as much a consumer of the AT as the child.

In the ATD Selection Framework (Scherer et al., 2007), the authors indicate that two broad categories of factors (environmental and personal) as well as the interplay between them, influence the ATD decision making and selection process. Within the ATD Selection

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Framework, environmental factors (including cultural and financial priorities, legislation and policies as well as the attitudes of key others) form the backdrop to ATD selection, influencing the entire selection process. The framework acknowledges that personal factors of the consumer as well as the provider influence the selection of AT within a particular environment. Personal factors (pertaining to the child and family as well as the provider) include the resources at their disposal (e.g. financial), their knowledge and information, their expectations as well as their personal preferences and priorities. Personal factors (influenced by the particular environmental factors) are brought to the ATD decision making and device selection process (based on assessments of the objective and subjective needs of the consumer and provider) and contribute to the eventual procurement and provision of a device.

In order to better understand the factors that influence professionals in their provision of AT, the authors undertook a review of literature. This review focussed on factors influencing the selection of the AT. The aim of the systematic review was therefore to identify factors uncovered in published research studies as perceived by occupational therapists (OT), physiotherapists (PT) as well as speech language pathologists (SLP) to influence their provision of assistive technology (AT) to children with disabilities.

Method

Search

A librarian was consulted in the selection of databases and development of the search terms. The searched databases comprised of CINAHL, PsycINFO, ERIC, Medline, Academic Search Complete, Health Source: Nursing/Academic Edition, African Wide Information, Humanities Source (all accessed through EBSCO HOST), as well as IEEEExplore, as these cover content related to allied health professions and/or assistive technology.

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Search terms included variations of words describing the population that was targeted in the search. These included variations of *professional*, as well as *child with a disability*. Variations of the term *assistive technology* were also included. Specific types of AT (those typically recommended by OT, SLP or PT) were included as alternatives (for example mobility device or augmentative and alternative communication device) as authors frequently use these specific terms in papers rather than using the more generic term assistive technology (for example Lindsay, 2010).

The specific search terms as used on EBSCO HOST searches were (*profession* OR service provider* OR clinician* OR therapist**) AND (*assistive technolog* OR assistive device* OR adapt* equipment OR adapt* technolog* OR adapt* device* OR mobility aid OR power* mobility OR non-power* mobility OR switch OR adapt* toy* OR "Augmentative and Alternative Communicat*" OR augment* communicat* OR low technolog**) AND (*child* OR toddler* OR infant* OR preschool**) AND (*disab* OR disorder* OR impair* OR handicap**)

There were 805 articles identified by means of the database searches.

In addition to these searches, hand searches were undertaken by going through the reference lists of identified articles. Nineteen (19) additional articles were identified in this manner.

Eligibility Criteria

In order to limit the articles to only the relevant ones, selection criteria were applied by the reviewers during the screening process. Articles were only included if they 1) were published in English between 1990 and 2014 within a peer reviewed journal; 2) described a research study (qualitative, quantitative or mixed-method); 3) aimed (amongst other aims) to determine what factors are perceived by OTs, PTs or SLPs to influence them in their provision of AT to children. The AT described in the article had to be 4) limited to that

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generally recommended by the named professions; and 5) had to be provided to children (aged between 0 and 18 years) with a disability.

As only research studies were included, all review articles, theoretical articles, conference presentations and expert opinion articles were excluded. Case studies with one participant were also excluded. Articles were excluded when data obtained from other professions (for example teachers) were analysed and discussed together with data obtained from the included professionals. If results were discussed separately for the different professional groups (for example Wilcox, Guimond, Campbell, & Weintraub Moore, 2006), the studies were included. Articles discussing specifically cochlear implants or hearing aids were excluded, as these particular forms of AT do not fall within the professional scope of the named professionals.

Study Selection

After the articles were identified through the database and hand searches, duplicates were removed and the remaining 496 articles were reviewed. The articles were independently screened by two reviewers on title level. The first author was involved in screening all the articles, with one of the co-authors reviewing each article independently as well. At this point, where reviewers did not agree on the selection of a particular article, the article was included.

The remaining articles were independently reviewed on abstract level by the first author and one of the co-authors. Inter-rater agreement (as described by Schlosser & Koul, 2015) on the abstract level was calculated to be 95%. When reviewers did not agree on the selection of the article, the article was included in the next phase of the review.

