A bird's eye view of speechBITE™

What do we see?

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speechBITE™ is a freely available online database of published intervention studies (currently n = 3550) sourced from eight research databases (e.g., Medline, CINAHL). It is designed to provide better access to the growing intervention research relevant to speech pathology practice. In this paper, the contents of the research studies contained in speechBITE™ have been synthesised to describe the scope of the database. This paper presents the frequency of research studies across target areas of intervention, intervention type, service delivery method, research design/method, client subgroup/ etiology and age group using the search heading categories of speechBITE™. The authors also consider the changing profile of research design in intervention studies across time. The findings provide clinicians with an overview of the scope of the intervention research literature relevant to speech pathology practice.

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THIS ARTICLE HAS BEEN PEER-REVIEWED

Evidence based practice (EBP) involves clinical decision-making that incorporates the most current and relevant evidence published in the peer-reviewed literature, clinical expertise/data, client expectations and values and organisational context (Hoffmann, Bennett & Del Mar, 2010). Being confident that a selected intervention works is a primary concern for the evidence based clinician. Key components to undertaking EBP include accessing and critiquing an ever-increasing number of intervention studies (see Dollaghan, 2007 for an outline of the EBP process) and understanding the relative strength of the evidence presented with different methodologies. This can be a difficult and time-consuming responsibility for clinicians (Togher et al., 2009).

speechBITE™ is a freely available online EBP resource that can assist clinicians with both accessing and critiquing intervention studies. It is a database of published intervention studies sourced from a variety of research databases (e.g., Medline, CINAHL) relevant to the scope of speech pathology practice (see Smith et al., 2010). The database received over a million hits in 2012 and was accessed by individuals in 120 countries, with the top five being Australia, USA, UK, Germany and Canada.

Intervention studies within speechBITE™ are categorised according to a range of parameters. These include;

1. the target area of speech pathology practice (speech, language, voice, fluency, swallowing and literacy). These areas mostly reflect the Speech Pathology Australia competency-based occupational standards (CBOS; Speech Pathology Australia, 2011). Multimodal was not a target area at the inception of speechBITE™ and is therefore not currently catalogued while literacy was included to enhance usability for private practitioners;
2. the intervention type (e.g., language therapy). For a full listing of intervention types, see the speechBITE™ website (www.speechbite.com) or Table 1 in Smith et al. (2010);
3. the service delivery method (e.g., individual/consultation-collaboration);
4. the research method or design (e.g., randomised control trial);
5. the client subgroup, or etiology (e.g., cerebral palsy); and
6. the age group of participants in the study (e.g., school-aged children).

These index categories allow clinicians to perform individual customised searches relevant to their clinical practice. Papers are included in speechBITE™ if they meet four criteria: the paper needs to be a full-length paper in a peer-review journal; the populations must have or be at risk of having a communication or swallowing disorder/s; treatment is part of speech pathology practice or could become part of speech pathology practice but need not be carried out by speech pathologists; and the paper needs to include the evaluation of at least one intervention which contains empirical data regarding treatment efficacy. Following the application of these inclusion criteria (see Smith et al., 2010 for more details) the paper is indexed according to a protocol by speechBITE™ staff.

When a clinician searches the speechBITE™ database, their search will reveal a list of relevant articles with author, study title and year of publication. This list is organised by research design/method and rating score. The range of research designs includes systematic reviews (SRs), randomised controlled trials (RCTs), non-RCTs, single-case experimental designs (SCEDs) and case series (CSs) (see http://www.speechbite.com/about.php for a description of these research designs). Clinicians can draw some conclusions about the relative strength of intervention studies from the research design used in the paper.

Natalie Munro (top), Emma Power (centre) and Kate Smith

Additionally, RCTs and non-RCTs are rated for methodological quality by a team of trained raters using the Physiotherapy Evidence Database – PsycBITE™ (PEDro-P) scale (Perdices, Savage, Tate, McDonald, & Togher, 2009). These ratings further assist clinicians to appraise the methodological quality of research studies (for example, whether or not the study randomly allocated participants or had a blinded assessor for the pre and post intervention assessment tasks). Recently, Murray et al. (2012) conducted a reliability study on the first 100 RCTs and non-RCTs methodological ratings and showed that these ratings were reliable.

speechBITE™ uniquely provides a comprehensive database of intervention studies across our scope of practice. While other databases focus on specific areas of practice (e.g., PsycBITE™: Acquired brain injury, Togher et al., 2009), to date, there has not been a broader database to examine the speech pathology profession's evidence base. Additionally, because speechBITE™ includes a wider variety of research designs (e.g., single case experimental designs), it represents a broader collation of intervention research than other databases (e.g., Cochrane Library: http://www.thecochranelibrary.com). Therefore, examination of the content of the speechBITE™ database offers the opportunity to describe the scope and extent of the current state of play of intervention research relevant to the speech pathology profession.

