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A systematic review of the association between childhood speech impairment and participation across the lifespan

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Abstract
Speech impairment of unknown origin is one of the most common communication impairments in childhood. The purpose of this systematic review was to identify limitations in life activities that may be associated with speech impairment, through analysing the findings of papers published in the past 10 years. Domains from the Activities and Participation component of the International Classification of Functioning, Disability and Health were used as search terms, and resulted in 57 papers being identified. Findings from each paper were reviewed in terms of the association between speech impairment and Activity Limitations and/or Participation Restrictions as defined by the ICF. The systematic review revealed that speech impairment in childhood may be associated with the following Activity Limitations and/or Participation Restrictions: learning to read/reading, learning to write/writing, focusing attention and thinking, calculating, communication, mobility, self-care, relating to persons in authority, informal relationships with friends/peers, parent-child relationships, sibling relationships, school education, and acquiring, keeping and terminating a job.

Keywords: *Speech impairment, impact, ICF, systematic review, articulation, phonology.*

Introduction

Speech-language pathologists have reported that speech impairments (including articulation and phonology) are one of the most common forms of communication impairment among children presenting at their clinics (e.g., Broomfield & Dodd, 2004; Joffe & Pring, 2008; McLeod & Baker, 2004). In 2000, a systematic review of studies found the estimated prevalence of speech delay ranged from 2.3% to 24.6% in children under 16 years of age (Law, Boyle, Harris, Harkness, & Nye, 2000). Since that time, additional studies have been conducted that support the prevalence of speech impairment among preschool children (e.g., McLeod & Harrison, 2009; Ttofari Eecen, Reilly, & Eadie, 2007) and children at school (e.g., Jessup, Ward, Cahill, & Keating, 2008; McKinnon, McLeod, & Reilly, 2007) with similar results.

"Speech and language development is intimately related to all aspects of educational and social development" (Law, Boyle, Harris, Harkness, & Nye, 1998, p. 2). Consequently, a communication impairment that first presents in childhood may be associated with Activity Limitations and/or Participation Restrictions that extend across the lifespan. For example, a systematic review published in 1998 found children who do not receive speech intervention, or who begin speech intervention in the school years, can continue to have difficulties for at least 28 years (Law et al., 1998). Felsenfeld and colleagues reported that childhood phonological (speech) impairment may be associated with difficulties with communication skills, education and employment in adults 28 years after their initial presentation (Felsenfeld, Broen, & McGue, 1992, 1994; Felsenfeld, McGue, & Broen, 1995). As people are increasingly expected to be proficient communicators in employment and social activities, the association between such a communication impairment and life activities will become more apparent (Byles, 2005). A framework which promotes a more holistic understanding of the concepts of health and functioning is useful to consider this association.

The International Classification of Functioning, Disability and Health (ICF) released by the World Health Organization (WHO) in 2001 has been recommended as an appropriate framework for use

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within the profession of speech-language pathology (Threats, 2006; Threats & Worrall, 2004) including with children with speech impairment (McLeod & McCormack, 2007). According to the ICF framework, health is not so much the absence of disease as an individual's ability to function optimally in a given context. The framework recognises health to be the result of a complex interaction between biological, individual and societal factors (Reed et al., 2005). That is, the ICF recognizes the inter-relationships that exist between impaired Body Structures and/or Functions (e.g., speech impairment), Personal and Environmental Factors and Participation in everyday activities.[1]

While researchers such as Felsenfeld and colleagues have investigated the immediate and lasting effects of speech impairment (Felsenfeld et al., 1992, 1994, 1995), these effects have not previously been explicitly linked to the Activities and/or Participation of individuals in their lives. This paper presents the results of a systematic review of the literature, published in the past 10 years, which has investigated the association between speech impairment and Activity Limitations and/or Participation Restrictions[2] across the lifespan. This time-frame was chosen as it reflects the shift in conceptualizing health that has taken place in speech-language pathology (and other health fields) as an integration of medical and social factors. The purpose was to identify the ways in which participation may be restricted for individuals with a history of speech impairment. These were defined using the Activities and Participation component from the ICF (WHO, 2001). In the ICF, an Activity is defined as "the execution of a task or action by an individual" while Participation is "involvement in a life situation" (WHO, 2001, p. 14). The Activities and Participation component is divided into nine chapters (see Table II), which are further divided into domains that cover "the full range of life areas" (WHO, 2001, p. 14). It has been suggested that such a construct has "significant promise to document the social dimensions of disability" (Simeonsson, Carlson, Huntington, McMillen, & Brent, 2001, p. 61). The aim of this paper was not to suggest speech impairment may *cause* Participation Restrictions since current research does not allow these cause-effect relationships to be drawn. Therefore, the aim of this paper was to review research that identified an *association* between the two, in order to better understand the social dimensions of childhood speech impairment.

Method

Search strategy

Computer-based searches were undertaken to locate papers investigating speech impairment during the past 10 years. The databases included in the search are presented in Table I. This selection of databases was designed to capture the publications in which papers relevant to the investigation were most likely to be published. Identical searches were undertaken in each database. Following the computer-based search, references of identified papers were scanned for further papers that might be relevant to the review.

Search terms

A multi-layered search strategy was employed in the computer-based searches to identify relevant papers. Initially, limits were put in place to restrict the search to scholarly papers (i.e., peer-reviewed) published in a 10 year period between January 1998 and August 2008. A combination of terms referring to speech impairment was used in an attempt to capture the most relevant papers. These terms incorporated those most commonly used to refer to speech

Table I. Databases and terms used in systematic review.

