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STATE OF THE ART PAPER

Deaf children's bimodal bilingualism and education

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Abstract

This paper provides an overview of the research into deaf children's bilingualism and bilingual education through a synthesis of published studies over the last 15 years. This review brings together the linguistic and pedagogical work on bimodal bilingualism to inform educational practice. The first section of the review provides a synthesis of the research, addressing linguistic, cognitive and social aspects of bimodal bilingualism. This is followed by a focus on bimodal bilingual language experience and use in different learning contexts. These first two sections provide the context for the main focus of the review: education and learning. The third section reports on links made between bimodal bilingualism and learning with regard to deaf children's literacy development. The fourth section examines further research into bimodal bilingual pedagogies. The final section considers the theoretical and practical implications of the field to date in developing a contemporary model of bimodal bilingual education for deaf children. It also charts future research priorities.

Biography

Dr Swanwick is an Associate Professor in Deaf Education at Leeds University in the School of Education. Her research and publications centre on deafness, language and learning and the development of pedagogies and practitioner understanding. Her funded research includes a

collaborative ESRC funded project looking at deaf children's early literacy experiences in the home; a Nuffield funded project on the role of sign language for deaf children with cochlear implants and a British Academy project on approaches to critical thinking and reflective practice across the national training provision for teachers of the deaf. Her current work, funded through a British Academy Mid-Career Fellowship, centres on the development of a model of bimodal bilingualism and learning which situates deafness and language learning within a plural view of language and culture in society.

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1. Introduction

The practice of educating deaf children bilingually through the use of sign language alongside written and spoken language initially developed during the 1980s in Scandanavia, the USA and the UK. This approach developed as a response to concerns about deaf children's attainments within traditional spoken language approaches (see, for example, Conrad 1979) and research demonstrating sign languages to be naturally evolving rule-governed languages (Stokoe 1960; Klima & Bellugi 1979; Kyle & Woll 1985). As the linguistic study of sign languages burgeoned, the increasing role of sign languages in education fostered the development of new teaching approaches (Mahshie 1995; Knight & Swanwick 2002). The articulation of a socio-cultural understanding of deafness provoked new research into deaf children's language development, culture and identity. Developments in practice and research, and the increasing activity of interest

groups in the deaf community, raised the visibility of sign language in the media, education and research. The development of a bilingual approach became the focus of much debate and critique in professional and research forums as this innovation challenged traditional methods which hitherto had focused solely on deaf children's spoken language development.

There is no one globally agreed-upon definition for the bilingual education of deaf children. Policies and practices vary markedly across different national contexts, particularly regarding the role and use of spoken and written language. However, there is a common philosophy and an underlying set of principles which do traverse countries and cultures. Philosophically, bilingual education strives towards the humanitarian and democratic goals of social inclusion and diversity. It is an approach to education that recognises the unique and distinctive features of deaf language and culture, validates the linguistic and cultural choices of deaf people and celebrates this diversity. The central tenet of this approach is that access from birth to a language for learning and development is the right of every child and that delay in language development is never acceptable.

A bilingual educational approach gives deaf children the opportunity to learn sign language and spoken/written languages and grants them access to the curriculum in whichever language is most accessible to them in an environment that values deafness, sign language and deaf culture (Swanwick 2010). This approach has been labelled 'sign bilingual' in some contexts and 'bilingual bicultural' in others (Marschark & Lee 2014). The term 'cross-modal bilingualism' is also used to indicate the use of two different languages and two different modalities (Menéndez 2010). For the purposes of this review, the terms bimodal and bilingual are used to talk about this exceptional language learning situation that involves the use of two or more modalities (sign, text and speech) and two or more languages. The incorporation of spoken language within this definition extends the usual use of the term bimodal bilingualism to refer to sign language and

written language (Ormel & Giezen 2014). The educational approach will be referred to throughout as 'bilingual'. This use of these terms deliberately places the emphasis on the language learner and language repertoires, rather than on language policy. Bimodal communication in this context will refer to the way in which individuals draw on their range of sign, spoken and written language resources to make meaning.

This review brings together research in bimodal bilingual language development and educational practice to synthesise key issues for future research. Currently these two areas of research are quite distinct in their research questions and paradigms, and there has been little cross-fertilisation. This review draws on the linguistic research to underpin an educational perspective. The reported research concentrates primarily on the school-aged population (5-18) but studies relating to the preschool and further/higher context are included where they illuminate research issues and directions.

Use of the term 'deaf' in this review refers to any level of hearing loss significant enough to have an impact on language development and learning. This includes mild, moderate, severe and profound categories in audiological terms (British Society of Audiology 1998). The use of the term 'deaf' also communicates the cultural and linguistic aspects of deafness in preference to 'hearing impaired' which was rejected in the 1991 joint statement by the World Federation of the Deaf and International Federation of Hard of Hearing People. The term 'Deaf' (capitalised) will only be used to refer specifically to Deaf culture and community (Senghas & Monaghan 2002).

The timeliness of this review relates to the changing climate of deaf education and the need to re-consider the goals and implementation of a bilingual approach. The reasons for this are firstly, that deaf children's contexts for learning are changing as access to inclusive educational provision is afforded by new and developing hearing technologies. Further, new audiological technologies have had a significant impact on deaf children's language experience and use.

Specifically, digital hearing aid technology and cochlear implants have improved deaf children's potential for spoken language development, and Universal Newborn Hearing Screening secures access to these technologies and early intervention programmes from birth. The success of these audiological advances and enhanced access to spoken language has changed the language and communication potential, and profiles of deaf children (Watson, Archbold & Nikolopoulos 2006; Mayer & Leigh 2010). However, research suggests that there are still many educational challenges for these learners, who, although better equipped to access the mainstream curriculum through spoken language, may still benefit from a bilingual approach for a range of language, learning and social needs.

This review was completed in two stages. Stage 1 involved an initial scope of the literature to identify main research themes in bilingual education and deafness since the 1980s. The literature search drew on published research written in English in peer-reviewed journals. 'Scopus' was employed as the main search engine, cross-referenced with ERIC and BEI, as well as with searches in specific journals in the field (*Journal of Deaf Studies and Deaf Education*; *Deafness and Education International*; *American Annals of the Deaf*; *Sign Language Studies*).

A first, speculative search was undertaken using the terms 'deaf' and 'bilingual', limited in the first instance to the Title, Abstract and Key Words categories for peer-reviewed research or review papers. This initial scope yielded 134 papers. This pool appeared to be too small given the extent of educational research in the field and the range of topics. The outcomes of the search were cross-checked with the main journals in the field. This confirmed that using only the 'Abstract and Title and Key Word' categories did not capture the full range of pedagogical research in this field. The search process was therefore refined in two ways: the search category was extended to include 'all fields' and the word 'education' was added to the search terms 'deaf' and 'bilingual'.

The outcomes of this search were calibrated with the initial search and an analysis of the abstracts was undertaken to remove any papers which did not mention 'deaf' and/or 'bilingual' and/or 'education' An initial grouping of these papers revealed major themes and sub themes in the research literature as well as trends in research contexts, key research questions and key international sources. Four major themes were identified within the literature on deaf children's bilingualism and bilingual education:

- Bimodal bilingual language development

- Bimodal bilingual language usage

- Bimodal bilingual literacy development

- Bimodal bilingual pedagogies

Stage 2 of the process refined the search by concentrating on research since 2000 and increasing the depth and rigour of the research into the main areas of focus identified in stage 1. For this stage of the process the search terms were extended to incorporate some of the key words that had been identified in stage 1 in the relevant areas. The term 'deaf' was expanded to include 'hearing impaired' and 'deaf/hard of hearing'. The term 'bilingual' was expanded to include 'bimodal' and 'sign language'. The term 'education' was expanded to include 'learning' 'instruction' and 'literacy'.