This paper provides a bird's eye view of the landscape of speech pathology intervention research. Descriptive data is presented for the 3550 research papers contained within speechBITE™ according to the following parameters: target area across our scope of intervention practice; intervention type, service delivery method, research method or design, major etiologies and client age. In order to assist clinicians to contextualise the current state of research within their main area of practice, research design has then been cross-tabulated with target area, etiology, intervention type over time. Given the ever-increasing number of studies being published each year (Bastian, Glasziou & Chalmers, 2010), trends in the type of research designs being published over the last 10 years are examined to determine the nature of this increase in the speech pathology evidence base.

(Top to bottom) Melissa Brunner, Leanne Togher, Elizabeth Murray and Patricia McCabe

Gaining a bird's eye view of speechBITE™

The following descriptive analysis is based on all 3550 indexed research papers that had been added to the speechBITE™ database since its inception in May 2008 until 7 Nov. 2012. This included studies that were published from 1951 to 2012. References for the database are stored and managed utilising FileMaker Pro (Version 11) software and all references were retrieved from the database and exported into a Microsoft Excel™ worksheet. Each retrieved reference was accompanied by data on each of the indexing parameters identified above (e.g., target area, etiology) and also year of publication. Descriptive statistics including frequency counts and percentages were then calculated to provide an understanding of the relative frequency of categories within the parameters, for example, the number and percentage of studies that represented each type of target area (speech, language, voice, fluency, literacy, swallowing). As some papers may investigate more than one area (e.g., language *and* speech) or several service delivery types (e.g., individual compared to group), in some sections of this overview, the total number of speech pathology intervention areas exceeds the total number of listed papers examined (n = 3550).

What does speechBITE™ look like?

Target areas across our scope of intervention practice

Of the papers contained in the speechBITE™ database, language was the most reported area of intervention research (*n* = 1717, 43%). The number of papers indexed for developmental versus acquired language impairment was comparable. The next most researched area was literacy (*n* = 822, 21%), followed by speech (*n* = 494, 12%), voice (*n* = 377, 9.6%), swallowing (*n* = 402, 10%) and fluency (*n* = 100, 3%).

Intervention type

The most common types of intervention were: language therapy (*n* = 1378, 41%), literacy and pre-literacy intervention (*n* = 780, 23%), assistive devices and technological interventions (*n* = 412, 12%), speech/articulation/phonological therapy (*n* = 391, 11%), and voice therapy (*n* = 345, 10%). Table 1 reports the number and frequency of other intervention types.

Table 1. Number of intervention papers per intervention type listed in speechBITE™

Intervention type	Number	%
Language therapy	1,378	41
Literacy and pre literacy intervention	780	23
Assistive devices and technological interventions	412	12
Speech/articulation/phonological therapy	391	12
Voice therapy	345	10
Swallowing/feeding intervention	335	10
Surgical	337	10
Augmentative/alternative therapy	310	9
Computer based intervention	263	8
Pharmacological	236	7
Other	214	6
Education	105	3
Fluency/stuttering therapy	102	3
Complementary therapies	61	2
Aural habilitation	58	2
Counselling	27	1

Service delivery trends

Individual intervention was the most frequent service delivery option reported. Seventy percent (*n* = 2988) of the intervention papers described individual service delivery and 16% (*n* = 671) described group service delivery. Educator/parent/caregiver or peer intervention was reported in 12% of studies (*n* = 521) while consultation/collaboration models were identified in 2% (*n* = 83) of papers. Distance (or telehealth) models of intervention represented just 0.5% of papers (*n* = 23).

Types of research design

Overall, the majority of studies in speechBITE™ were SCEDs (*n* = 1487, 42%) followed by CSs (*n* = 778, 22%), RCTs (*n* = 645, 18%), and non-RCTs (*n* = 395, 11%) while SRs were the least represented (*n* = 245, 7%).