Databases searched	Terms Included	Terms Excluded
Academic Search Premier	**One of the following:**	**Not the following:**
CINAHL Plus with Full Text	Speech impair*	Cleft lip
Education Research Complete	Speech delay*	Cleft palate
ERIC	Speech disorder*	Down* syndrome
Health Business Fulltext Elite	Speech difficult*	Cerebral palsy
Health Source - Consumer Edition	Articulation impair*	Autis*
Health Source - Nursing/Academic Edition	Articulation delay*	Cochlear implant
MEDLINE (1950-present)	Articulation disorder*	Stutter*
Professional Development Collection	Articulation difficult*	Voice
Psychology and Behavioral Sciences Collection	Phonological impair*	Hearing impair*
SocINDEX with Full Text	Phonological delay*	Traumatic brain injur*
	Phonological disorder*	Acquired brain injur*
	Phonological difficult*	Aphasia
		Stroke
		Parkinson* disease
		Epilepsy
		Dysphagia
		Multiple Sclerosis

impairment, including articulation and phonology (Shriberg, Tomblin, & McSweeny, 1999). Search terms are presented in Table I. Truncation was used to eliminate the possibility of papers being overlooked due to morphological differences in terms. All fields were searched, and the search result contained 7190 articles.

The first 100 titles were scanned, and papers were found in which speech impairment occurred in association with other conditions. Further limitations were put in place to reduce the likelihood of other conditions influencing reported outcomes. The participants in the articles were required to have speech impairment of unknown origin (i.e., not a result of neurological or other medical conditions), speech impairment as the sole or primary impairment experienced by the participants, and have first presented in childhood (0–6 years). A list of exclusionary terms was developed to refine the search (see Table I). This refined search resulted in 4172 articles, hereafter referred to as the ''base search''.

In order to identify the papers within this base search that examined the association between speech impairment and Participation Restrictions, domains and definitions from each chapter of the Activities and Participation component of the ICF (WHO, 2001) were utilized as search terms (see Table II). A separate search was performed for each chapter using the listed terms. Results from these searches were individually combined with the base search to identify potential papers relevant to each chapter. These results are presented in Table II.

Titles and abstracts of papers were examined to exclude papers considered outside the scope of this review. Papers were excluded on the basis of type (e.g., discussion and review papers) or purpose (e.g., tool validation or intervention studies). Additionally, papers were excluded when the participant group had co-occurring conditions that had not been previously excluded, or presented with non speech-related conditions (such as dysphagia). For the purpose of this review, studies in which the nature and extent of the speech impairment experienced by the participant group was not defined have been excluded. For instance, the database search revealed a number of papers published by Dockrell, Lindsay and colleagues investigating self-esteem and behaviour of children with ''speech and language difficulties'' and their interactions with peers (e.g., Dockrell & Lindsay, 2001; Lindsay, Dockrell, Letchford, & Mackie, 2002; Lindsay, Dockrell, & Mackie, 2008; Lindsay, Dockrell, & Strand, 2007). These papers were excluded from the review as no information was provided about the speech impairment experienced by participants; yet extensive information was provided about their language skills. Other studies in which the participants had co-occurring impairments were retained, when difficulty with producing sounds (articulation) or the use of phonological processes were listed as characteristics of at least some of the group. It is acknowledged that as a result, the findings reported in these studies cannot be attributed to speech impairment alone, and this issue is further discussed in the Limitations section.

Relevant papers were then obtained and the reference lists were searched manually for additional papers. The final tally of papers reviewed for each chapter of the Activities and Participation component of the ICF (WHO, 2001) is presented in Table II. During the review process, the content of each paper was examined, and codes from the ICF Activities and Participation domains were mapped onto the findings. In this way, the review enabled an examination of the association between speech impairment and Participation Restrictions, guided by the ICF framework (WHO, 2001).

Table II. Results of the search strategy for each Activity and Participation (ICF) component.

ICF Chapter	Chapter title	Search terms	Number from database	Number from title/ abstract/paper	Number from manual search	Total*
1	Learning and applying knowledge	*attention or read* or writ* or spell* or calculat* or problem-solv* or think**	487	27	4	31
2	General tasks and demands	*(undertak* task*) or (perform* task) or (handl* stress) or (manag* stress) or routine or coping*	30	0	0	0
3	Communication	*communication or (receptive language) or (expressive language) or conversation*	594	14	0	14
4	Mobility	*mobility or motor skill* or mov**	162	4	1	5
5	Self care	*self care or activities of daily living*	10	1	0	1
6	Domestic life	*household tasks or caring or assisting others*	1	0	0	0
7	Interpersonal interactions and relationships	*relations* or friend* or interact**	364	12	3	15
8	Major life areas	*education or employment*	355	6	0	6
9	Community, social and civic life	*community or recreation or leisure or religion*	52	2	0	0

**Note:* Some of these papers were duplicated (i.e. occurred in searches for more than one chapter).

Results

The search resulted in 57 papers being identified and reviewed as relevant to understanding the association between childhood speech impairment and Participation Restrictions across the lifespan. When the content was examined, domains from six of the nine ICF Activities and Participation chapters (WHO, 2001) could be mapped onto the findings. That is, Activities and Participation as defined in six of the ICF chapters could be found in the reviewed literature investigating speech impairment. A brief summary is provided in Table III and the list of studies is presented in the Appendix. The three areas that were not included were: General tasks and demands, Domestic life and Community, social and civic life. Findings from the 57 eligible studies will be outlined and discussed in greater detail under the relevant domains pertaining to the ICF in the following sections. In each section, the heading is an Activities and Participation chapter from the ICF. When specific domains are discussed, the numbers in brackets correspond to the ICF domain codes.

Learning and applying knowledge (d1)

The first chapter in the Activities and Participation component of the ICF is Learning and applying knowledge, which is defined as: ''learning, applying the knowledge that is learned, thinking, solving problems, and making decisions'' (WHO, 2001, p. 125). Thirty-one papers were identified which investigated an association between speech impairment and activities related to learning and applying knowledge (see Appendix).