The fields of the search remained the same and the emphasis remained on peer-reviewed published articles and significant books or chapters in books. Results of the stage 2 review were cross referenced with stage 1 to ensure that nothing had been missed to provide a total of 420 peer-reviewed papers over a 15 year period. These papers were then reviewed and selected or rejected according to their relevance to one or more of the four main review topics. The final review collates research from 160 articles and four key edited books to present relevant research on deafness, language and learning. Reference is made to some chapters, books and articles

outside of the review period in the case of landmark publications or to provide essential contextual or historical information.

The first section of this review provides a synthesis of research addressing linguistic, cognitive and social aspects of bimodal bilingualism. The second section focuses on bimodal bilingual language experience and use in different learning contexts. These two initial sections provide the context for the main focus on education and learning. The third section reports the links made between bimodal bilingualism and learning in the domain of literacy. The fourth section reviews the research into bimodal bilingual pedagogies. In the final section the theoretical and practical implications of the findings are considered for the development of a contemporary model of bimodal bilingual education and for future research priorities.

2. Linguistic aspects of bimodal bilingualism

The study of bimodal bilingualism is of interest to applied linguistics because the reception and production of sign language and spoken language take place through different channels (vision and gesture, and audition and voice respectively). Even though deaf people may receive spoken language through visual perception of oral articulations and accompanying voice (speechreading), the two languages are differently articulated and received. Research interest in this field has thus explored aspects of bimodal bilingualism which are not encountered in the study of unimodal (where there is a shared modality) bilingualism. The key areas of research centre on the linguistic structure of sign language; the organisation of sign language in the brain; the process of sign language development, in particular, the developmental milestones and early interaction and deaf people's language experience and use. A particular focus of the latter topic is the potential for language blending (the simultaneous use of signs and speech) that bimodal bilingualism presents.

2.1 Sign language linguistics

Research into the linguistic structure of sign languages is still quite young. The most extensive early work emerged primarily in response to American Sign Language (ASL) and British Sign Language (BSL) between the 1960s and the 1980s (Stokoe 1960; Klima & Bellugi 1979; Kyle & Woll 1985). Since then interest has developed globally in different sign languages, particularly regarding their role in education. The linguistic structure of sign language has been fully described elsewhere (see for example Sutton-Spence & Woll 1999). It is sufficient to underline that research has demonstrated that sign languages, as natural languages, fulfil the same linguistic, social and cognitive functions as spoken languages (Emmorey 2002). A growing literature on sign languages continues to develop our understanding of their linguistic structure (Yang & Fischer 2002; Hunger 2006) and the social and cultural contexts of their use (Branson & Miller 2004; Slegers 2010; McKee & McKee 2011; Behares, Brovetto & Peluso Crespi 2012; De Quadros 2012; Geraci 2012; Parisot & Rinfret 2012; Quer 2012; Schermer 2012).

The visual-gestural characteristics of sign language have prompted extensive interest in the neurological processing of the sensory motor aspects of sign language. The most significant finding for this review demonstrates that the neural systems that support sign and spoken language similarly involve the left-lateralised network of the brain (Hickok, Love-Geffen & Klima 2002). Although there is some right hemisphere activity in sign language processing for spatial and movement encoding, the left hemisphere of the brain shows dominance for sign language processing (Mineiro et al. 2014). Interestingly, as will emerge in the consideration of literacy development (Section 3), the phonological processing of signs and words is identical (MacSweeney et al. 2008).

2.2 Sign language acquisition

Sign language acquisition studies have focused on how individuals master aspects of sign language structure such as phonology (Morgan 2006; Mann et al. 2010), spatial language

(Schembri, Jones & Burnham 2005; Morgan et al. 2008), narrative skills (Robertson et al. 2012) and grammar features (Thompson, Emmorey & Kluender 2009). This area of research has extended to include the study of impairments or disorders in sign language use (Meronen & Ahonen 2008; Mason et al. 2010; Quinto-Pozos, Forber-Pratt & Singleton 2011; Woll & Morgan 2012). Nonetheless, this work is still very much in its infancy and, for many countries, the indigenous sign language has not yet been fully described.

Studies of sign language acquisition in children show that sign language development is comparable to spoken language development. This knowledge is mainly based on research in the USA and the UK with deaf children of deaf parents, demonstrating that early fluency in sign language leads to equivalent word and sentence level milestones and pragmatic skills (Petitto et al. 2001; Most 2003; Rinaldi & Caselli 2009). However, this is not the case for the majority of deaf children who are non-native or non-fluent signers. These are usually children of hearing parents who have no prior experience of deafness or sign language. The development of sign language fluency for this group of deaf children is problematic as they experience a general delay in sign language development and difficulties in catching up. This has been evidenced through scores on standardised sign language assessments (Herman & Roy 2006) as well as general language comprehension (Rodríguez 2007) and early pragmatic and narrative competence (Becker 2009; Surian, Tedoldi & Siegal 2010).

This delay is explained in part by the limited access to everyday conversation and routine interactions, such as story telling or parental commentary around a shared activity. Hearing parents reportedly find it difficult to learn sign language as adults, as a second language (L2) (Napier, Leigh & Nann 2007; Von Pein & Altarriba 2011). Even though many of these families do develop their own 'homesign', these communication strategies do not fulfil the experience of

early access to a fluent language from birth (Janjua, Woll & Kyle 2002; Morford & Hänel-Faulhaber 2011).

The case of deaf children who are born without full access to a spoken language and who have limited or no exposure to a sign language provides insight into the impact of delayed exposure to a first language (either spoken or signed). There are of course many mediating factors which alter individual circumstances (age of diagnosis, aetiology, comorbidity, intervention experience, parental hearing status, access to hearing technology) and which can facilitate the development of a fluent spoken and/or sign language. However, when considering what happens when accessible exposure to sign language as a first language (L1) is delayed, research has focused on neurological development, the overall ability to learn language (Cormier et al. 2012), and stages of development (Berk & Lillo-Martin 2012). These studies find there are processing deficiencies when access to either a spoken or a sign language as L1 is delayed and that this has a subsequent impact on the development of literacy (Mayberry 2007; Malaia & Wilbur 2010; Mayberry et al. 2011a).

2.3 Sign language assessment

The growth of understanding of sign language acquisition has led to the development of standardised assessments for sign language in several developed counties and these are also emerging in less developed countries (see, for example, Lichtig et al. 2011). The most widely used of these tests in the literature are the BSL receptive (Herman, Holmes & Woll 1999) and productive tests (Herman et al. 2004). The receptive skills test has been adapted for the USA context (Enns & Herman 2011), Germany (Haug 2012) and Australia (Johnston 2004). Advances in sign language assessment development are also reported in the Netherlands (Hermans, Knoors & Verhoeven 2010). These tests currently only provide fractional information about sign language development. Nonetheless, the outcomes confirm the problems that some deaf children

experience in developing sign language fluency (with the exception of deaf children of deaf parents) even when pupils in bilingual educational programmes (Johnston 2004).

2.4 Summary

The study of sign language acquisition provides a foundation for understanding bimodal bilingualism. This work has changed our understanding of human language learning and the mind. This research has shown that sign languages are linguistically organised and that meaning is produced and perceived in the same way as spoken languages, even though the mode of communication is visual-manual and not auditory-oral. We have learned that the architecture of the brain for the structure and processing of language exists independent of modality and that the milestones for sign language acquisition are parallel to those of spoken language where language is accessible in the learning environment.

This research provides the linguistic context for the exploration of bimodal and bilingual education. From this knowledge base we can appreciate the bilingual language learning potential and challenges for deaf children and the very specific issues for children in hearing families (over 95% of deaf children) who grow up without access to a fluent model of sign language from birth. Application of this knowledge to learning and teaching requires an understanding of actual bimodal bilingual language experience and use to see how the linguistic research might engage with everyday interactions in deaf children's lives.

3.Bimodal bilingual language usage

Research into deaf children's bimodal bilingual language is generally underdeveloped and tends to focus on particular groups of children. One of the most prevalent research questions concerns the nature of interactions in mixed deaf and hearing families. This work has focused largely on hearing bimodal bilingual children who are native sign language users, often children of deaf adults. These studies, although tangential to this review, usefully touch on questions of how sign

and spoken languages can be used alternately and blended in language contact situations. This latter issue is explored in the research in relation to bimodal bilingual deaf children and how their language use can be described and assessed. The other prevalent focus group is made up of deaf children with cochlear implants. The questions explored with this group centre on the way in which sign language is used alongside spoken language and how this alternate and blended language use, as explicit and visible language interaction, changes over time.