The major etiologies

The range of etiologies represented in intervention papers within speechBITE™ is presented from largest to smallest in number (see Table 2). Common client etiologies represented within speechBITE™ included: stroke/cerebrovascular accident (CVA) (*n* = 743, 17%), autism spectrum disorders (*n* = 438, 10%), intellectual disability (*n* = 305, 7%) and traumatic brain injury (TBI) (*n* = 201, 5%). However, "other/not specified" etiologies represented the largest group (*n* = 1276, 30%). The high proportion of the "other/not specified" client etiology occurs as several target areas including developmental disorders of speech and language have no known cause and as such cannot be indexed in this parameter. The larger numbers within this category compared to autistic spectrum disorders for example, also reflect the inclusion of studies where the participants being treated are "at risk". This occurs more frequently in the areas of early literacy and language, voice disorders and fluency disorders.

Table 2. Number of intervention papers per etiology listed in speechBITE™

Etiologies	Number	%
Other/not specified	1,276	30
Stroke/CVA	743	17
Autistic spectrum disorders	438	10
Intellectual disability	305	7
Traumatic brain injury	201	5
Cerebral palsy	167	4
Degenerative disorders/diseases	162	4
Congenital syndromes	161	4
Hearing and visual impairment	160	4
Neurological conditions	133	3
Cancer	117	3
Alzheimer's and other dementias	111	3
Cleft lip/palate and craniofacial abnormalities	72	2
Attention deficit disorder	55	1
Neonatal conditions	44	1
General medical	42	1
Gastrointestinal conditions	39	1
Mental health	38	1
Laryngectomy	27	1
Gerontology	15	<1
Tracheostomy	10	<1
Respiratory conditions	8	<1

Age

Forty percent (*n* = 1770) of intervention studies targeted adults, while children aged between 5–12 years represented 30% (*n* = 1327) of the research. Intervention studies of children under 5 years of age (*n* = 656, 15%) and studies involving adolescents (*n* = 513, 11%) followed. The proportion of treatment studies for children less than two years of age was limited (*n* = 176, 4%).

Number of publications by year

Publication numbers are increasing over time, with 595 (16%) publications collected from between 1951 and 2000, 378 (10%) publications for the period 2000–03, 980 (26%) for 2004–07, and 1619 (44%) for 2008–11. At the time of analysis, 141 (4%) publications had been added for 2012. However, further studies from 2012 were still to be uploaded at the time.

Investigation of research design

The most common research design used within speech, language and literacy interventions was single case experimental design (SCEDs) (47%, 54% and 36% respectively). The most common research design utilised in the remaining target areas of voice, fluency and swallowing was case studies (CS) (49%, 38% and 32%). Table 3 outlines research designs for studies listed in speechBITE™ by main target area, etiology, intervention type and publication year.

In terms of etiology, SCEDs dominated the top five client etiologies (intellectual disability: *n* = 206, 68%; ASD: *n* = 262, 60%; stroke/CVA: *n* = 435, 59%; TBI: *n* = 100, 50% and other: *n* = 361, 28%). The remainder of client etiologies was dominated by either SCEDs or CSs designs. There were exceptions to the predominate use of SCEDs and CS in neonatal conditions and tracheostomy client etiologies. These etiologies had a high proportion of RCTs and non-RCTs respectively, in addition to SCEDs.

In terms of research design and intervention type, Table 3 identifies SCEDs as the most frequently reported design for four of the five top intervention types (language therapy: *n* = 753, 55%; speech/articulation/phonological therapy: *n* = 197, 50%; assistive devices and technological interventions: *n* = 214, 49%; literacy and pre-literacy intervention: *n* = 286, 37%) with the exception of voice which had mostly CSs (*n* = 165, 48%). The remainder of intervention types was either SCEDs or CSs. The exception for intervention type was complementary therapies and education (of clients/staff), with RCTs the largest proportion of research designs for these two groups in addition to SCEDs and CSs.