The reviewed papers differed in terms of research design, such as participant recruitment and characteristics, and the specific skills investigated. For instance, some studies relied on parent/self report to identify past history of speech impairment (e.g., DeThorne et al., 2006; Lewis et al., 2007; Tunick & Pennington, 2002) while others utilized clinical diagnoses (e.g., Carroll & Snowling, 2004; Hauner, Shriberg, Kwiatkowski, & Allen, 2005; Lewis, Freebairn, Hansen, Iyengar & Taylor, 2004). Some employed control groups with a history of typical speech acquisition (e.g., DeThorne et al., 2006; Gernand & Moran, 2007; Larrivee & Catts, 1999; McGrath et al., 2008; Ozcebe & Belgin, 2005; Pershey & Clickner, 2007; Preston & Edwards, 2007; Sutherland & Gillon, 2007), others compared subgroups of children with speech impairment (e.g., Hauner et al., 2005; Leitão & Fletcher, 2004; Lewis, Freebairn & Taylor, 2000; Lewis et al., 2004; Raitano et al., 2004), while some reported results from control groups and subgroups (e.g., Bishop & Clarkson, 2003; Holm, Farrier & Dodd, 2008; Nathan, Stackhouse, Goulandris & Snowling, 2004b; Rvachew, 2007). Many of the studies investigated reading, or reading related skills (such as phonological awareness). A small number investigated spelling and/or writing, thinking and attention, and calculation (maths) skills. Results from these investigations are briefly outlined below.

Learning to read (d140) and Reading (d166)

Learning to read is preceded by the development of decoding or phonological awareness skills (such as the ability to think about and manipulate sounds in words). Comprehension of written material requires efficient decoding skills (Leitão, 2002). Findings from the systematic review indicated that individuals with a speech impairment may have associated difficulties with phonological awareness/processing skills and reading (Carroll & Snowling, 2004; Gernand & Moran, 2007; Holm et al., 2008; Pershey & Clickner, 2007; Rvachew, Ohberg, Grawburg, & Heyding, 2003), and these skills may continue to be affected into adulthood (Lewis et al., 2007; Preston

Table III. Activities and Participation domains associated with speech impairment (ICF codes are in brackets).

Chapter/Component	Specific Domains
Learning and applying knowledge (d1)	Learning to read (d140)/Reading (d166)
	Learning to write (d145)/Writing (d170)
	Focussing attention (d160)/Thinking (d163)
	Calculating (d172)
Communication (d3)	Speaking (d330)
	Writing messages (d345)
	Conversation (d350)
Mobility (d4)	
Self care (d5)	
Interpersonal interactions and relationships (d7)	Relating with persons in authority (d7400)
	Informal relationships with friends (d7500)
	Informal relationships with peers (d7504)
	Parent-child relationships (d7600)
	Sibling relationships (d7602)
Major life areas (d8)	School education (d820)
	Acquiring, keeping and terminating a job (d845)

& Edwards, 2007). However, the difficulties appeared to be related to the particular phonological processing skills being assessed, and varied according to individual profiles (Hesketh, 2004; Hesketh, Adams & Nightingale, 2000; Holm et al., 2008).

A range of factors appeared to influence the risk of developing such difficulties. Individuals with speech impairment may be at increased risk of reading difficulties when the speech impairment co-occurs with a language impairment (Larrivee & Catts, 1999; Lewis et al., 2007; Lewis et al., 2000; Nathan, Stackhouse, Goulandris, & Snowling, 2004a; Raitano et al., 2004; Sices, Taylor, Freebairn, Hansen & Lewis, 2007; Young et al., 2002), or poor phonological awareness/processing skills (Hesketh, 2004; Larrivee & Catts, 1999; Nathan et al., 2004b; Rvachew, 2007). Individuals with speech impairment were also at greater risk if their speech impairment persisted into school-age (Nathan et al., 2004a; Preston & Edwards, 2007; Young et al., 2002) and/or was characterized by non-developmental speech errors (Leitão & Fletcher, 2004). Children with apraxia of speech were also at increased risk (Lewis et al., 2004). Larrivee and Catts (1999) reported that increased severity of speech impairment was a risk factor; however, Sices et al. (2007) found language status, rather than severity, related to reading and writing skills.

Learning to write (d145) and Writing (d170)

Learning to write involves the development of adequate spelling and grammatical knowledge as well as fine motor skills. Results from this systematic review indicated that difficulties with spelling and writing may be associated with speech impairment in childhood (Lewis, Freebairn, & Taylor, 2002). However, the risk of developing such difficulties again appeared to be influenced by factors such as the persistence of the speech impairment (Nathan et al., 2004b), the type of speech impairment (Holm, et al., 2008; Leitão & Fletcher, 2004), and the co-occurrence of language impairment (Bishop & Clarkson, 2003; Lewis et al., 2000). For instance, Bishop and Clarkson (2003) found that ''children with pure speech difficulties did not have any evidence of written language problems'', but most children (aged 7–13 years) with combined speech and language difficulties were ''functionally illiterate'' (p. 231).

Teverovsky, Bickel and Feldman (2009) reported the results of a survey distributed among parents of children with childhood apraxia of speech. They asked parents to identify functional difficulties that their children experienced from a given list, which corresponded to items from the Body Functions and Structures, and Activities and Participation components of the ICF-Children and Youth (ICF-CY; World Health Organization, 2007). Learning to write was one of the most commonly reported areas of difficulty with almost half (49%) of the parents reporting that their child had difficulty with this Activity (Teverovsky et al., 2009).

Focusing attention (d160) and Thinking (d163)

Results from this systematic review indicated that children with speech impairment may also experience difficulty with attention and thinking, although the relationship between the two is unclear. McGrath et al. (2008) reported attention deficits were higher when participants had co-occurring speech and language impairment, even when the speech impairment had resolved. In contrast, Snowling, Bishop, Stothard, Chipchase and Kaplan (2006) found attention difficulties did not persist in children with resolved speech impairment. Ozcebe and Belgin (2005) found information processing skills, thinking, reasoning, and memory appeared to be most affected when the speech impairment was characterised by multiple speech sound errors. In contrast, Hauner et al. (2005) suggested that decreased task persistence/attention, when combined with negative affect and negative emotionality/mood, ''may act to increase the severity of speech delay as well as to impede normalization rates'' (p. 645).