3.1 Research with hearing bimodal bilinguals

Studies of interaction between hearing children and their deaf parents provide some insights into fluent bilingual and bimodal usage, while acknowledging that different language learning experiences obtain for most deaf children in terms of early language access and fluency. In these case studies deaf parents use both spoken and sign language with their deaf and hearing children (van Den Bogaerde & Baker 2005; Baker & Van Den Bogaerde 2008). Mixing sign and spoken language is a language contact phenomenon and, as such, a natural part of daily interaction even where sign language is the shared and fluent language for all.

This type of language contact is illustrated further in examples of code blending by adults and children that draws on and integrates the grammars of sign and spoken language. A specific example of this is the presence of ASL in spoken English structures as when the use of grammatically correct ASL facial expression accompanies spoken wh-type questions or the use of pointing during a spoken English utterance clarifies the subject and object of a sentence (Bishop & Hicks 2005; Bishop 2010). This way of blending the two languages is again a natural feature of talk in a bimodal bilingual language environment. It is acknowledged here that this is a specific language learning context. Nonetheless, these findings exemplify fluent bimodal bilingual language usage and illustrate that flexible mixing and blending of sign and spoken language constitutes a normal part of individual language repertoire in this context.

3.2 Research with deaf bimodal bilinguals

Research into deaf bimodal and bilingual language usage has only recently begun to emerge and, as with the hearing bimodal bilingual research, these are often small-group or case studies (for example Levesque, Brown & Wigglesworth 2014). The key research questions consider how deaf children use their sign and spoken languages in different situations with deaf and hearing communication partners, how their different and blended language competencies can be measured and described, and how their spoken and sign language repertoires and usage change over time.

The main findings that emerge from this work ascertain that deaf children's alternate and blended use of sign language and spoken language is a normal component of bimodal bilingual communication. Deaf bimodal bilingual children are able to switch flexibly between languages and modes and in some studies the most advanced use of language, in terms of lexical richness and syntactic complexity was when sign and speech were used together (Klatter-Folmer et al. 2006; Krausneker 2008; Rinaldi & Caselli 2009).

In terms of description and assessment, although we have some sign language assessments and many spoken language assessments developed for deaf children, we currently lack tools or protocols to document deaf children's mixed or blended use of sign and spoken language. We also lack systematic means of accurately identifying language dominance. Studies which have sought to explore this have tended to develop context specific protocols. Examples can be found in research in Brazil and the Netherlands (Klatter-Folmer et al. 2006; Lichtig et al. 2011). These studies reveal the extent to which deaf children's mixed (signed and spoken) utterances can provide the most efficient means of producing linguistic complexity and communicative richness. Although there is some question as to whether these mixed utterances

inhibit children's optimal use of either language, the findings suggest that the separate assessment of languages does not demonstrate the linguistic complexity of which deaf children are capable

3.3 Research with children with cochlear implants

Deaf children's changing bimodal and bilingual language practices have come under scrutiny in the specific context of cochlear implant (CI) research because of the early and increased access to the full range of speech sounds that CIs afford. The use of sign language changes following CI but nonetheless continues, particularly for those children with additional difficulties or where the outcomes of the CI are not as predicted (Hyde & Punch 2011). Studies of children's language show a general shift towards spoken language use but with the continued flexible use of sign language depending on individuals and contexts (Watson et al. 2006). Parents and young deaf people themselves report that sign language continues to be useful after implantation, providing support for learning, communication and networking flexibility, and for social-emotional development and identity (Christiansen & Leigh 2004b; Preisler, Tvingstedt & Ahlström 2005; Watson et al. 2008; Wheeler et al. 2009; Walker & Tomblin 2014). Ongoing research shows that bimodal and bilingual children with cochlear implants do not suffer any disadvantage in the development of spoken language. In fact, early sign language input mitigates the disadvantages of early auditory deprivation (Davidson, Lillo-Martin & Chen Pichler 2014). Furthermore, implanted native signers develop better spoken language skills when compared to children with hearing parents (Hassanzadeh 2012).

An important conclusion drawn from this work is that sign language continues to be part of the communication journey of young people with implants and an important part of growing up deaf with an implant (Christiansen & Leigh 2004a; Cramér-Wolrath 2013). This area of research marks a significant development in deaf education's understanding of children's language usage and provides insights into the flexibility and pragmatism of young deaf people

and their families. This avenue of research also incorporates the voices of young deaf people and their parents about their language use, rarely visible in the language research to date.

3.4 Summary

The research into bimodal bilingual language experience and use illustrates that the mixed and blended use of sign and spoken language is a normal part of deaf children's daily lives. However, running through this research are questions regarding the extent to which mixed and blended language use compromises or supports the autonomous development of the individual languages. There is an evident tension here in understanding mixed language use: either it is a stage in developing competence in both languages or it is a creative use of new language structures and as such a stable end point in itself. These questions probe theoretical issues regarding the nature of language itself, as separate bounded systems or a dynamic set of resources for meaning-making. The limited evidence provided by case studies observing deaf children thus far suggests an integrated language potential that exceeds the skills in either languages when examined in isolation. These findings encourage a move away from a fractional view of bilingualism which focuses on separate proficiencies in separate languages and from pedagogies which aim to separate the use of sign and spoken language. That is not to suggest that proficiency in both languages does not remain a goal, but rather that we investigate the creative use of children's full language repertoires to achieve such a goal. The development of this new knowledge also highlights the need for more integrated approaches to assessment which recognise the fluctuating dominance of different languages in children's lives and different language proficiencies across different domains.

4. Bimodal bilingual literacy development

Research into bimodal bilingualism and deaf children's learning interconnects within the field of literacy development. This substantial area of research provides a natural bridge for the

exploration of bimodal bilingual learning and pedagogies. Deaf children's literacy development is the most researched topic in deaf education. Research since the 1970s has consistently shown that deaf children significantly underperform in literacy during their school years, hampering their access to all other aspects of learning and the curriculum (Kyle & Harris 2010; Kyle & Harris 2011). This continued underachievement means that the majority of deaf young people leave school with insufficient literacy skills to participate fully in further and higher education or employment, regardless of their levels of hearing loss or whether or not they have had a cochlear implant (Moeller et al. 2007; Archbold et al. 2008; Marschark et al. 2010).

The main research question in bilingualism and literacy research interrogates the role of sign language in the learning and teaching process. There is some consensus in the literature regarding the importance of sign language for providing early fluency in a language and developing the background and conceptual knowledge needed as footings for the development of literacy skills (Wilbur 2000). Crucially this opens up the potential for dialogue and interaction in the classroom around literacy events, the construction and negotiation of meaning, and the development of metalinguistic skills and language awareness (Swanwick 2001; 2002; Kelman & Branco 2009). The use of sign language for literacy instruction and particularly for translation activities (e.g. from ASL to English) allows for conceptually matched input from teachers and the use of language comparison and analysis (Evans 2004). Alongside the use of sign language for mediating literacy learning there is growing interest in how sign and speech can be combined in different ways to provide support for literacy learning. This research has focused largely on the potential of the transfer of skills between languages which has excited the following theoretical debate and developments in practice.

4.1 The theoretical debate

As sign language became more widely used in education and research began to develop, a number of studies in the 1980s and 1990s demonstrated a positive relationship between reading skills and sign language competency. This body of research revealed that deaf children of deaf parents, where sign language is the shared language of the home, are generally more successful readers than deaf children of hearing parents (Prinz & Strong 1998; Hoffmeister 2000; Padden & Ramsey 2000). The finding that good signers are good readers was interpreted as evidence of how sign language could support deaf children's literacy development and the potential of routes to literacy which need not necessarily rely on access to the phonological aspects of the spoken language. A model of bilingual education thus began to emerge in the 1980s which envisaged sign language as the first or dominant language and a basis from which to develop literacy skills in the second language. As this model became increasingly articulated, especially in the USA, Scandinavia and the UK, Cummins' linguistic interdependence theory (1981) became an accepted theoretical basis upon which to speculate about the role of sign language in supporting literacy development (Mayer 2009; Grosjean 2010; Swanwick 2010).