Finally, chronological change and research design is reported in Figure 1. All types of study designs increased in frequency over the time period. Visual inspection of the yearly data specifically for the period 2000–11 revealed a number of trends (Figure 1). Across all designs, publication rate was stable during 2000–05, with each design increasing in relative frequency from 2006. SRs increased during 2006–09 but appeared to plateau from 2010; RCTs increased from 2006 onwards and overtook SCEDs in 2011 in frequency; non-RCTs increased in the period 2005–11; CSs plateaued from 2007 and SCEDs increased substantially until a peak and subsequent drop off from 2008.

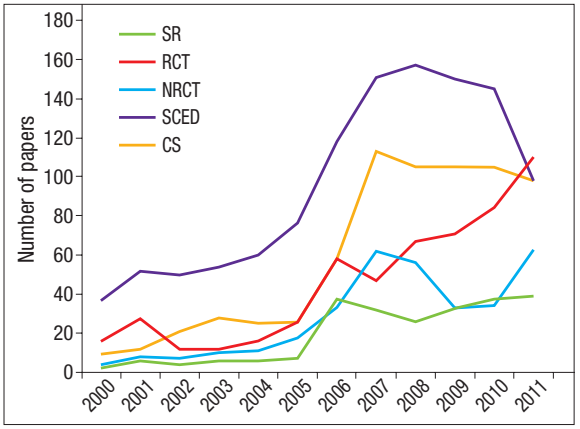

Figure 1. Number of papers listed in speechBITE™ according to year of publication from 2000–2011 and research design

Note: SR = systematic review, RCT = randomised controlled trial, NRCT = non-randomised controlled trial, SCED = single-case experimental design and CS = case series.

Table 3. Research design of papers listed in speechBITE™ by target area, etiology and intervention type and year of publication

Variable	Systematic reviews (SRs)		Randomised controlled trials (RCTs)		Non-RCTs		Single case experimental designs (SCEDs)		Case series (CSs)	
Main target area	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Speech	38	8	51	10	54	11	**233**	**47#**	118	24
Language	113	7	276	16	145	8	**933**	**54#**	250	15
Voice	19	5	50	13	52	14	71	19	**184**	**49#**
Fluency	4	4	16	16	9	9	33	33	**38**	**38#**
Swallowing	54	13	101	25	40	10	77	19	**130**	**32#**
Literacy	42	5	217	26	146	18	**300**	**36#**	117	14
Etiology (Client subgroup)										
Alzheimer's and other dementias	7	6	34	31	12	11	**41**	**37#**	17	15
Attention deficit disorder	3	6	6	11	7	13	**28**	**52#**	10	19
Autistic spectrum disorders (3)	45	10	59	13	30	7	**262**	**60#**	42	10
Cancer	9	8	25	21	23	20	11	9	**49**	**42#**
Cerebral Palsy	23	14	15	9	8	5	**87**	**52#**	34	20
Cleft lip/palate and craniofacial abnormalities	9	13	8	11	13	18	11	15	**31**	**43#**
Congenital Syndromes	13	8	19	12	12	7	**93**	**58#**	24	15
Degenerative disorders/diseases	24	15	29	18	10	6	34	21	**65**	**40#**
Hearing and visual impairment	10	6	12	8	19	12	**64**	**40#**	55	34
Gerontology	0	0	1	7	1	7	4	27	**9**	**60#**
Intellectual disability (4)	23	8	23	8	20	7	**206**	**68#**	33	11
Laryngectomy	2	7	4	15	8	30	4	15	**9**	**33#**
Mental health	2	5	2	5	1	3	**26**	**68#**	7	18
Neurological conditions	18	14	8	6	11	8	**61**	**46#**	35	26
Gastrointestinal conditions	3	8	9	23	1	3	7	18	**19**	**49#**
Respiratory conditions	1	13	**3**	**38#**	1	13	0	0	**3**	**38#**
Stroke/CVA (2)	42	6	87	12	40	5	**435**	**59#**	139	19
General medical	3	7	3	7	4	10	14	33	**18**	**43#**
Neonatal conditions	8	18	**14**	**32#**	3	7	13	30	6	14
Tracheostomy	0	0	1	10	**4**	**40#**	2	20	3	30
Traumatic brain injury (5)	23	11	22	11	14	7	**100**	**50#**	42	21
Other/not specified (1)	85	7	319	25	209	16	**361**	**28#**	302	24
Intervention type										
Speech/articulation/phonological therapy (4)	31	8	41	10	40	10	**197**	**50#**	82	21
Language therapy (1)	89	6	210	15	121	9	**753**	**55#**	205	15
Fluency/stuttering therapy	3	3	16	16	8	8	37	36	**38**	**37#**
Swallowing/feeding intervention	47	14	82	24	31	9	71	21	**104**	**31#**
Voice therapy (5)	19	6	47	14	46	13	68	20	**165**	**48#**
Literacy and pre literacy intervention (2)	41	5	208	27	136	17	**286**	**37#**	109	14
Computer based intervention	16	6	58	22	29	11	**111**	**42#**	49	19
Augmentative/alternative therapy	37	12	15	5	13	4	**214**	**69#**	31	10
Assistive devices, technological interventions (3)	23	5	61	14	40	9	**214**	**49#**	103	23
Surgical	28	8	34	10	51	15	49	15	**175**	**52#**
Pharmacological	27	11	67	28	15	6	42	18	**85**	**36#**
Counselling	6	22	3	11	3	11	**9**	**33#**	6	22
Complementary therapies	7	11	**27**	**44#**	5	8	6	10	16	26
Education	6	6	**32**	**30#**	14	13	25	24	28	27
Aural habilitation	1	2	9	16	10	17	12	21	**26**	**45#**
Other	23	11	50	23	40	19	**55**	**26#**	46	21
Publication period										
pre 2000 (earliest publication 1951)	14	2	75	13	56	9	**357**	**60#**	93	16
2000–03	18	5	68	18	29	8	**193**	**51#**	70	19
2004–07	82	8	147	15	125	13	**405**	**41#**	221	23
2008–11	136	8	332	21	188	12	**550**	**34#**	413	26