A total of 64 articles remained and were assessed for eligibility on full text level. The same process was followed, with the first author reviewing all the articles and co-authors each blindly reviewing a third of the papers. Inter-rater agreement on full text level was

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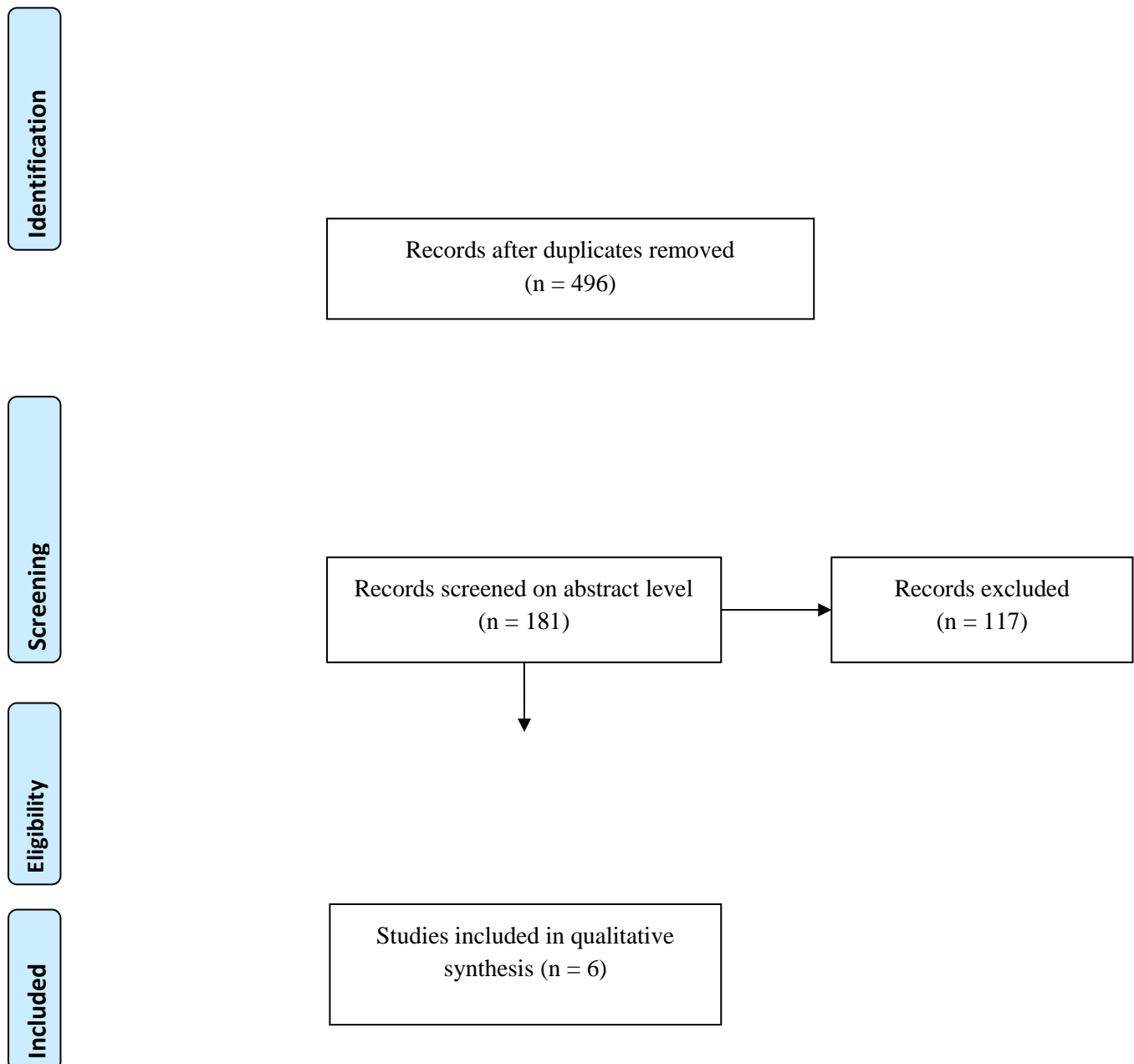


Figure 1. Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) flow diagram for studies included in the review. Format developed by Liberati et al. (2009)

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calculated at 84%. When two reviewers did not agree on whether an article should be included, the authors discussed this, and asked a third reviewer to review the paper as well. Results were then discussed, until agreement was reached. A total of 58 articles were excluded after review of the full text. The reasons for exclusion of articles were that articles included professionals other than OT, PT or SLP in the data analysis (n=5); did not focus specifically on AT (n=10); were not limited to children (n=3); did not focus on factors influencing professionals in AT provision (n=27); or the article was not an empirical study/ was a case study with a single participant (n=13). Six articles were identified through this process to be included in the final review. The PRISMA diagram indicating the different phases of the review as recommended by Liberati et al. (2009) is illustrated in Figure 1.