The ensuing debate problematised the bilingual model of literacy development which assumes sign language to be the first language (L1) and written language to be the second language (L2). In a landmark and influential publication, Mayer & Wells (1996) argued that deaf children are not learning the written form of the spoken language in circumstances commensurate with other L2 learners for a number of reasons. Firstly, sign language has no written form and so, unlike most L2 learners, deaf children have no prior experience of the use of this modality. Secondly, deaf children are usually unable to approach the learning of L2 literacy with established and fluent L1 sign language skills. Deaf children are thus not able to approach the learning of literacy as an L2 or an L1 experience.

Mayer & Wells (1996) described this as a 'double discontinuity' (p.103) and their theoretical critique has been influential in the deaf education literature. However, this critique is problematic in a number of ways. Firstly, the argument that transfer cannot take place between dissimilar languages is based on a narrow view of linguistic transfer and of routes to literacy development. Cummin's (2006) view of linguistic transfer incorporates conceptual knowledge, metacognitive strategies and pragmatic skills as well as linguistic and phonological knowledge. There is growing evidence of positive interaction between sign and spoken languages at all of these levels and indeed that transfer can take place across between two or more dissimilar languages (Tang, Lam & Yiu K 2014).

Further, this critique assumes that there are no goals relating to spoken language development in bimodal bilingual deaf education and that the only route to literacy considered is via a sign language. This ignores the fact that approaches to bilingual education are more diverse and nuanced than this. The goals associated with bilingual education and interventions to support and enhance spoken language development are not mutually exclusive (Swanwick et al. 2014).

The theoretical debate demonstrates the need for a model of bimodal bilingual literacy development that draws on research in the wider field of bilingualism while remaining relevant to deaf learners. This involves understanding how bimodal bilingual deaf children deploy their language resources in the process of learning to read and write, and examining bimodal bilingual pedagogies that have been developed to support these processes.

4.2 The reading processes

Research into bimodal bilingual deaf children's language mixing and blending has been used in the exploration of deaf children's literacy development. One aspect of this research literature is concerned with the neurological processes involved for bilingual deaf readers, recognising that the reading process may be a qualitatively different experience for these learners. For hearing

unimodal bilinguals we know that both languages are activated in reading, whether or not the two languages have similar scripts (Piñar, Dussias & Morford 2011). That is to say that there is evidence of cross language activation between words which are phonologically or orthographically similar. The case of bimodal bilinguals raises the question as to whether cross language activation happens during reading, given that the two languages do not share phonology or orthography. This research has looked at the extent to which written words activate sign translations in deaf (proficient) bimodal bilinguals. Morford et al (2011) present evidence that deaf bilinguals activate the sign translation of words when processing written words. This evidence of cross language processing is also reported by Ormel et al. (2012) who conducted a similar experiment with deaf children (who were not yet proficient bilinguals) using word picture pairs with and without strongly iconic sign translation equivalents. These findings mirror those for less proficient hearing unimodal bilingual children, who activate their L1 when reading.

4.3 Language interaction

The interrelationship between sign, spoken and written languages has also been explored in the domain of bimodal bilingual literacy development. There is emerging empirical evidence aimed at the lexical level, and particularly at vocabulary learning, that found children with more extensive sign language vocabularies tend to have more extensive written vocabularies (Hermans et al. 2008; Holzinger & Fellinger 2014). This work has made an important contribution to our thinking about transfer between sign and spoken languages, suggesting that transfer at the semantic lexical and grammatical level can be obtained in the case of bimodal bilingual deaf learners (Tang et al. 2014). Hermans, Ormel & Knoors (2010) suggest that this should be described as an 'associative' and not a 'direct' transfer, but argue that this can nonetheless can be 'cultivated' (p.194) through the right kind of teaching to become automatic.

The pedagogical question that this research raises is how to support learners to make the association between sign and written vocabularies. Hermans et al. (2008) propose that one way to do this is through 'chaining'. This term refers to a way of making connections between ASL sign, fingerspelling and written English (Padden & Ramsey 2000). Typically it uses different sequences of the presentation of a sign, the fingerspelling of its English equivalent and the written version of the same word. This can be done in any order, depending on the teaching objective, but the strategy is often used where there is a teaching emphasis on learning new English terminology or vocabulary or to point out equivalence of meaning across two languages. For example, a teacher might point to a new English word, fingerspell the word and then give the ASL sign for the word. The term 'sandwiching' is also used for this type of language presentation which implies the alternated use of signs and fingerspelt words. In much the same way as spoken and written languages are blended in reading (we say the words as we read or write them), encoding written words via a sign-based system cultivates links between the two language modalities (Mayberry, DelGiudice & Lieberman 2011b).

Hermans et al. (2008) also emphasise that the role of spoken language, specifically phonological awareness, should not be overlooked in relation to bilingual deaf children's reading development. Some of the sign based support systems such as visual phonics and cued speech and speechreading which exploit associations between signs and spoken and written words, have a role to play here (Wauters et al. 2001; Mollink, Hermans & Knoors 2008; Harris & Terlektsi 2011). These are discussed in full in section 3.6.

4.4 Bimodal bilingual deaf children's writing

The study of deaf children's writing has provided fertile ground for analysing children's bimodal bilingual usage and for speculation about the interaction between visual/gestural and written modalities. The challenges that this experience of language learning presents for writing centre

on the 'unmappability' between multi-channel visual languages and written languages, such as the absence of one-to-one correspondence between written and spoken words and signs and the different grammatical structures of the languages (Swanwick et al. 2012) . The most fruitful studies in this area are those which consider deaf children's writing from a bilingual rather than monolingual perspective and explore the different potential routes to literacy development, documenting how children use their repertoire of bilingual and bimodal resources (Swanwick 2002; Singleton et al. 2004; Koutsoubou, Herman & Woll 2006, 2007; Niederberger 2008; van Beijsterveldt & van Hell 2012).

From this perspective, the concept of transfer between languages has been explored via the influence of sign language on writing and the extent to which children draw on the resources of the visual-spatial language that they know to support the writing process across differences in modality. Menéndez (2010) describes deaf children's use of sign language structures in their writing as a transfer strategy. He suggests that that they draw on the skills that they have in sign language to engage with a written language and that the route to literacy does not have to be a predominantly phonological pathway. Niederberger (2008) argues that linguistic transfer can be identified at a pragmatic level, demonstrating that knowledge of construction and comprehension of narratives in sign language is transferable to deaf students' performance in their writing. Van Beijsterveldt & van Hell (2010; 2012) suggest that the enhanced use of evaluative writing devices by good sign language users is also evidence of language transfer, which reflects how integral the communication of evaluative information about objects or people (emotion states) is to description in sign language. Swanwick (2002) proposes that transfer can be construed at a metalinguistic level, which showed that deaf children's awareness of the different ways in which sign language and written languages express meaning supported the writing process.

Koutsoubou's (2008) finding, that writing from a translation task facilitated more complex writing and narrative structure, supports this thesis.

4.5 Bimodal bilingual approaches to supporting literacy development

Research into bimodal bilingualism and literacy development adds to our understanding of linguistic interconnections between languages and the flexibility of the language system in accommodating and working between different modalities. However there is as yet an insufficient amount of research on which to build evidence-based literacy pedagogies for deaf bimodal bilingual learners (Myers et al. 2010; Cannon & Guardino 2012). The literature in this area focuses more on development than on the evaluation of teaching approaches addressing the 'double discontinuity' described by Mayer & Wells (1996). Opinion is divided regarding the extent to which bilingual deaf readers do, or do not, rely on auditory phonological awareness (e.g. Chamberlain & Mayberry 2000; Wang et al. 2008; Miller, Lederberg & Easterbrooks 2013). Furthermore, the correlation between speechreading and subsequent literacy skills suggest that phonological awareness does not have to be a wholly auditory process (Kyle & Harris 2011). Nonetheless, several avenues of research have explored ways to 'bridge the gap' between sign language and literacy by using multi-sensory coding to support word learning and reading comprehension (van Staden 2013).