Note: Numbers in bold with # indicate the largest percentage design. In the first column, the most common client subgroups and interventions are indicated in **bold** with their ranked number listed in brackets (**number**). A glossary of client subgroup terms can be found on the search page within speechBITE.com

What does our bird's eye view tell us about intervention practice research?

This overview of the landscape of speechBITE™ revealed some interesting data. First, the major target areas of intervention and client etiology generally reflect areas of scope of practice identified in the Speech Pathology Australia (2011) CBOS document (e.g., speech, fluency, swallowing). Each area is represented by a body of research that clinicians can access to support their evidence based practice. While the new CBOS (Speech Pathology Australia, 2011) area of multimodal communication is not identified as a major target area for intervention within the target area search options, clinicians can access relevant intervention studies by searching under intervention type for augmentative/alternative therapy and assistive devices/technological interventions.

Second, at the end of 2012, the types of intervention and client etiologies reported appear to reflect the major areas of contemporary speech pathology intervention practice. Language and literacy intervention were most common, followed by assistive devices/technological interventions, speech/articulation/phonological therapy and voice and swallowing intervention. However, the higher percentage of language and literacy intervention studies indicates areas where multiple professions are contributing to the evidence base. For example, interventions in literacy for children come from a range of professions including education, psychology, and occupational therapy as well as speech pathology (e.g., Miller, Connolly and Maguire, 2012). Therefore, clinicians using speechBITE™ can gain information to support their practice about the efficacy of interventions from a wide range of practitioners.

Third, the major etiologies represented included stroke/CVA, ASD, intellectual disability, TBI, cerebral palsy, degenerative disorders/diseases and others. Perhaps the least informative result for etiology was the large percentage of "other/not specified" category. Given that language and literacy interventions were the most common intervention types contained in speechBITE™, it is likely that some studies are not coded with a specific etiology, such as studies that include children with language-based learning difficulties. In this situation clinicians could search the language target sub area of "specific language impairment" or they can search using the language intervention category and combine that with a keyword or age category. The website for speechBITE™ is currently being upgraded so that this issue will be rectified by removing the "other" category and replacing this with more specific terms to reflect etiologies being investigated (e.g., "at risk" populations).

Fourth, in terms of service delivery, individual service delivery predominated (70% of sample) relative to other service delivery options such as group interventions (16%), and educator/parent/caregiver or peer intervention models (12%). The predominance of individual service delivery intervention studies is perhaps not surprising. It could reflect the phase of research whereby intervention efficacy is still being established before effectiveness studies are completed that then address alternate service delivery options (Fey & Finestack, 2009).