Quality Appraisals

The Lloyd-Smith hierarchy (Lloyd-Smith, 1997) was developed within a rehabilitation field (occupational therapy) and was used to categorise the quantitative studies. Level 1a on this hierarchy indicates that a study is a meta-analysis of randomised control trials, Level 1b points to one individual randomised controlled study. Level 2a indicates that a study is a well-designed, non-randomised controlled study, with Level 2b pointing to a well-designed quasi-experimental study. Level 3 indicates that a study is non-experimental descriptive. Studies on Level 4 of the Lloyd-Smith hierarchy would be respectable opinions and provide the lowest level of evidence.

The hierarchy proposed by Daly et al., (2007) is one of the few appraisal tools that allow qualitative studies to be hierarchically appraised for the level of evidence provided (a process that is typically only applied to quantitative studies). It was used in this review in order to have a method of appraising the qualitative studies in a similar way as the quantitative studies. The hierarchy categorises qualitative studies into one of four broad

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levels, Level 1 (Generalizable studies), Level 2 (conceptual studies), Level 3 (descriptive studies) and Level 4 (single case studies), indicating a decreased likelihood to produce good evidence (Daly et al., 2007).

As the Mixed Methods Appraisal Tool (MMAT, 2011) (Pluye, Robert, Cargo, & Bartlett, 2011) has been found useful to concomitantly appraise the quality of qualitative and quantitative studies in a mixed study review (Pace et al., 2012), it was used to appraise all articles. This tool has two subsections (for qualitative and quantitative studies), each with four items posing questions regarding the methods of the included studies. The qualitative subsection of the MMAT was completed and scored for the qualitative studies and the quantitative descriptive subsection of the tool was completed for the remaining four (quantitative) studies. Scores were calculated by dividing the number of criteria an article met, by four and multiplying by a hundred. Therefore, when one criterion is met, the score is 25%, when all four are met, the score would be 100%.

The first author completed an appraisal of all 6 articles, with two of the co-authors each rating 3 articles independently. The results of the appraisals were discussed until consensus (100% agreement) was reached.

Data Synthesis

A mixed methods synthesis was undertaken in order to synthesise qualitative and quantitative data gathered from the six articles. A convergent design with qualitative synthesis (only) of all study types (Pluye & Hong, 2014) was deemed most appropriate for this study's purpose. According to this method, the result of both the qualitative and quantitative articles was converted into qualitative data, namely themes.

Thematic analysis has been described as a synthesis method that is very adaptable and that can be used with diverse evidence types (Dixon-woods, Agarwal, Jones, Young, & Sutton, 2005). A thematic analysis of the results was conducted in two phases. The first phase

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was a deductive thematic analysis based on the ATD Selection Framework. Every factor identified in the ATD Selection Framework (Scherer et al., 2007) was used as a theme for this analysis. Each factor was operationalized for the purpose of this review with definitions included in a coding manual for use during the analysis process. This is available as Appendix A. Two components of the ATD Selection Framework (assessment of functional AT need and assessment of functional AT disposition) (Scherer et al., 2007) were combined into an "Assessment " category, as it proved to be challenging to distinguish between the two separate categories during analysis. Themes from the framework therefore included (1) Cultural and financial priorities, (2) Legislation and policy, (3) Attitudes of key others, (4) Resources (family, friends, significant others, financial), (5) Knowledge and information, (6) Expectations, (7) Personal preferences and priorities, and (8) Assessment. It should further be noted that, as indicated in the original framework, Themes 1-3 related to environmental factors, and Themes 4-7 to personal factors (of the provider and consumer). During this phase of coding, a theme was created for data items that did not seem to fit into any of the existing eight themes, initially named "other".

As the authors were interested only in the factors identified in the primary studies (and not the extent to which a certain factor influenced AT provision), the measurement instruments (when available) was analysed according to the themes within the quantitative articles. If the measurement instrument was not available, the results section of the paper was analysed (also only according to the themes). For the qualitative papers, thematic analysis was done for the results section of the paper. The first author analysed all the papers according to the themes, with one co-author checking the analysis to ensure consistency. Items where the authors did not agree were discussed until 100% agreement could be reached.

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After this initial deductive analysis, all the data items across the different articles were collated under each of the themes. A process of inductive analysis (second phase) followed in order to further delineate the theme termed 'other' and also to identify subthemes within each of the identified themes. This inductive analysis was conducted by the first three authors during a joint meeting. Authors agreed that all items grouped under the theme 'other' were related to assistive technology, and therefore this was identified as a theme. Together with the themes from Phase 1, this amounted to nine themes. Items under each of the themes were discussed and grouped by the first three authors, resulting in the identification of a total of 31 subthemes.