These lines of enquiry are underpinned by the predominant perspective that literacy development relies on some conversational experience of the target language and an internal representation of the spoken language (Hermans et al 2008). This raises the pedagogical question: how may the rich oral and conversational experience needed to support the development of text based literacy skills be facilitated? This question has prompted the exploration of teaching approaches which deploy the mixed and blended use of sign language and spoken language.

4.6 Mixed and blended language use in literacy development

Most of the terms related to mixed and blended use of signs and speech used in this review emanate from the USA or the UK literature on the various invented sign systems which have been developed to represent English semantics and syntax and which have a specific pedagogical purpose relating to the teaching of English.

Manually Coded English (MCE) is a general term which encompasses all the different ways in which sign language and spoken language can be used in combination to provide visual support for spoken English. In broad terms, MCE involves the use of signs borrowed from BSL or ASL (usually meaning-carrying words) to accompany speech. This should not be confused with Total Communication (TC), a term which originally evolved to describe an educational philosophy and approach involving the flexible use of sign and spoken language to meet individual communication needs (Evans 1982). Over the years the philosophical use of this term to denote a child-centered approach has been lost and TC is now more often used to describe the simultaneous combination of signs with speech (Marschark, Knoors & Tang 2014). This is generally referred to as Simultaneous Communication (SimCom) in the American literature, and Sign Supported English (SSE) in the UK. All of these terms refer in some way to the simultaneous production of grammatically correct spoken English and signs for educational purposes and/or for a mixed deaf/hearing audience.

4.6.1 Sign Supported English

The literature refers to SSE in a variable way as its use depends on context and audience. It is used by adult deaf people to describe a variety of signing with substantial mixing and blending of English. SSE is also the natural result of contact between deaf and hearing interlocutors and is spontaneously used by deaf and hearing children and adults to ensure that both deaf and hearing parties can participate (Sutton-Spence & Woll 1999). In an educational context, SSE is usually

used to support the comprehension of speech. In this context, the use of SSE tends to be spoken language driven and the objective is to maintain the integrity of the spoken message.

During the 1980s, when bilingual education for deaf children was developing, there were linguistic concerns about the combined use of sign and spoken language and the impact on the integrity of the linguistic message for both languages (Singleton et al. 1998). It was acknowledged that, for hearing people in particular, using SSE or SimCom effectively was very difficult. The overriding concern was that children were not receiving a fluent model of a sign language and that this mixed use of language was confusing. There were also ideological concerns around SimCom because of the way it was usually used in classrooms (by hearing teachers) where the spoken language was usually the dominant language. However, it has been shown that this mixed use of languages does not confuse deaf children and is very much a part of their own language repertoire. Further, there is evidence that there are benefits to using SSE and that it can be an effective learning and teaching strategy where adults are appropriately trained. The benefits are that SSE enables learners to match spoken language to signs, access spoken English, and provide communicative flexibility (Knoors & Marschark 2012).

4.6.2 Fingerspelling

The use of fingerspelling to present a visual representation of written graphemes has been extensively discussed as a way of supporting deaf children's developing reading skills (Padden 2006; Haptonstall-Nykaza & Schick 2007; Alvarado, Puente & Herrera 2008). Fingerspelling is a result of language contact and is thus rather hybrid. The use of fingerspelling is a natural part of interaction in sign language (Roos 2014) and it has particular relevance to pedagogy as it reflects the imperative to refer to written language in sign language (Senghas & Monaghan 2002). Fingerspelling is a method of spelling out the written version of words using a handshape for each letter. It is used as part of sign language to spell out names of people and places for which

there is no sign or to clarify a new, unknown or regional sign. In BSL, single manual letters are sometimes used in the place of signs. In ASL, the first fingerspelled letter of a word can become the handshape for a sign (such as the handshape of the letter 'C' to mean 'coffee') and this is referred to as 'initialisation'.

The case for using fingerspelling to support the reading process for deaf children is compelling for a number of reasons. The first of these is that fingerspelling is already a part of the natural lexicon of sign language and so is a very accessible tool for deaf children, potentially providing a direct link to the printed word. Secondly, because fingerspelling can be used in conjunction with speech reading and mouthing, there is potential support for deaf children's developing phonological coding as they begin to associate visual speech patterns with letters and letter groupings and gain experience of the sequencing and segmenting of graphemes in the decoding process (Emmorey & Petrich 2012). As such, it is argued that fingerspelling can provide a phonological bridge towards the decoding component of the reading process, compensating to some extent for the difficulties that deaf children experience with auditory short term memory in their reading (Harris & Terlektsi 2011). Crume (2013) describes fingerspelling as a 'true hybrid of a signed language and an alphabetic system writing system' (p.466) and argues that its use can support bilingual deaf children's development of phonological awareness of a sign language (in this case ASL). Other, similar arguments have been made that awareness of the phonological features of ASL (the handshape, movement and location of signs) can support the development of English literacy skills (Puente, Alvarado & Herrera 2006). Examples of working from this premise have been observed in bilingual practice, but empirical evidence is lacking as our understanding of cross-linguistic phonological activation for bilingual deaf readers is only just emerging (Morford et al. 2011).

4.6.3 Signed English

There are also a number of other more systematically codified language systems such as Signed English (SE) and Signed Exact English (SEE). These both include made up signs, as well as signs borrowed from ASL or BSL, to convey morpho-syntactic aspects of spoken English. Both of these invented systems make visible those grammatical features of the spoken and written language that are not expressed in sign language in the same way. This is done through the use of invented manual signs for morphemes such as apostrophe 's' or 'ing' or 'ed' combined with the use of fingerspelling to provide the full graphic form of the word, and initialisation. SEE has more morphological markers that SE but they are both used to provide a 'through the air' experience of spoken English to support the development of an internal model of English (Nielsen, Luetke & Stryker 2011). It is argued that this strategy provides an effective way to make morphemes visible so that similar words can be differentiated by deaf readers, and advocates of this strategy suggest that this will create a bridge to reading (Mayer & Akamatsu 2000; Gaustad & Kelly 2004; Mayer 2007).

4.6.4 Cued Speech

There are some systems which do not draw on any aspect of sign language to convey the phonetic information of spoken language visually. The most widely studied of these is Cued Speech (CS). This system uses handshapes combined with the shapes of articulated words to create a distinct visual hand/mouth combination for each phoneme of the spoken language (Leybaert & LaSasso 2010). CS was developed in the 1960s (Cornett 1978) at Gallaudet University in the USA and became quite popular in the 1980s and 1990s particularly in Belgium, France and Spain. There is a substantial body of work by Francophone Belgian researchers that demonstrates the benefits of using CS for deaf children's phonological awareness and literacy development (see, for example, Leybaert 2000), but, as an approach, this has not been widely used in English speaking countries.

4.6.5 Visual phonics

A more recent approach to literacy development emerging in bimodal bilingual education entails the use of visual phonics as a means of developing deaf children's code-based skills (Trezek & Wang 2006). The development of this approach reflects the extent to which the development of phonological skills has become a high priority in general literacy curricula in the UK and the USA. Visual phonics is a multi-sensory approach to teaching grapheme-phoneme relationships, which combines hand cues and written symbols with speech and/or speech reading to represent the individual phonemes of a language (Trezek & Hancock 2013). The evaluation of this approach suggests that this approach has increased deaf learners' phonological abilities, but the direct impact on the development of literacy skills remains uncertain (Wang et al. 2008; Smith & Wang 2010).