Calculating (d172)

Mathematical computational skills have been found to be associated with mastery of phonological processing skills, including phonological memory and phonological awareness (Hecht, Torgesen, Wagner, & Rashotte, 2001). Calculating may be associated with speech impairment given the link between speech impairment and phonological processing skills. Nathan et al. (2004b) found children with persisting speech difficulties were significantly different to matched controls in maths skills at age 7 years, although there was no statistical difference between children with resolved speech and the control group. This impact may be due to an underlying difficulty with symbol representation (affecting both numerals and letters), storage and retrieval (Hecht et al., 2001).

Communication (d3)

The third chapter in the Activities and Participation component of the ICF is communication, which is defined as: ''general and specific features of communicating by language, signs and symbols, including receiving and producing messages, carrying on conversations, and using communication devices and techniques'' (WHO, 2001, p. 133). There were 14 studies that investigated the association between speech impairment and other communication skills. These were studies by Bishop and Clarkson (2003), Glogowska, Roulstone, Peters and Enderby (2006), Hansson, Nettelbladt and Nilholm (2000), Haskill

and Tyler (2007), Hauner et al. (2005), Leitão, Fletcher and Hogben (2000), Lewis et al. (2002, 2004, 2007), Nathan (2002), Nathan, Stackhouse and Goulandris (1998), Pershey and Clickner (2007), Teverovsky et al. (2009), and Yont, Hewitt and Miccio (2002). Many of the communication skills investigated in the reviewed papers are covered in other Activities and Participation chapters (e.g., Interpersonal interactions and relationships) (see Appendix).

A speech impairment, affecting the production of sounds, may be associated with other communication impairments. These impairments may persist beyond early childhood, as evidenced by studies of individuals (Glogowska et al., 2006) and family members (Lewis et al., 2007). Findings from this review indicated that speech impairment may be associated with language production difficulties, including the development of morphosyntactic skills (Haskill & Tyler, 2007). However, language output (number of utterances and vocabulary) appeared to be influenced by the conversational partner (Hansson et al., 2000). Conversation and discussion were reported to be difficult for children with apraxia (Teverovsky et al., in press), and for children with speech impairment with psychosocial involvement (Hauner et al., 2005). Speech impairment may be associated with breakdowns in conversation due to phonological errors and reduced intelligibility (Yont et al., 2002), and may be associated with social communication difficulties (e.g., communicative coherence, use of conversational context) according to teacher/speech-language pathologist report (Nathan, 2002). Furthermore, children with speech and language impairment appeared to have greater difficulties with speech processing (Nathan et al., 1998).

Mobility (d4)

The fourth chapter in the Activities and Participation component of the ICF is mobility, which is defined as: ''moving by changing body position or location or by transferring from one place to another, by carrying, moving or manipulating objects, by walking, running or climbing, and by using various forms of transportation'' (WHO, 2001, p. 138). Five studies were identified that investigated an association between speech impairment and activities related to mobility. These were studies by Gaines and Missiuna (2006), McCabe, Rosenthal and McLeod (1998), Newmeyer et al. (2007), Teverovsky et al. (2009) and Visscher, Houwen, Scherder, Moolenaar and Hartman (2007).

These studies differed in terms of the type of speech impairment experienced by participants (e.g., childhood apraxia of speech, speech impairment) and the research design (e.g., file audit, parent questionnaire). Results indicated that childhood apraxia of speech may associated with limb apraxia/clumsiness/awkwardness (McCabe et al., 1998), difficulty with fine motor skills (Newmeyer et al., 2007; Teverovsky et al., 2009), and difficulty walking (Teverovsky et al., 2009). There is an association between children with speech and/or language difficulties and motor difficulties affecting manual dexterity, ball skills and balance (Gaines & Missiuna, 2006; Visscher, et al., 2007). These studies indicate that the skills of children with speech impairment may be affected to a greater extent than those with language impairment (Visscher et al., 2007). However, comparison to a control group was not made in these studies, which limits the possibility of making claims about causation. Visscher and colleagues (2007) made an interesting observation by stating that communication difficulties may impact on social acceptance and play with peers, which in turn may affect learning and practice of motor skills during play activities.

Self care (d5)

The fifth chapter in the Activities and Participation component of the ICF is Self care, which is defined as: ''caring for one's self, washing and drying oneself, caring for one's body and body parts, dressing, eating and drinking, and looking after one's health'' (WHO, 2001, p. 149). One study was identified that investigated the association between speech impairment and activities related to self care (Gaines & Missiuna, 2006). Findings of this study suggested an association between speech (and/or language) impairment and parental report of self-care skills, but the specific skills were not discussed. However, the study utilized a small, convenience sample and lacked a control group; thus further investigation of the co-occurrence of both impairments is needed to investigate the relationship between the two.

Interpersonal interactions and relationships (d7)

The seventh chapter in the Activities and Participation component of the ICF is interpersonal interactions and relationships, which is defined as: ''carrying out the actions and tasks required for basic and complex interactions with people (strangers, friends, relatives, family members and lovers) in a contextually and socially appropriate manner'' (WHO, 2001, p. 159). Fifteen papers were identified which investigated the association between speech impairment and activities related to interpersonal interactions and relationships (see Appendix).