Results

Study Characteristics

A summary of the final 6 articles can be found in Table 1. Two of the articles reported on qualitative studies involving inductive data analysis of data collected during interviews with their participants. Four of the six articles reported on quantitative surveys. All of the studies were conducted in developed countries, with three conducted in the USA, two in Canada and one in Australia. Two of the studies focused only on augmentative and alternative communication, one focused on computers, while three looked at general AT.

Critical Appraisal Results

All of the quantitative studies were categorised to be on level 3 (non-experimental descriptive studies) of the Lloyd-Smith hierarchy (Lloyd-Smith, 1997) and both qualitative studies were categorised on level 3 (descriptive studies) of the hierarchy proposed by Daly et al. (2007).

Table 1. *Summary of included articles*

Author	Aim of study	Sample	Setting	Type of AT	Methods	Summary of results
Chmiliar (2007)	Determining levels of, and satisfaction with, training in AT; funders of AT; Barriers associated with AT; Importance and availability of support strategies	Teachers (n = 129), SLP (n = 32), Health professionals (OT or PT according to the article) (n = 87)	Province of Alberta, Canada	General AT	Quantitative: Survey Different surveys distributed to each professional group - teachers, health professionals, and SLPs	Data presented from the SLP group was analysed. 6% of SLPs indicated that they felt very proficient in aspects related to AT, and only 6% were very satisfied with their skills related to AT. The percentage of time a specific support was rated as significant by the SLPs: Funding (81%); Time to set up AT (78%); Availability of training (75%); Access to expert support (72%) Availability of equipment (73%)
Iacono & Cameron (2009)	Exploring the knowledge, perceptions of SLPs about AAC, evidence-based practice, and barriers to AAC practice.	SLP (n=14)	SLPs that provide early childhood intervention services in Victoria, Australia	AAC	Qualitative: On-site group interview (n=6), Teleconference group interview (n=5) Individual phone interviews	Six main themes were generated through a process of inductive thematic analysis. These included perceptions of the use of AAC, best practice, the role of the family, barriers to implementation of AAC, clinical struggles as well as clinical experience. Each of the themes has at least one subtheme.

Author	Aim of study	Sample	Setting	Type of AT	Methods	Summary of results
					(n=2) Individual on-site interview (n=1)	
Lahm & Sizemore (2002)	To determine the approaches that professionals take in arriving at decisions about AT. Specific questions: Determining the amount of AT training; How AT decisions were made; Issues in AT service delivery; Perceived barriers.	Service providers employed in the Kentucky First Steps Programme, serving children 0 to 3years. Total (n=15); OT (n=1) SLP (n=6) Educator (n=2) AT supplier (n=4) AT practitioner (n=2)	All participants were providers employed by the Kentucky First Steps Programme in Kentucky, USA.	General AT	Quantitative: Survey	The level of training of all of the participants was reported. Several issues and perceived barriers were reported per discipline. As example 100% of OTs indicated that family/client demands were extremely important, with 66% of SLPs finding it extremely important, 17% indicating that it is of moderate importance and 17% stating it is of little importance.
Lindsay (2010)	Exploring the challenges that health care providers experience in prescribing AT to children with	SLP (n=7) OT (n=7)	Children's Rehabilitation Hospital in Ontario, Canada.	AAC	Qualitative: Individual interviews	Three main themes were generated through inductive thematic analysis. These included the barriers (including technical, social and political), the personal philosophy of technology, as well as recommendations made

Author	Aim of study	Sample	Setting	Type of AT	Methods	Summary of results
						disabilities. regarding improving the prescription process.
Reed & Kanny (1993)	Determining the application of computer technology in assessment and intervention; OT's perceptions regarding advantages, disadvantages of computer technology for children; Perceived barriers to using technology in interventions; Training needs in this area.	OT (n=78)	OTs employed within the public school system. Washington State, USA.	Computer technology applications	Quantitative: Survey	The study reported OTs' use of computer technology with children on their caseload: 75.6% of OTs used it with 1-25% of children on their caseload, 16.7% (26-50% of caseload); 2,6% (51-75% of caseload) and 1,3% (76-100% of caseload). Article reports on specific factors considered when deciding to use computers, including their own familiarity with the AT (69%), and previous use with a child with a specific diagnosis (84%). Characteristics of the AT, such as portability (44%) and availability for trial (51%) were mentioned as changes needed to enable OTs to use computers more often.
Wilcox et al. (2006)	Determining Early Intervention (EI) provider perspectives on AT use in their EI practices; Beliefs and	n= 922 from selected states n= 45 responded to web recruitment notices from 20	EI providers in representative sample from USA. Selected states: West/Southwest (California,	General AT	Quantitative: Survey	Results discussed extensively. Indication given of AT use, as well as provider definitions of low and high technology. Provider beliefs about AT were reported. One example is that SLPs are more likely than other disciplines to