4.7 Insights from early literacy

Alongside these artificial mixed and blended approaches to supporting literacy development, research into how deaf children read and share books with deaf parents offers insights into natural and fluent bimodal bilingual interaction around written language. This work began to emerge in the 1980s (Swanwick & Watson 2005) and there have been several studies since 2000 which have looked specifically at ways in which bilingual deaf parents (usually mothers) mediate between written language and sign language during book sharing activities with their young deaf children (Plessow-Wolfson & Epstein 2005; Kaderavek & Pakulski 2007; Swanwick & Watson 2007; Mueller & Hurtig 2010; Berke 2013).

Some of the techniques that mothers reportedly use reflect those described in the pedagogical literature, such as the use of sign language to talk about language and specifically to give definitions, and interpret and explain either individual words or written language conventions and features such as rhyming or onomatopoeia. Parents also use chaining to pair words to signs through fingerspelling, and there is evidence to suggest that very young deaf

children initially see fingerspelt words as a single integral shape. By five years old, they start to see that there is an individual correspondence between a fingerspelt and a written letter (Padden 2006). Another strategy is parents' use of signing in English word order or incorporating English grammatical features in a signed utterance (such as a fingerspelt function word), which is also documented as a teaching strategy in the pedagogical research literature (Humphries & MacDougall 2000). Aside from these linguistic practices, these studies observe the setting, positioning and placement of their signing by deaf parents vis a vis the child and the book, and how they manage this along with touch and non-manual communication to engage and maintain attention and indicate shifts in the activity, add characterisation or emphasis. This research has to some extent brought the voice of deaf parents of deaf children to the fore. The value of the parent experience and perspective has been recognised as essential to understanding bilingual literacy development and to underpin coaching and support strategies for hearing parents and teachers (Mounty, Pucci & Harmon 2014). However, there are as yet few published studies which provide evidence of positive outcomes of coaching other than increased reading time and effectiveness of communication (Delk & Weidekamp 2001). Nonetheless, we have much to learn from this research about how sign and spoken language might be used to support literacy development and how parents facilitate this.

4.8 Summary

The research questions related to bimodal bilingualism and literacy span theoretical and pedagogical issues about the interaction between sign, spoken and written modalities. The theoretical questions have centred on the interrelationship between signed, spoken and written communication. This work has contributed to, and expanded, our understanding of routes to literacy development and in particular the different ways in which phonological knowledge can be acquired and processed. The outcomes of this research have also extended our understanding

of language transfer by demonstrating that, regardless of difference in modality, transfer can occur at the conceptual, metalinguistic, linguistic and phonological levels as Cummins (2006) suggests in his treatment of unimodal bilingualism.

In terms of pedagogy, this area of research has provoked debate about approaches to bimodal bilingual education for deaf children. The role of spoken language and the various mixed and blended language systems have been extensively discussed and described. However, empirical evidence demonstrating the success of any one approach over another cannot be found. This is hardly surprising, given the heterogeneity within any group of deaf learners of language experience, use and ability. What emerges from this research is that understanding the individual language profiles and skills within and across sign and spoken language must precede decisions about language policy. It is clear that teachers need an extensive repertoire of specialist teaching skills and strategies for making links between sign and spoken/written languages in order to support bimodal bilingual deaf children's literacy development effectively (Wauters & de Klerk 2014). Moreover, the evidence base for these practices needs to be developed to provide a steer for education and training and ensure that such skills are properly deployed.

5. Bimodal bilingual pedagogies

This review reveals the lack of empirical studies which properly critique bimodal bilingual teaching methodologies in deaf education. Of the studies that claim to do this, few are recent or from peer-reviewed journals and even these tend to be problematic in the research questions that they pose and the methodologies they employ. There are a number of studies that show the relationship between deaf pupils' (sign) language skills and achievement, but these generally fail to explain the bilingual pedagogy or to show a relationship between teaching approach and improved learning outcomes. There are nonetheless a number of studies which have tried to explore the efficacy of different teaching approaches and measures of success. Studies into the

teaching and learning process have asked questions about teacher language use in the classroom and how this influences learning. Studies of the learning outcomes have interrogated the academic and social emotional benefits of bilingual education.

5.1 Language use in the classroom

Discussions of practitioner use of sign language and spoken language in the teaching context usually centre on text-based activities where the role of sign language is explored as a bridge to facilitate the learner's access to, and understanding and use of, written language (Akamatsu, Stewart & Becker 2000). Much of this work is concerned with SimCom in bilingual education, either trying to critique or defend its use, and the writing here tends to be passionate (Tevenal & Villanueva 2009). This is explained by a legacy of anxiety about the use of SimCom in deaf education practice, which has both linguistic and ideological roots, as discussed in section 3. What comes through from this body of literature is that language in the classroom has thus far been driven by individual beliefs, attitudes and the language skills of educators in this field, rather than being responsive to children's usage.

Despite these language politics, there are studies which have tried to evaluate the specific role of English-based signing in improving deaf children's English learning and demonstrate the impact of bimodal bilingual pedagogical approaches. This body of work provides some description of the creative ways that teachers blend or mix sign and spoken languages to provide lexical, semantic and conceptual support for learners who may not be fluent signers or speakers. Some of these emphasise the importance of separating the languages in teaching. In these cases ASL is described as the main language of instruction, and access to English is facilitated via literacy with little focus on spoken language development. Although the teachers switch between languages, the blended use of voice with signs (SimCom) is discouraged (DeLana, Gentry & Andrews 2007; Andrews & Rusher 2010). Other studies have specifically explored the

effectiveness of English-based signing in to provide an internal representation of English in order to support literacy development (Mayer & Akamatsu 2000; Power, Hyde & Leigh 2008). The detail given about the way in which language is actually used in the classroom is very variable and in some cases the learning context is described very generally as a Signed English or dual language environment. In other examples, bimodal bilingual classroom strategies are documented in detail. Among these, Humphries & MacDougall (2000) provide an informative taxonomy of strategies used by deaf and hearing teachers demonstrating the practice of 'chaining' as one of the ways of making connections between ASL signs, fingerspelling and written English.

Methodically, all of these studies struggle with the difficulties of demonstrating the effectiveness of one or other approach. The Andrews & Rusher (2010) study is informative in terms of teacher practices, but, from the data provided, we cannot conclude that it is code switching specifically that makes a difference to children's learning. The Delana et al. study (2007) shows a relationship between number of years of ASL use and reading comprehension and raises interesting points about early language use and parental involvement, but there is no clear link between the instructional practices and the learning outcomes. Similarly, no direct link can be made in the Mayer & Akamatsu study (2000) between the use of English-based signing, grammar skills and reading improvement other than to say that the use of English-based signing improves deaf children's English-based signing and does not 'hurt' literary development (p.462).

Some bilingual teaching approaches are still based on the perceived need to separate languages in the teaching environment to preserve the integrity of each language. Andrews & Rusher's (2010) study, for example, presents a very 'monolingual' view of deaf children's language potential with an emphasis on switching between the two languages to give learners the language that they need to 'survive' (p.420). The Delana et al. study (2007) also emphasises a 'dual language methodology' (p.74), where the use of SimCom is avoided. Research is

developing however, to examine more closely the role of English-based signing such as SE and SSE in the teaching and learning process (Knoors & Marschark 2012).

5.2 Evidence of learning

Although the emphasis in the pedagogical literature is on mode of delivery, interest is developing the quality of interaction around learning and the actual learning taking place. Molander, Halldén & Lindahl (2010), for example, look at the difference between deaf and hearing learners' extended discussions around a learning objective and in particular their scientific reasoning. They found that deaf learners' discussions are more quickly truncated than those of their hearing peers because of difficulties with new curriculum vocabulary and nuanced meanings of certain curriculum terms. Showing the importance of looking beyond modality, they demonstrate that, although new vocabulary can be presented in fingerspelt form, this does not necessarily connect to meaning generally for deaf learners or the appropriate meaning for a given learning context. These difficulties were found to inhibit deaf and hearing group work and thus curtail deaf learners' opportunities to extend learning through discussion with peers.