These papers differed in terms of the types of speech impairment (and co-occurrence with language impairment), and relationships being investigated. Data collection methods also varied across studies as some examined conversational transcripts (e.g., Hansson et al., 2000), others employed parent and/or teacher questionnaires (e.g., Marshall, Ralph, & Palmer, 2002; Overby, Carrell, & Bernthal, 2007;

Teverovsky et al., in press), others used rating scales (e.g., McCabe, 2005; Perry-Carson, Carson, Klee & Jackman-Brown, 2007; Wink, Rosanowski, Hoppe, Eysholdt & Grässel, 2007), and some conducted interviews and/or focus groups (e.g., Barr, McLeod, & Daniel, 2008; Glogowska & Campbell, 2000; Markham & Dean, 2006; McLeod & Daniel, 2005). However, they all indicated that a speech impairment may be associated with limitations in forming and maintaining interpersonal relationships as outlined below.

Relating with persons in authority (d7400)

Findings from this systematic review indicated that speech impairment may be associated with limitations in formal relationships, specifically teacher-child relationships. This may be in terms of teacher expectations regarding the children's skills (Overby et al., 2007) or in terms of teacher's feelings about teaching these children (Marshall et al., 2002). Overby et al. (2007) found ''recurring descriptive statements by 31.1% of the teachers directly attributed the child's academic, social, and/or behavioral difficulties to the child's speech skills'' (Overby et al., 2007, p. 334). They reported teachers expected children with moderately intelligible speech to struggle at school, especially in relation to literacy (major delays) and social skills (shyness/timidity). Marshall and colleagues (2002) found trainee teachers did not feel positive or competent teaching children with speech and/or language difficulty, although this depended on the severity of the difficulty. It may be that such attitudes and expectations influence the interactions between teachers and these children.

Informal relationships with friends/peers (d7500/d7504)

Speech impairment may be associated with difficulties interacting with, and developing relationships with peers. However, it is not possible to make conclusive statements regarding the impact of speech impairment in isolation as much of the research in this area investigates children with co-occurring speech and language difficulties. Children with a history of speech and language impairment were reported to experience higher rates of social difficulties at follow-up and lower social competence ratings compared to a control group (Glogowska et al., 2006; McCabe, 2005). Additionally, individuals with speech and language difficulties rated themselves with low peer self-concept, which related to their self-perceptions of their ability to make friends and their popularity with peers (Robertson, Harding & Morrison, 1998). However, participants in this sample were bilingual, and the authors suggested that language, rather than speech, may have been the greater area of concern.

Hansson et al. (2000) found dialogues between children with speech and language difficulties and their peers were more symmetrical than those with adults (parents or clinicians). That is, in conversations with peers, both participants contributed equally to the dialogue. However, the children were more productive in their interactions with adults. The authors suggest that this may be due to adults encouraging the children's attempts at communication and making more effort to understand these attempts (Hansson et al., 2000).

Parent-child relationships (d7600)

A number of studies have reported the association between speech and language impairments and parent-child relationships. Firstly, the association between speech and language impairments and parent-child interactions was reported in a study by Perry-Carson et al. (2007). They found that parents of young children with speech and language impairment characterised themselves as being less nurturing, and their children as being more detached and underreactive (Perry-Carson et al., 2007). Children with speech impairment in isolation were excluded from the study due to limited numbers, so it is only possible to conclude that co-occurring speech and language impairment appeared to influence the parenting behaviour and quality of interactions among parents and their children.

The association between speech impairment and parent-child interactions may also be expressed in terms of parental concern and anxiety for their children's social and academic success (Glogowska & Campbell, 2000; Markham & Dean, 2006), or parental feelings of frustration at associated behaviour problems, and subsequent guilt at this frustration (McLeod & Daniel, 2005). Additionally, the impact may be reflected in parental health status, as mothers of children with speech impairment have been found to have lower scores on Health-related Quality of Life (including physical functioning, general health, vitality, and social functioning) in comparison to a control group (Rudolph, Kummer, Eysholdt & Rosanowski, 2005), and were significantly more likely to meet criteria for emotional disorders (namely anxiety and depression) (Rudolph, Rosanowski, Eysholdt & Kummer, 2003; Wink et al., 2007). Furthermore, Wink and colleagues (2007) found a high correlation between the presence of these emotional disorders and the perception of subjective burden of being a caregiver. However, they acknowledged difficulty associated with interpreting such results as it is unclear whether the child's speech impairment may have influenced the well-being of the mother, or the mother's well-being may have affected the speech development of the child (Rudolph et al., 2005). Recent research has found maternal well-being to be a protective factor in relation to speech and language concerns

among preschool children (Harrison & McLeod, 2009).

Sibling relationships (d7602)

Speech impairment may also be associated with demands on sibling relationships (Barr et al., 2008; McLeod & Daniel, 2005). For instance, Barr et al. (2008) found siblings reported a need to protect the child with the speech impairment from potential bullying and to interpret their needs when others could not understand their speech. In contrast, siblings also reported feelings of jealousy and resentment, possibly due to the reduced parental attention they received in comparison to the child with the speech impairment.

Major life areas (d8)

The eighth chapter in the Activities and Participation component of the ICF is Major life areas, which is defined as: ''carrying out the tasks and actions required to engage in education, work and employment and to conduct economic transactions'' (WHO, 2001, p. 164). Six studies were identified which investigated the association between speech impairment and activities associated with major life areas, specifically, school education and acquiring, keeping and terminating a job (Allard & Williams, 2008; Marshall et al., 2002; Mitchell, McMahon & McKee, 2005; Robertson et al., 1998; Ross, Neeley & Baggs, 2007; Snowling, Adams, Bishop & Stothard, 2001).

School education (d820)

For most children living in Western countries, school forms a major life area for a number of years. Education is seen by many to be essential for future success and thus achievement at school is highly desirable. However, parents and teachers of children with speech impairment (with or without co-occurring language impairment) have expressed concern about the training provided to teachers and the resources available to assist the education of these children (Marshall et al., 2002). Consequently, there is concern that these children may experience some difficulty with academic achievement.