Author	Aim of study	Sample	Setting	Type of AT	Methods	Summary of results
	factors that may influence EI providers' decision-making about AT; Perceived access to resources that support AT use; Differences in stated aims in terms of specific disciplines or the amount of training about AT that EI providers report receiving.	additional states Total (n=967) OT(n=189) PT(n=187) SLP(n=214) Child development specialist/teacher (n=284) Other (n=93)	Arizona, Texas), Northwest (Oregon), Midwest (Kansas, Illinois, Michigan, Missouri), South/Southeast (Georgia, Louisiana), and Northeast (Pennsylvania, Massachusetts)			agree that young children should have certain skills before they are able to use AT. Providers rated the importance of different factors in the AT recommendation process. These were reported per discipline. The respondents reported their access to resources: A lot (23.6%); Some (48%); Only a few (25.3%); No resources (2.3%). Several analyses were conducted e.g. regarding the belief and provider discipline.

Table 2. *Appraisal of Qualitative Articles*

Author and year	Design and level of evidence ^a	Qualitative appraisal ^b				Total score
		Relevance of sources of data	Relevance of analysis of data	Appropriate consideration of how findings relate to context	Appropriate consideration of how findings relate to researchers influence	
Iacono & Cameron (2009)	Descriptive qualitative Level 3	1	1	0	0	2(50%)
Lindsay (2010)	Descriptive qualitative Level 3	1	1	0	0	2(50%)

Note. 1=present, 0=absent. Percentages calculated by dividing the number of criteria an article met, by four and multiplying by a hundred. Therefore, when one criterion is met, the score is 25%, when all four are met, the score would be 100%.

^aAccording to hierarchy of Daly et al., (2007). ^bThe qualitative subsection of the Mixed Methods Appraisal tool (MMAT, 2011) (Pluye, Robert, Cargo, & Bartlett, 2011) was used for qualitative appraisal

Table 3. *Appraisal of Quantitative Articles*

Author and year	Design and level of evidence ^a	Quantitative descriptive appraisal ^b				Total score
		Relevance of sampling strategy	Representativeness of sample	Appropriateness of measurement instrument (validity, clear origin, etc.)	Acceptability of response rate (60% or above)	
Chmiliar (2007)	Non experimental descriptive Level 3	1	1	0	0	2 (50%)
Lahm & Sizamore (2002)	Non experimental descriptive Level 3	0	0	0	1	1 (25%)
Reed & Kanny (1993)	Non experimental descriptive Level 3	1	1	0	1	3 (75%)
Wilcox et al.(2006)	Non experimental descriptive Level 3	1	1	0	0	2 (50%)

Note. 1=present, 0=absent. Percentages calculated by dividing the number of criteria an article met, by four and multiplying by a hundred. Therefore, when one criterion is met, the score is 25%, when all four are met, the score would be 100%.

^aAccording to hierarchy of Lloyd-Smith (1997). ^bThe quantitative subsection of the Mixed Methods Appraisal tool (MMAT, 2011) (Pluye, Robert, Cargo, & Bartlett, 2011) was used for quantitative appraisal.

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The appraisal of the qualitative articles using the Mixed Methods Appraisal tool (MMAT, 2011) (Pluye, Robert, Cargo, & Bartlett, 2011), is shown in Table 2. The summary of the appraisal of the quantitative articles is shown in Table 3.

The qualitative studies each met two of the four criteria set in the MMAT. The studies did include relevant sources of data as well as appropriate data analysis. However, neither of the qualitative studies provided appropriate consideration for how their findings related to the particular context that was studied, or how the findings related to the influence of the researchers themselves. Regarding the quantitative appraisal, the studies met between one and three of the four criteria set in the quantitative part of the MMAT. A concern identified across all four quantitative studies was the appropriateness of the measurement instrument. Although studies differed in the rigour with which validity and reliability of the survey instruments were determined, none met the high standards set by the appraisal tool. This could negatively influence the quality of the results obtained in the studies.

Data Synthesis

In Tables 4, 5, 6 and 7 the results of the data synthesis are provided. The tables provide each theme as operationalized from the ATD Selection Framework (Scherer et al., 2007) as well as subthemes identified by inductive thematic analysis. Studies mentioning each subtheme are also specified. The additional theme identified during thematic analysis (Assistive technology), together with its subthemes are also included.