Fifth, the number of published intervention studies each year is increasing. This indicates an increasing evidence base that speech pathologists are challenged to find, critique, interpret and disseminate to members of our own profession, other health professionals, clients, carers, and the public. There are also interesting trends over the period of 2000–11. For instance, RCTs increased in frequency (from 2006>) so much so that they surpassed the number of SCEDs for the year 2011. In a recent study, Hoffmann, Erueti, Thorning and Glasziou (2012) identified that the growth in research is evident in both the sheer number of articles and also in the number of journals. To illustrate this, they evaluated the number of journals required to locate 50% and 100% of RCTs and SRs, published in 2009 across a number of medical specialties. For neurological diseases, 114 journals were needed to identify 50% of RCTs while 896 journals were needed to locate 100% of RCTs. Fifty-three journals were needed to locate 50% of published SRs while 292 journals would locate 100% of SRs published that year. They identified that new developments are "increasingly scattered" and this "continuing expansion is both a blessing and a curse" (p. 1). Among their suggestions for managing this scatter, the authors call for "systems that cover sufficient journals and filter articles for quality and relevance". speechBITE™ searches eight databases, filters articles according to inclusionary criteria relevant to speech pathology practice and currently reports on the methodological quality of RCTs and non-RCTs, thus benefitting speech pathology clinicians and researchers alike. Hoffmann and colleagues (2012) also suggest the use of social media to highlight new research as another way for clinicians to keep abreast of developments. To this end, speechBITE™ utilises Twitter to share results (@speechBITE) and currently has approximately 1,200 followers and 1,000 tweets.

Future directions for speechBITE™ and evidence based practice

It is interesting to observe that SCEDs represented the most frequent research design for the main intervention target areas of speech, language and literacy intervention. While users of speechBITE™ can be confident in the methodological ratings supplied for RCTs and non-RCTs (see Murray et al., 2012), there is also a pressing need for rating the methodological rigour of SCEDs. In response to this, speechBITE™ will commence rating SCEDs using the risk of bias in N-of-1 trials (RoBIN-T) scale (Tate et al., in press) in the latter half of 2013. This will inform clinicians about the methodological rigour of SCEDs within their area of practice which in turn can assist them in making evidence based practice decisions. There is also a plan to analyse and publish on the quality of treatment research across the scope of intervention practice by evaluating and reporting on the methodological ratings of RCTs, non-RCTs and SCEDs across our target areas of intervention.

The current study revealed that while SCEDs are the most frequent research design in the areas of speech, language and literacy intervention, for the practice areas of voice, fluency and swallowing, CSs were utilised more often. Intervention research often progresses in phases associated with differing research questions and increasing research rigour (Fey & Finestack, 2009). SCEDs and CSs are often used for pre-trial, feasibility and early efficacy studies. Well-designed SCED methodology provides the opportunity for controlled treatment studies, which can represent the highest level of evidence (i.e., Level 1) when randomisation is incorporated into the design of the N-of-1 trial (OCEBM Levels of Evidence Working Group, 2011). CSs designs (e.g., pre-post studies) instead represent a relatively weak form of research evidence. The problem with these designs is the lack of experimental control. The trend of higher numbers of CS research identified within voice, fluency and swallowing suggests a call for further methodological rigour and research development in these

areas of practice. It will also be interesting to observe future trends in research design particularly in light of the debate concerning levels of evidence, and how this reflects intervention research and rigour across various clinical populations. Traditionally, RCTs are considered more methodologically robust compared with SCEDs and CSs as portrayed in the National Health and Medical Research Council of Australia (NHMRC, 1999) guidelines, for example. However, SCEDs are gaining traction as a valid alternative methodology for efficacy and effectiveness research with various populations (e.g., Hegde, 2007; Kearns & de Riesthal, 2013; Tate et al., 2008). Indeed, N-of-1 trials are listed in equal standing to RCTs in the Oxford Levels of Evidence (OCEBM Levels of Evidence Working Group, 2011). The high rate of SCEDs used for etiologies such as autism spectrum disorder may also be related to the considerable heterogeneity across clients in such groups.

Compared to some other health and education professions, speech pathology is a relatively "new" field. However, the scope of intervention practice research listed on speechBITE™ is encouraging and future work will continue to improve the identification and reporting of the quantity and quality of intervention studies. Speech pathologists, be they clinicians and/or researchers, can utilise this resource which should contribute to our clinical decisions and evidence based practice.

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