It has already been shown in this paper that children who enter school with persisting speech difficulties (moderate-severe) are at increased risk of literacy problems (e.g., Leitão et al., 2000). It is also clear that these children may have difficulty with peer and formal (teacher) interactions at school (e.g., McCabe, 2005; Overby et al., 2007). Other studies have investigated the association between children with speech and language impairment and behaviours requiring discipline infractions (e.g., Ross et al., 2007) and the individual's resilience (Robertson et al., 1998). This review found no evidence that speech impairment (in the absence of language impairment) is associated with discipline/conduct disorders; however, students with speech and/or language impairment are reportedly at risk for school drop-out as they reported feeling less connected to school (Robertson et al., 1998). Snowling et al. (2001) reported the majority of adolescents with a history of speech and/or language impairment remained in full-time education, although they were more likely to complete vocational and employment training than complete higher years of schooling (Snowling et al., 2001).

Acquiring, keeping and terminating a job (d845)

Communication disorders have been associated with high rates of unemployment (Ruben, 2000). Allard and Williams (2008) found a speaker with an articulation disorder was rated less employable than a speaker without a disorder by a group of 455 adults. They concluded that ''negative stereotypes exist toward individuals with speech and language disorders'' (Allard & Williams, 2008, p. 118). Mitchell et al. (2005) examined allegations of workplace discrimination related to speech impairment in comparison to allegations related to orthopaedic or visual impairments. They found the most frequent allegation issues for people with speech impairment related to discharge (25%), harassment (12%) and hiring (12%). The comparative percentages for harassment and hiring were significantly less for people with orthopaedic or visual impairments (Mitchell et al., 2005).

Limitations

There were two major limitations to this systematic review that warrant further discussion. Firstly, the terminology used in the reviewed studies was inconsistent. For instance, some studies referred to articulation delay, some to speech impairment, and some to phonological impairment. It is unclear if these terms refer to identical, similar or different phenomenon. The lack of consistent definitions is a major issue within the speech-language pathology profession (Walsh, 2005). Until the definitions become standardized, it is difficult to make comparisons between studies, and to make conclusions about the association between specific communication impairments (e.g., speech impairment) and participation in life activities.

In this review, efforts were made to ensure that speech impairment was one of the main phenomena under investigation in the reviewed studies. That is, studies were included when at least some of the participants were explicitly described as having difficulty with producing sounds (articulation) or the use of phonological processes. In most of the cited studies, a distinction between articulation and phonological-based impairments was not made. It is

acknowledged that phonology is often considered a part of language, and therefore participants with phonological-based impairments may experience speech *and* language impairments. In such instances, it is not possible to isolate the association between the presenting speech impairment and the identified Participation Restrictions. The same is true when participants presented with identified, co-occurring speech and language impairments. In this review, a decision was made to include studies investigating different participant groups—some with speech impairment in isolation and others with co-occurring speech and language impairment—when the speech impairment was explicitly described (as above). It is recognized that the inclusion of both groups of participants is a second limitation of this review. However, it is also recognized that individuals with speech impairment are a heterogenous group. In some instances, the speech impairment experienced by participants may be associated with a yet undiagnosed cause. In other cases, Environmental Factors (e.g., support/attitudes of their significant others, access to services) or Personal Factors (e.g., temperament, age) may also contribute to the Participation Restrictions experienced.

Due to the unique factors that contribute to each participant's life and the variable nature of speech impairment itself, it will never be possible to remove all confounding variables in order to research a group with identical characteristics—individual variation will always exist. However, future research could investigate some of the factors that may contribute to this individual variation. The ICF (WHO, 2001) provides a starting point for such research. For instance, researchers could develop a system to classify severity of speech impairment (e.g., mild, moderate, etc.) using the quantifiers from the Body Functions and Structures component, and investigate the association between severity and Participation Restrictions; researchers could develop assessment tools incorporating the domains from the Activity and Participation component and administer these with participants and/or their significant others to investigate their perceptions of Participation Restrictions associated with speech impairment, or to investigate the three domains not identified in previous research (General tasks and demands, Domestic life and Community, social and civic life); alternatively, researchers could investigate specific Environmental Factors such as the perceptions and attitudes of others towards individuals with speech impairment, or Personal Factors such as social upbringing and family history of speech impairment, to examine the association between these variables and participation in life activities.

Conclusion

The preceding review indicated that speech impairment may be associated with limitations and restrictions defined in at least 6 of the 9 Activities and Participation chapters of the ICF (WHO, 2001). These include: Learning to read/reading, Learning to write/writing, Attention and thinking, Calculating, Communication, Mobility, Relating to persons in authority, Informal relationships with friends/peers, Parent-child relationships, Sibling relationships, School education and Acquiring, keeping and terminating a job. The three ICF chapters that were not associated with speech impairment were: General tasks and demands, Domestic life and Community, social and civic life; however, this may be due to the fact that to date no-one has studied potential associations. It is not possible to make conclusions about the nature of the association between speech impairment and these activities. That is, it is unclear whether experiencing a speech impairment causes or increases the likelihood of these Participation Restrictions. Furthermore, it is unclear what role other factors (Environmental and Personal Factors) play in facilitating or acting as barriers to success in these activities. Ongoing research will continue to inform speech-language pathologists of the nature of the association between speech impairment and life activities, and the contribution of other factors. However, the findings of this review show the need for holistic consideration of individuals with speech impairment, and support the use of a framework such as the ICF (WHO, 2001) as a means to do this.

Notes

1. Capitalization has been used for these terms to be consistent with usage in the ICF and to differentiate between everyday usage of these terms.
2. Hereafter referred to as Participation Restrictions.

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Appendix. Reviewed studies and the reported areas of difficulty.