Environmental factors (Including themes 1 to 3). The cultural and financial priorities from the environment (theme 1) (interpreted as influences from the macro systemic environment) were only mentioned by participants in the study by Lindsay (2010). Environmental factors relating specifically to legislation and policy (theme 2) were also mentioned in this article and one quantitative article (Wilcox et al., 2006). The attitudes of key others toward the AT (theme 3) was mentioned in three articles (Iacono & Cameron,

Table 4. *Identification of Three Themes and Respective Subthemes related to Environmental Factors in the Selected Studies*

	Cultural and financial priorities (theme 1)	Legislation and policy (theme 2)			Attitudes of key others (theme 3)			
	Ethno- cultural factors	Policy	Prescription guidelines	Fragmentation between departments	Excessive red tape	Attitudes of parents & family	Attitude of teachers	Social acceptability
Iacono & Cameron (2009)	-	-	-	-	-	✓	-	-
Lindsay (2010)	✓	✓	✓	✓	✓	-	✓	✓
Chmiliar (2007)	-	-	-	-	-	-	-	-
Lahm & Sizamore (2002)	-	-	-	-	-	-	-	-
Reed & Kanny (1993)	-	-	-	-	-	-	-	-
Wilcox et al (2006)	-	✓	-	-	✓	✓	-	-

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2009; Lindsay, 2010; Wilcox et al., 2006). This would indicate that participants in the remaining quantitative articles were not asked about attitudes of key others as influencing AT.

Personal factors (Including themes 4 to 7). Tables 5 and 6 show the themes and subthemes unpacking the personal factors of the child, family and provider that influence ATD selection. Resources (Table 5) pertaining to family, friends and significant others (theme 4), as well as financial resources were discussed in all the papers. The resource of time, for example time required to teach families to use a device (Iacono & Cameron, 2009), was identified as a subtheme. This implies that rehabilitation professionals consider the time it will take them to teach AT during the selection process.

The knowledge theme (theme 5) included subthemes of training, experience and knowledge specifically of AT assessment and best practice, which were each mentioned in four of the six articles. This would imply, for example, that how long a professional has been working in the field of AT (Lahm & Sizemore, 2002) or their training on AT (Chmiliar, 2007) would influence the AT that they select. The perceptions of professionals regarding their own skill levels (self-efficacy) was identified as a subtheme. The implication of this would be that professionals' confidence in their own skills influence the AT they recommend. The theme of expectations (theme 6) did not include many items, with only a few noted between the different articles - particularly related to the expectation of families and teachers. In the article by Wilcox et al. (2006) it was indicated, for example, that a parent's expectations of a child could influence the likeliness of AT being listed on a child's Individualised Family Service Plan. Although the expectations of families and teachers were perceived to influence the provision of AT to children, the expectations of the child themselves were not mentioned in the qualitative articles or asked about in the quantitative articles. Personal preferences and priorities (theme 7) of both the provider as well as the

Table 5. *Identification of the Theme Resources and Respective Subthemes in the Selected Studies*

	Resources (theme 4)					
	Funding and funders	Availability of time	Expert/mentor support	Teamwork/support from co-workers	Social support	Sustained professional support
Iacono & Cameron (2009)	-	✓	-	✓	-	-
Lindsay (2010)	✓	✓	✓	-	✓	✓
Chmiliar (2007)	✓	✓	✓	-	✓	-
Lahm & Sizamore (2002)	✓	-	✓	✓	-	-
Reed & Kanny (1993)	✓	✓	-	-	-	-
Wilcox et al (2006)	✓	-	-	✓	-	✓

Table 6. *Identification of the Themes Knowledge, Expectations and Personal Preferences and Priorities and related Subthemes in the Selected Studies*

	Knowledge & information (theme 5)				Expectations (theme 6)		Personal preferences & priorities (theme 7)		
	Experience	Training	Knowledge of AT		Expectations of parents/ family	Expectations of teachers	Preferences of professionals	Preferences of family	Conflict between the two
assessment			Self-efficacy						
Iacono & Cameron (2009)	-	-	✓	✓	✓	-	-	-	✓
Lindsay (2010)	✓	-	-	-	✓	✓	✓	✓	✓
Chmiliar (2007)	-	✓	-	✓	-	-	-	-	-
Lahm & Sizamore (2002)	✓	✓	✓	-	-	-	✓	✓	-
Reed & Kanny (1993)	✓	✓	✓	-	-	-	-	-	-
Wilcox et al (2006)	✓	✓	✓	-	✓	-	✓	✓	-

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family were mentioned (n=3), while the two qualitative articles referred to conflict and tension between what parents would like for their child, and what the providers are able/willing to recommend. The preferences of the child (in addition to their expectations) were not mentioned, which could have implications for the acceptance of the AT by the child themselves.

Assessment (theme 8). Table 7 unpacks the theme of assessment, with the subthemes created by the authors, including assessment of the child characteristics, (for example diagnosis) mentioned in four of the articles. The subtheme of physical environment (demands of the environment as well as the environment of assessment), activity, as well as goodness of fit between device and the child and family in need of the device, was each mentioned twice. This illustrates that rehabilitation professionals do consider aspects regarding assessment when recommending AT.