The Kelman & Branco (2009) study of deaf and hearing teaching teams in an inclusive setting also examines interaction in the classroom. They look beyond modality to consider what makes for successful dialogue in the learning context and how the use of non-verbal features such as touch, proximity, and use of space in the classroom supports mutuality, co-construction and negotiations of meanings.

Marschark et al. (2006) look beneath the surface issues of delivery to examine access to and comprehension of bimodal and bilingual instruction. They compared the accessibility of information provided to students in ASL and MCE, and explored the effects on comprehension when real time text is added into the delivery. Their study of young deaf adults (post 16) provides evidence that adding sign language support to lesson delivery does not ensure deaf students'

learning or comprehension to a level equivalent to that of their hearing classmates (Marschark et al. 2006; Marschark et al. 2009). Although some combinations of information sources, such as the addition of text, certainly enhance access, deaf students still learn less than hearing peers.

This work illustrates that bimodal bilingual delivery in the classroom, even from skilled sign language users, does not in itself guarantee learning. More research is needed into the quality of interaction in bimodal bilingual teaching and how deaf and hearing teachers can combine bimodal bilingual teaching tools with strategies that extend discussion and facilitate engagement and learning.

Work which has examined teaching 'quality' and how it might be identified and measured in a bimodal bilingual context reiterates this finding (Knoors & Renting 2000; Hermans et al. 2014). These studies identify the language of instruction, the interactional style of the teaching, student engagement and teacher-student relationships as indicative of the quality of instruction. Using these measures, and incorporating the view of the learners, Hermans et al. (2014) suggest that teachers still find it difficult to attune the language input and classroom talk to bimodal bilingual deaf learners and engage them fully in learning. This focus on learning and teaching illustrates that bilingual programmes may need to adapt themselves to the changing communication profiles and leaning needs of deaf children. In response to a changing language landscape, bimodal bilingual approaches need to evolve and embrace the diverse language learning profiles of deaf children. Specifically, there is a need to closely examine the way in which sign and spoken/written languages are used in the classroom and how different types of language use support learning. Developing bimodal bilingual pedagogies entails a review of what we know and what we can learn from other bilingual contexts, as well as revisiting some of the essential conditions that facilitate learning in the classroom.

5.3 Outcomes of bilingual education

There are repeated calls in the literature for the success of bilingual education to be demonstrated in terms of academic outcomes. The central criticism is that that no research demonstrates that it is a more successful approach than any other, in terms of academic attainment. This critique has fuelled a fruitless and problematic dialogue on a number of counts. The first is that bilingual education was not established with the goal of being a more successful approach than any other. Instead, it developed as an educational response to the language and learning needs of deaf children, for whom spoken language approaches are not sufficiently inclusive. Secondly, the measurement of the success of an educational approach in terms of academic outcomes has eclipsed the discussion of the wider and fundamental linguistic, cognitive and social-emotional outcomes. Thirdly, to produce research with a small and heterogeneous population that demonstrates the superiority of one educational approach over another is fraught with methodological issues. The 'weak' support in the literature is not limited to the bilingual approach. There is no educational approach in deaf education that has been identified as more successful than any other.

Studies of the academic outcomes of bilingual education are sparse and generally inconclusive, even in settings where bilingual education is well established. The available national studies tend to demonstrate limited educational advantages and do not suggest that this approach closes the progress gap between deaf and hearing children (Hendar 2009; Rydberg, Gellerstedt & Danermark 2009).The methodological issues centre on the difficulty of demonstrating a direct relationship between a bilingual approach and children's learning outcomes. Although some relationships are found between children's attainment and background factors such as language experience and use, parental involvement, level of hearing loss, IQ, ethnicity and use of amplification, they are not causal and do not thus link attainment to approach. Further, many of the studies available are largely descriptive of bilingual policy and

practice and lack established measures of interventions or teaching approaches and pupil data often lacks sign language or spoken language measures. It is also to be noted that few of these studies have appeared in peer-reviewed journals.

There are a few studies that show the learning achievements of students in specific bilingual contexts and, as such, provide useful programme evaluation information and some evidence of attainment against national benchmarks. Lange et al. (2013) and Nover et al. (2002) are both examples of longitudinal studies of cohorts of pupils in bilingual schools for the deaf in the US. Lange et al. (2013) demonstrate that after 4 years 'immersion' in a bilingual programme 66% achieve average or above average scores in maths and reading, comparable to the nationally normed group of deaf and hearing children. Nover et al. (2002) also found reading comprehension levels above the reported norms for deaf children after at least 3 years in the programme. We are not able to extrapolate much about the teaching approach from either of these studies in order to analyse these results further and we cannot generalise the findings to other deaf leaners. They nonetheless present evidence of the benefits of this approach for some deaf children.

Aside from these isolated studies of attainment, there are some reported outcomes of bilingual education with regards to cognitive control and metalinguistic abilities. This generally relates to the interaction between sign and spoken language and the potential convergence or 'pooling' of language knowledge and abilities (Mineiro et al. 2014; Ormel & Giezen 2014; Plaza-Pust 2014). Other identified advantages include the psychosocial wellbeing resulting, in part, from improved access to the curriculum and to peer interaction in the classroom (Bagga-Gupta 2000; Dammeyer 2010). The establishment of early language and communication (Rinaldi et al. 2014) as well as support for the development of reading and vocabulary knowledge (Hermans et al. 2008) and early literacy skills (Kristoffersen & Simonsen 2012; Dammeyer 2014). These more

general gains can be explained by the advantages that fluent, early communication provides in terms of linguistic, cognitive and social-emotional development, but they have yet to translate into attainment data.

5.4 Summary

This review illustrates the range of bimodal and bilingual instructional practices deployed by teachers in deaf education. They signify a move towards examining the outcomes of bimodal bilingual teaching approaches but they are limited in terms of their scope and methodological rigour. What emerges from the review of practice is a predominant focus on language modality issues, with the focus on policy rather than practice. There is a gap in the research relating to actual learning in bilingual settings and the detail of teaching approaches. We need to know more about how first and second language teaching methods are differentiated and employed and how languages are used in the classroom and across the curriculum.

Furthermore, the intricacies of communication around learning in the classroom are seldom explored in terms of learning and teaching styles, interaction, dialogue and engagement in the learning context, and how that is challenged and optimised by bilingual and bimodal methods. There are very few studies which look at curriculum specific areas beyond literacy. There is emerging treatment of science, technology and maths subjects but not specifically with reference to bilingual education, and there is developing interest in the use of technology in bilingual contexts. In terms of overall outcomes the results are mixed. The use of sign language clearly supports some aspects of learning and development for some children but has not closed the progress gap between deaf and hearing children. The confounding factors in the research make it difficult to extrapolate the nature of the support for learning that sign language provides and the relationship between experience, environment and educational outcomes.

6. Conclusion: Directions for research policy and practice

The aim of this review was to provide a synthesis of linguistic and pedagogical research on deafness, bimodal bilingualism and learning, to show the intersection of these two areas within an educational context. The review has highlighted a number of theoretical and practical issues about deafness, bimodal bilingualism, and learning, which are discussed in terms of research directions and implications for policy and practice.

6.1. Bimodal and bilingualism and deafness

This review has demonstrated the development of our theoretical understanding of deaf children's bimodal bilingualism to recognise (linguistic and visible) language interaction as an integral characteristic of language experience, development and use. The research is beginning to document the different (cognitive and social) dimensions of language interaction and the ways in which deaf children organise and deploy and their 'separate but interconnected' language systems (Plaza-Pust 2014 p.45). This represents a shift to a view of bimodal bilingualism as an integrated set of language resources rather than as sets of skills in two different languages. This more flexible concept of bimodal bilingualism also entails an acceptance that language dominance or preference may fluctuate over time and/or according to the communicative and learning context. The challenge that this presents for practice is the description and assessment of children's language skills and the provision of appropriate language intervention and support for individuals.