Author(s)	No. of participants	Age at first testing	Age at follow-up	Description of communication impairment	ICF areas of difficulty*
Chapter 1: Learning and applying knowledge					
Bishop & Clarkson (2003)	75 (+161 in control group)	7–13 years	N/A	Specific speech and/or language impairment	Learning to write (spelling)/Writing/ Writing messages[3]
Carroll & Snowling (2004)	34 (+17 in control group)	Approximately 4–6 years	N/A	Speech impairment	Learning to read (speech processing, phonological learning, phonological awareness)
De Thorne et al. (2006)	248 twin pairs	Mean 6;08 years	N/A	Speech impairment (+/− language impairment)	Learning to read (inc. phonological awareness, word identification)
Gernand & Moran (2007)	12 (+12 in control group)	5;11–7;2 years	N/A	Mild-moderate phonological impairment	Learning to read (phonological awareness)
Hauner, Shriberg, Kwiatkowski & Chad (2005)	29 (+87 in control group)	3–6 years	N/A	Speech delay (+/− developmental psychosocial involvement)	Attention/Conversation[3] (conversational competence)
Hesketh (2004)	35	3½–5 years	Approximately 6½–7½ years	Moderate-severe speech disorder	Learning to read (phonological awareness)
Hesketh, Adams & Nightingale (2000)	61 (+59 in control group)	3½–5 years	N/A	Phonological disorder	Learning to read (phonological awareness)
Holm, Farrier & Dodd (2008) [Experiment 1]	46 (+15 in control group)	Mean age 5–5½ years	N/A	Speech disorder (delayed/consistent errors/inconsistent)	Learning to read (phonological awareness)
Holm, Farrier & Dodd (2008) [Experiment 2]	9 (+9 in control group)	3–5 years	Approximately 7½–8½ years	Speech disorder (inconsistent)	Learning to write (spelling)
Larrivee & Catts	30 (+27 in control group)	5;8–7;3 years	N/A	Expressive phonological disorders (speech +/− language impairment)	Reading
Leitão & Fletcher (2004)	14	5–6 years	12–13 years	Specific speech impairment (developmental/non-developmental)	Learning to read (phonological awareness)/ Spelling/Reading (comprehension)
Leitão, Fletcher & Hogben (2000)	21	Approximately 5–6 years	Approximately 7–8 years	Specific speech impairment (delayed/non-developmental)	Reading/Spelling/Speaking[3] (residual speech errors)
Lewis, Freebairn, Hansen, Iyengar & Taylor (2004)	39	4–6 years	8–10 years	Speech sound disorder (+/− language impairment) Childhood apraxia of speech	Reading/Spelling/Speaking[3] (residual speech errors, expressive language)/Receiving spoken messages[3] (receptive language skills)
Lewis et al. (2007)	147 parents of children with speech sound disorder	N/A	N/A	Speech sound disorder (+/− language impairment)	Reading/Spelling/Speech[3]/ Receptive language Skills[3]
Lewis, Freebairn & Taylor (2002)	52	4–6 years	8–11 years	Phonological disorder (+/− language impairment)	Spelling/Reading (decoding and comprehension)/Speaking[3]
Lewis, Freebairn & Taylor (2000)	52	4–6 years	8–11 years	Phonological disorder (+/− language impairment)	Reading/Spelling
McGrath et al. (2008)	108 (+41 in control group)	4–7 years	N/A	Speech sound disorder (+/− language impairment)	Attention
Nathan, Stackhouse, Goulandris & Snowling (2004a)	28 (+19 in control group)	4 years	7 years	Speech difficulty (+/− language impairment)	Learning to read (e.g. phoneme awareness)

(*continued*)

Appendix. (*Continued*).

Author(s)	No. of participants	Age at first testing	Age at follow-up	Description of communication impairment	ICF areas of difficulty*
Nathan, Stackhouse, Goulandris & Snowling (2004b)	39 (+35 in control group)	4–5 years	Mean 6.71 years	Speech difficulty/disorder	Spelling/Reading/Reading (comprehension)/ Calculating (maths)
Ozcebe & Belgin (2005)	33 (+160 in control group)	6–10 years	N/A	Functional articulation disorder	Thinking (memory, thinking, reasoning and information processing)
Pershey & Clickner (2007)	23 (+23 in control group)	6–9 years	N/A	Phonological impairment	Learning to read/Reading/Spelling/ Communication[3]
Preston & Edwards (2007)	13 (+14 in control group)	10–14 years	N/A	Speech sound difficulty (residual errors)	Learning to read (phonological awareness/ processing)
Raitano et al. (2004)	101 (+41 in control group)	5–6 years	N/A	Speech sound disorder (+/− language impairment)	Learning to read (phonological awareness and letter knowledge)
Rvachew (2007)	33 (+35 in control group)	4½–5½ years	6–7½ years	Speech sound disorder	Learning to read (phonological awareness)/ Reading
Rvachew & Grawburg (2006)	95	Approximately 4–5 ½ years	N/A	Speech sound disorder	Learning to read (phonological awareness)
Rvachew, Ohberg & Grawburg (2003)	13 (+13 in control group)	4–5 years	N/A	Severe expressive phonological delay	Learning to read (phonological awareness, phoneme perception)
Sices, Taylor, Freebairn, Hansen & Lewis (2007)	125	3–6 years	N/A	Speech sound disorder (+/− language impairment)	Reading/Writing
Snowling, Bishop, Stothard, Chipchase & Kaplan (2006)	71	Approximately 4 years	15–16 years	Speech impairment (+/− language impairment)	Attention
Sutherland & Gillon (2005)	11 (+17 in control group)	4–5 years	N/A	Speech difficulty	Learning to read (phonological awareness, phonological representation)
Teverovsky, Bickel & Feldman (2009)	192 parents	Children 2–15 years	N/A	Childhood apraxia of speech	Learning to write/Conversation[3]/ Discussion[3]/Fine hand use[4]/Relating with strangers[7]/Informal relationships[7]
Tunick & Pennington (2002)	172 (86 twins)	Approximately 11 years	N/A	Reading disorder Phonological disorder	Reading
Young et al. (2002)	109 (+120 in control group)	5 years	18–19 years	Speech impairment (+/− language impairment)	Reading
Chapter 3: Communication					
Communication is also mentioned in papers indicated by a superscript 3 in the final column of this appendix.					
Glogowska, Roulstone, Peters & Enderby (2006)[7]	196 (+94 in control group)	Pre-school	7–10 years	Speech and/or language impairment	Speaking/Informal social relationships[7]/ Family relationships (parents, siblings)[7]
Hansson, Nettelbladt & Nilholm (2000)	10 children, parents, clinicians and peers	4–6 years	N/A	Phonological impairment (pervasive phonological processes) or Language impairment	Speaking (language output)/Informal social relationships[7] (peer interactions)/Formal/ family relationships (adult interactions)[7]

(*continued*)

Appendix. (*Continued*).