Assistive technology (theme 9). Although the ATD Selection Framework (Scherer et al., 2007) does not describe the assistive technology itself as something to be considered separately, this theme was added during the process of thematic analysis as items referring to this theme did not fit elsewhere. Firstly, it was mentioned that the characteristics of the device itself influenced its provision, for example, whether it was easy to set up or portable (for example in Reed & Kanny, 1993). The availability of the AT for trial was mentioned in three of the articles, with ease of maintenance of the AT mentioned once. Therefore the AT itself and whether it is available for trial will influence the recommendation by a rehabilitation professional.

Table 7. *Identification of the Themes Assessment and Assistive Technology and related Subthemes in the Selected Studies*

	Assessment (theme 8)					Assistive technology (theme 9)		
	Assessment of child characteristics	Assessment approach of the provider	Environment	Activity	Goodness of fit between device and user	Device characteristics	Availability of AT, also for trial	Ease of maintenance
Iacono & Cameron (2009)	✓	✓	-	-	-	-	-	-
Lindsay (2010)	✓	-	-	-	✓	✓	-	✓
Chmiliar (2007)	-	-	-	-	-	-	✓	-
Lahm & Sizamore (2002)	✓	-	✓	✓	-	-	-	-
Reed & Kanny (1993)	-	-	-	-	-	✓	✓	-
Wilcox et al (2006)	✓	✓	✓	✓	✓	-	✓	-

Note: The theme "Assessment" was a combination of "assessment of functional ATD need" and "assessment of functional ATD disposition" as specified in the ATD Selection framework(Scherer, Jutai, Fuhrer, Demers, & Deruyter, 2007, p. 4)

The theme Assistive Technology did not originate from the ATD Selection Framework (Scherer, et al., 2007). It was generated during thematic analysis.

Discussion

Both qualitative and quantitative data were synthesised in this review. These data types complemented each other in both broadening and deepening the understanding of this topic.

By synthesising data from empirical studies according to the ATD Selection Framework (Scherer et al., 2007) both the existing theoretical framework as well as the data available from empirical studies on this topic can be better understood, and gaps in the theoretical and the empirical knowledge base can be highlighted to guide further developments in this field.

On the one hand, the identification of the additional theme (AT) could indicate the need to expand and revise the theoretical framework. The identification of subthemes could facilitate a more detailed understanding of the different components of the framework. Each subtheme can be viewed as a factor influencing the selection of AT by rehabilitation professionals.

On the other hand, the data synthesis has also made it possible to identify gaps in the empirical knowledge base that should be addressed in future studies. For example, the review highlighted the relatively infrequent mention of macro systemic and cultural factors particularly in the quantitative articles, although the influence of these factors form an integral component of the ATD Selection Framework (Scherer et al., 2007), and have also been described in other theoretical models, for example the Human Activity Assistive Technology (HAAT) model (Cook & Polgar, 2008). Therefore, more studies should investigate the influence of these factors on AT selection.

Overall, it seems that a closer articulation of theoretical and empirical knowledge bases is desirable when studying AT provision. Empirical studies should pertinently set out to

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test the models that have been developed, and this information in turn should feed into the process of adjusting and updating the models developed.

As family-centered help giving practices (Dunst, Trivette, & Hamby, 2007) and family-centered AT decision making (Judge & Parette, 1998; Parette et al., 2000; Parette & Scherer, 2004) have been described as best practice when providing intervention to children it is important to view not only the child, but the family as the consumer of recommended AT. From a family-centered perspective, it is to be expected that the family's expectations and preferences should be considered in the AT selection process, as was reflected in the data. However, through the synthesis of the data, it became clear that the perspective and expectations of the child in need of the AT was not frequently mentioned as a factor influencing AT provision. While it is positive that the perspectives of the family are considered, the opinion of the child him-/herself should not be forgotten, as this could contribute to their satisfaction and ultimate utilisation of the AT. Rehabilitation professionals should focus on ensuring children's participation in the AT selection process as far as possible.

Furthermore, the review highlighted the important role the personal factors pertaining to the professional him-/herself play in the AT selection process. Training on topics related to AT can increase knowledge in this field and could improve the ability and confidence of rehabilitation professionals in recommending AT. Professionals should consider also how their own preferences regarding technology and specifically AT, could influence the children and families to whom they provide services.