A second theoretical development concerns the relationship between deaf and hearing models of bilingualism. The theoretical questions discussed in this review regarding language acquisition, use, interaction and transfer are also explored in the unimodal bilingual research. However, the significant differences between deaf and hearing bilingualism make the wholesale application of hearing models of bilingualism to the deaf bilingual context problematic. The questions around language transfer are particularly exercised by the modalities issue (see, for

example, Holzinger & Fellinger 2014). Scrutiny of these questions in the deaf bilingual context is beginning to shift the meaning of language transfer and extend our understanding of transfer between dissimilar languages (see, for example, Tang et al. 2014). The research challenge is to develop greater interaction between the hearing and deaf research to advance knowledge about language and learning.

A developing theoretical model of deaf children's bimodal bilingualism will also need to take account of deaf children and their families who use more than one spoken language at home. This area of research is in need of development as migrant and multilingual families make up at least 20% of the population, for example, in Australia, USA, Germany, Slovakia and the UK. Also, the increased availability and use of cochlear implants means that it is more possible for deaf children to become bilingual in two spoken languages as well as use a sign language. The research is currently sparse in this area, both in terms of demographic data and insights into individual language milieu (see, for example, Arnesen et al. 2008; Cline & Mahon 2010; Willoughby 2012). However, an understanding of deaf children's multilingualism will further inform the deafness research and wider understandings of language learning.

6.2. Methodological approaches

This review has highlighted a number of methodological issues that have made it difficult to connect linguistic and pedagogical issues and fully understand the learning and teaching issues associated with bimodal bilingualisms and learning. In contrast with the more experimental designs in the psycholinguistic research, studies of learning and teaching are more often case studies, single case design with small sample sizes. Findings are therefore difficult to generalise to the small but heterogonous population of deaf learners. With regard to the research into learning and attainment, it is acknowledged that the many confounding factors in the research (such as language experience and abilities, hearing loss and aetiologies, learning contexts and

teaching styles) make it impossible to reliably confirm directional relationships between, for example, sign language and literacy skills or teaching approach and attainment. Further, studies of attainment are often problematic where standardised tests are not used to assess language and literacy skills. Rating scales completed by teachers do not give sufficient confidence in attainment results and where there are no control groups, the relationship between the intervention and the result cannot always be confirmed. These issues present problems when it comes to measuring deaf children's progress or evaluating particular language intervention or teaching approaches. More robust methodological approaches thus need to be developed in the pedagogical research that balance validity with rigour to give a more comprehensive picture of what is happening in classrooms and in particular, how languages can be deployed in different ways to promote learning.

Diversification of methodologies in the linguistic research to produce more rich data about bimodal bilingual language use would help to bridge the gap between the two disciplines. In particular, more longitudinal studies of bimodal bilingualism would help us to understand how deaf learners respond to the diversity of languages and codes (sign language spoken language, written language, signed systems and fingerspelling) that they are exposed to in their daily lives. In addition, the linguistic information that we gather about deaf children needs to account for the full ecology of a child's life and include information about language environment, input and experience. This would support the development of appropriate pedagogies and more 'integrated language assessments' (Rinaldi et al. 2014 p.67).

Research with individuals needs to be set in the context of demographic work about deaf children's signed and spoken language that enables us to construct the wider 'language landscape'(Crowe, McLeod & Ching 2012). Ethnographic work of this nature has begun in some contexts but our knowledge is sparse (see, for example, Albertorio, Holden-Pitt & Rawlings

1999; Grimes, Thoutenhoofd & Byrne 2007; Arnesen et al. 2008). Demographic research alongside studies of individual sign and spoken language repertoires will further contribute to wider understanding of bimodal and multilingual language development and open up new research agendas for language and learning.

Finally, in terms of the research perspectives in this literature, there are few studies which bring the voices of the parents and deaf children themselves to the fore. Listening to those with first-hand experience of growing up and learning with a sign and spoken/written   language would open up new ways of seeing and understanding bimodal bilingualism and learning and as Sutherland & Young (2007) suggest expose the 'real-world language mosaic of deaf and hard-of-hearing students' (p.469).

6.3 Educational policy

This review points to a need for a re-conceptualization of what bilingual education means for deaf children in the 21st century in the light of rapid technological developments, an increasingly inclusive educational demographic and changing language profiles of deaf children. Specifically, more attention needs to be given to the diverse and shifting roles of signed, spoken and written modalities and how these interact in a deaf child's learning and development of bilingual competencies. It is evident that the categorisation of the roles of different languages, as has dominated in the policy literature with more attention to MODE rather than MANNER in the teaching context. This perspective needs to evolve to reflect the reality of growing up deaf and bilingual with state-of-the-art hearing technologies in an increasingly linguistically diverse world. Bilingual education is likely now to involve more than one spoken and written language and also entail numerous ways of combining sign, spoken and written languages for different purposes. The illustrations of mixed and blended language use, emerging from this review, suggest instead

that the creative use of two languages reflects one total resource. That is, a dynamic system which comprises an integrated set of flexible skills.

Dialogue on educational policy also needs to diversify to embrace international perspectives beyond North West Europe and North America. Although not reviewed in full here, publications on bilingual education have begun to emerge from increasingly diverse contexts across Europe, Asia, Africa and South America as global research into sign language and deaf culture evolves. These studies examine the theoretical and practical aspect of bilingual education within different cultural contexts and there is an emphasis on language planning and the recognition of sign language and its use in education. Engagement with this growing body of policy literature will expand constructs of bilingual deaf education to include wider multilingual issues such as the maintenance of community and heritage languages, the visibility of and support for language minorities and issues for professional training and development. Policy development thus needs to embrace a more dynamic understanding of language use and development which takes account of shifting language competencies of bimodal bilingual deaf children in multilingual societies.

6.4 Bilingual pedagogy

This review reveals a dearth of research into bilingual pedagogies in deaf education with the exception of the topic of literacy development where the potential role of sign language to support literacy development is explored extensively. This literature offers consensus that sign language, at a high level, can support the development of world knowledge and metalinguistic skills through which, word meanings, sentence and discourse structure can be directly taught. How cross-language transfer is conceptualized in this context is also a central topic of discussion. Evidence of supportive interaction between sign language and literacy at cognitive and linguistic levels is emerging prompting considerable exploration of the potential of the mixed and blended

use of languages in the classroom. These practices are reminiscent of the 'translanguaging' that takes places in bilingual classrooms first described by Lewis, Jones & Baker (2012). Although this is a term is not commonly used in the deaf education literature, it is helpful as a way of conceptualising mixed and blended language use as a natural part of individual repertoires and classroom pedagogy. Bimodal bilingualism actually affords opportunities for translanguaging which reach beyond the examples that we have seen so far in language research, because of the ability to combine and alternate different linguistic structures and systems, including modalities, to make meaning.

Publications on other aspects of classroom practice rarely examine the detail of classroom learning and teaching or provide empirical evidence and outcomes. Bilingual pedagogies tend to be outlined in very general terms, where principles of the approach are given rather than discussion of teaching strategies. A common approach to practice seems to entail attention to sign language as the first language and gradual introduction to English as a second language through literacy. However, there is no real agreement in the international literature regarding what comprises a bimodal bilingual teaching approach and so it is difficult to compare and contrast strategies or draw firm conclusions about efficacy.

The research into bilingual practice has been dominated by a focus on modality issues and, as a result, stopped short of examining the dynamics of the use of sign language in the classroom. We are just beginning to see attention to what actually takes place in terms of interaction, engaging and learning where two (or more) languages and modalities are in play. This developing area of research will hopefully extrapolate the dynamics of mixed and blended language use in the classroom and how this can scaffold and support learning and inform the development of more nuanced language provision for bimodal bilingual deaf pupils.

This review provides some directions for the development of a new theoretical model of bimodal bilingualism and deafness that recognises the multilingual and multimodal communicative resources of individuals as flexible and changing language repertoires. This represents a shift in perspective and the emergence of new constructs in deaf bimodal bilingualism, and discourses in the research and in the classroom. Bimodal bilingual learning for deaf children certainly involves different linguistic, cognitive and social factors than for hearing bilingual children. Nonetheless, a narrowing of the gap between deaf education and modern languages research and teaching would open up the potential for new knowledge about bimodal and bilingual multicompetency and implications for learning.

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