Author(s)	No. of participants	Age at first testing	Age at follow-up	Description of communication impairment	ICF areas of difficulty*
Haskill & Tyler (2007)	63 (+20 in control group)	3–5;11 years	N/A	Phonological and language impairment	Speaking (morphosyntactic skills)
Nathan (2002)	10 (+10 in control group)	4;66–7;75 years	N/A	Speech difficulty/disorder	Speaking (including language skills)/ Conversation
Nathan, Stackhouse & Goulandris (1998)	47 (+47 in control group)	4–5 years	N/A	Specific speech impairment (+/− language impairment)	Speaking/Receiving spoken messages (speech processing)
Yont, Hewitt & Miccio (2002)	12 (+12 in control group)	Mean age 4; 1 years	N/A	Specific language impairment: Phonological disorder	Conversation
Chapter 4: Mobility					
Mobility is also mentioned in papers indicated by a superscript 4 in the final column of this appendix.					
Gaines & Missiuna (2006)	40	2–5 years	5–7 years	Speech/language impairment	Mobility/Self help[5]
McCabe, Rosenthal & McLeod (1998)	50	2;4–8;8 years	N/A	Articulation and/or phonological impairment	Mobility (limb apraxia, clumsiness)
Newmeyer et al. (2007)	32	2–6 years	N/A	Severe speech sound disorder	Mobility (fine motor skills)
Visscher et al. (2007)	125	6–9 years	N/A	Developmental speech and language disorder	Mobility (fine and gross motor skills)
Chapter 5: Selfcare					
Selfcare is mentioned in papers indicated by a superscript 5 in the final column of this appendix.					
Chapter 7: Interpersonal interactions and relationships					
Interpersonal interactions and relationships is also indicated by a superscript 7 in the final column of this appendix.					
Barr, McLeod & Daniel (2008)	6 siblings 15 'significant others'	Pre-school/school	N/A	Speech impairment	Sibling relationships
Glogowska & Campbell (2000)	16 parents	Children were pre-school aged	N/A	Speech/language delay	Parent-child relationships
Markham & Dean (2006)	12 SLPs 12 professionals 11 parents	Parents of children aged 2–9 years	N/A	Speech and language difficulty	Parent-child relationships
Marshall, Ralph & Palmer (2002)	268 trainee teachers	–	N/A	Speech and language difficulty	Formal interactions (teachers)/ School education[8]
McCabe (2005)	131 (+39 in control group)	Approximately 3 ½–5 years	N/A	Speech and/or language impairment	Informal relationships with peers (social skills and behaviour)
McLeod & Daniel (2005)	Reported data from 2 (subsample of larger research study)	Pre-school/ school	N/A	Speech impairment	Parent-child relationships
Overby, Carrell & Bernthal (2007)	48 2nd grade teachers	Median age of teachers 41;2 years	N/A	Speech impairment (moderate)	Formal interactions (teachers)

(*continued*)

Appendix. (*Continued*).

Author(s)	No. of participants	Age at first testing	Age at follow-up	Description of communication impairment	ICF areas of difficulty*
Perry-Carson, Carson, Klee & Jackman-Brown (2007)	17 (+30 in control group)	Mean approximately 2½ years	N/A	Speech and language delay	Parent-child relationships
Robertson, Harding & Morrison (1998)	103 (+66 in control group)	School-aged (5th and 6th grades)	N/A	Difficulties in articulation, abnormal voice, fluency or language disorder	Informal relationships with peers/ School education (resilience)[8]
Rudolph, Kummer, Eysholdt & Rosanowski (2005)	91	Mothers (22–40 yrs) Children (1–7 yrs)	N/A	Speech (dyslalia) and/or language delay	Parent-child relationships (maternal quality of life)
Rudolph, Rosanowski, Eysholdt & Kummer (2003)	100	Mothers (22–47 yrs) Children (1–8 years)	N/A	Speech impairment (not otherwise defined)	Parent-child relationships (maternal depression)
Wink, Rosanowski, Hoppe, Eysholdt & Grässel (2007)	89	Mothers (19–44 yrs) Children (1–7 years)	N/A	Speech and/or language impairment	Parent-child relationships (maternal depression and anxiety)
Chapter 8: Major life areas					
Major life areas is also mentioned in papers indicated by a superscript 8 in the final column of this appendix.					
Allard & Williams (2008)	455 adults	18–49 years	N/A	Articulation (lisp), language, fluency, voice disorders	Acquiring, keeping and terminating a job (employability)
Mitchell, McMahon & McKee (2005)	1637 allegations of discrimination	Mean age approximately 41 yrs	N/A	Speech impairment (not otherwise defined)	Acquiring, keeping and terminating a job (employment discrimination)
Ross, Neeley & Baggs (2007)	125 (+47 in control group)	2nd grade (US)	N/A	Speech impairment Language impairment	School education (discipline infractions)
Snowling, Adams, Bishop & Stothard (2001)	71 (+49 in control group)	Approximately 4 years	16–17 years	Speech / language difficulty	School education

Note: *Numbers indicate the other ICF Activities and Participation chapters to which the paper relates.
Abbreviations: SLP – Speech-language pathologist.