This review has several limitations. First, very few relevant studies were identified. It is possible that by including additional data bases, more articles could have been identified. Second, the studies that were identified employed descriptive methodologies that are regarded as presenting a lower level of evidence. They also had methodological shortcomings

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that further reduced the quality of the information that could be gleaned from them. These limitations preclude strong recommendations for practice emerging from this review but also highlight the urgent need for well-designed studies employing methodologies that produce a higher level of evidence regarding factors that influence professionals in their selection of AT.

The review highlights that a multitude of factors can influence AT selection and provision, including environmental factors and factors related to the key role players in this process (child, family, and rehabilitation professionals). By becoming aware of these factors, rehabilitation professionals can identify and possibly also address some of the barriers to appropriate AT selection and provision for young children, in order to maximise their participation.

Declaration of interest

The authors report no conflict of interest.

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Appendix 1. *Definitions of themes for deductive thematic analysis with examples from text*

Theory driven theme	Definition	Examples of coding from text
Theme 1: Cultural & Financial priorities	Factors important to a specific culture or within a specific financial climate/society. Factors on a macro level. Cultural aspects refer to "specific patterns of behaviours and values (such as the provision of care) that are shared among members of a designated group and are distinguishable from those of other groups. Culture includes, but is not limited to, geographic origin, language, traditions, values, religion, food preferences, communication, education, and lifestyle" (Scherer, Jutai, Fuhrer, Demers, & Deruyter, 2007, p.4).	"Ethno-cultural" factors are reported to influence use of AAC (Lindsay, 2010) .
Theme 2: Legislation & Policy	Any mention of legislation (laws)/policy. Mention of red tape or bureaucracy.	Participants required to rate the importance of specific factors on a five-point scale (Question 5h): "Red tape or excessive requirements associated with using assistive technology for infants and toddlers"(Wilcox, Guimond, Campbell, & Weintraub Moore, 2006, p. 37).
Theme 3: Attitudes of key others	Attitudes of others – including family, stakeholders, team members Attitude has been defined as having three parts, namely cognitive (thoughts and ideas), affective (feelings and emotions) and behavioural (overt behaviours/behavioural intentions) regarding a specific object - in this case AT (Triandis, 1971).	"Attitudes towards the implementation of AAC" as well as "how negative attitudes were addressed" were subthemes identified (Iacono & Cameron, 2009, p. 240).
Theme 4: Resources	Resources available through family/friends, including team members, mentors, technicians. This includes finances available to pay for AT, from	"Do you work with others that are the same discipline as yourself when making decisions about AT" (Lahm

Theory driven theme	Definition	Examples of coding from text
(Family & Friends & significant others; Financial)	consumer, government, medical aid, funders etc. Any mention of time taken to assess/teach AT to family was included as a resource.	& Sizemore, 2002, p. 26).
Theme 5: Knowledge and information	Knowledge & information regarding AT – including experience. Self efficacy was added here and refers to a person’s belief in his/her ability to successfully complete actions in any given domain (Bandura, 1995).	SLPs were required to rate their satisfaction with their "current skills and knowledge" (Chmiliar, 2007).
Theme 6: Expectations	Consumers & providers bring expectations to the process that are internal and external. They carry the expectations of their culture, parents, spouses, employers, peers, and society in general".(Scherer et al., 2007, p.5).	Participants requested to indicate on a 5 point scale how likely they are to list AT on a IFSP (Question 4f) when "There is a change in the parent's expectations for the child"(Wilcox et al., 2006, p. 37).
Theme 7: Personal preferences and priorities	"Beyond the expectations placed on consumers from external sources are expectations they place on themselves due to prior history with ATDs, their particular level of motivation, judgment, and outlook, and many other factors that serve to combine in a way defining each of us as unique individuals. These influences include personality and temperament characteristics (such as degree of self-determination and self-confidence, anxiety and depressed mood) serve to determine our preferences and priorities" (Scherer et al., 2007, p.6).	The SLPs indicated that "the priority that communication takes compared to the other health problems" to the family will influence the use of AAC (Lindsay, 2010, p.214).
Theme 8: Assessment	This theme was created by combining two components of the ATD Selection Framework (assessment of functional AT need and functional AT	Rating of the importance to AT decision making of the "demands of environment" and "client diagnosis"

Theory driven theme	Definition	Examples of coding from text
Theme 9: Assistive technology	<p>disposition) (Scherer et al., 2007), as it proved to be very challenging to distinguish between these two separately. All aspects influencing the actual face-to-face assessment included here e.g. environmental demands, e.g. terrain: client characteristics & diagnosis, aspects related to feature matching.</p> <p>Including all issues that are considered that pertains primary to the AT itself. Also including the availability of AT for trails.</p>	<p>(Lahm & Sizemore, 2002, p.26).</p> <p>Reasons for not using computers with clients included : "...lack of access to this equipment in the typical treatment areas..."(Reed & Kanny, 1993).</p>