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Chapter 16:

Research Methods in Studying Reading and Literacy Development

in Deaf Children Who Sign

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This chapter discusses research concerning deaf individual's reading and spelling development, with a focus on collecting literacy data from deaf children and adolescents. I will begin by presenting an overview of what we know about reading development in deaf individuals covering topics such as: *What are the reading achievements of deaf children? How do deaf children learn to read? Do they learn to read in a similar way to hearing children?* This will be followed by a more detailed discussion of the different types of methodologies that have been used to conduct literacy research with deaf children, highlighting important findings. Lastly I will describe some of the issues involved with researching literacy development in deaf children who sign and potential ways of dealing with these issues.

Introduction to key topics in reading and literacy

Literacy achievements in deaf children

Becoming literate is one of the biggest challenges a deaf child or adolescent is likely to face at school. Most deaf children experience difficulties with learning to read and exhibit significant delays in comparison with their hearing peers. Because deaf children only make approximately a third of the progress that one would expect a hearing child to make each year (Allen, 1986; Kyle & Harris, 2010; 2011), their reading delay cumulatively increases as they progress through school resulting in the average deaf school leaver having a reading age equivalent to that of a nine year old (e.g. Allen, 1986; Conrad, 1979; Qi & Mitchell, 2011; Wauters, van Bon & Tellings, 2006). Deaf children typically exhibit delays in most reading components, suggesting that they find reading difficult because deficits in bottom up skills such as phonological processing and syntactical knowledge are compounded by top down deficits in vocabulary, world knowledge and inferencing skills. Nevertheless, it is important

to note that not all deaf children find reading difficult and some do become skilled and fluent readers (e.g. Gravenstede & Roy, 2009; Harris & Moreno, 2006).

Deaf children come from diverse language and communication backgrounds, ranging from native sign language users with deaf parents through to the vast majority who communicate through speech and have hearing parents. In addition, a large proportion of deaf children have English as a second spoken language at home and although this is beyond the scope of the current chapter, it is an important issue to bear in mind. Given this variety, an obvious question is what effect do differences in language preferences and backgrounds have on literacy skills? Higher levels of reading achievement have been reported in orally educated deaf children (e.g. Daneman et al, 1995; Geers & Moog, 1989). For example, Daneman and colleagues (1995) described a group of orally-educated deaf children who were reading at levels above their chronological age. Similarly, deaf children with cochlear implants, who typically use speech to communicate, are more likely to have reading levels commensurate with their hearing peers during the primary school years (e.g. Archbold, Harris, O'Donoghue, Nikolopoulos, White & Lloyd Richmond, 2008; Geers, 2003), although these early high levels of reading achievements are not necessarily maintained in the teenage years (e.g. Geers, Tobey, Moog & Brenner, 2008; Harris & Terlektsi, 2011). On the other hand, better reading skills have also been reported in deaf children with deaf parents, who generally use sign language to communicate (e.g. Vernon & Koh, 1970), and in deaf children who are native signers (e.g. Strong & Prinz, 2000). On the face of it, these findings seem contradictory; however, the language preferences of the good deaf readers in Kyle and Harris (2010) help shed light on this issue. Although the good readers were predominately those who used speech to communicate, four of the seven best readers had also been exposed to BSL from an early age and one was a native BSL user with deaf parents. A plausible interpretation of these findings is that early exposure to language is essential for reading

ability in deaf children, regardless of the modality of that language (see also Marschark & Harris, 1996).

Deaf children's use of phonology during reading

Despite decades of research, there is still no definitive answer to the question of *how* deaf children learn to read, and whether they do so in the *same* way as hearing children. Hearing individuals tend to utilize their knowledge of the relationships between letters and sounds when reading and spelling, i.e. they use a phonological code. Indeed, one of the strongest predictors of reading development in typically developing children is their performance on tasks measuring phonological awareness (see Goswami & Bryant, 1990; Castles and Coltheart, 2004). Phonological awareness refers to the ability to detect and manipulate the constituent sounds of words. As deaf individuals typically have incomplete access to spoken language, it is interesting to consider if they also use phonology when reading. Furthermore, do signing deaf children learn to read in the same way as deaf children who communicate through speech? There is some evidence that deaf individuals use phonological coding strategies during reading and spelling, albeit to a lesser extent than hearing individuals (e.g. Dodd, 1987; Leybaert & Alegria, 1993; Hanson, Shankweiler & Fischer, 1983), but equally, other studies find little evidence of phonological coding (e.g. Aaron, Keetay, Boyd, Palmatier & Wacks, 1998; Beech & Harris, 1997; Ormel, Hermans, Knoors, Hendriks & Verhoeven, 2010). Collating the findings suggests that deaf individuals CAN make use of phonological skills but whether they DO seems to be dependent upon experimental factors such as type of paradigm used, task demands and task stimuli; and participant characteristics such as age, reading ability, educational level and speech intelligibility.

Surprisingly few studies have actually measured whether the use of a phonological code is associated with reading achievements in deaf children; out of those that have, only a small number observed a positive relationship between the ability to use phonological coding and reading (e.g. Hanson, Liberman & Shankweiler, 1984; Harris & Moreno, 2006; Leybaert & Alegria, 1993). Likewise, whilst some studies find a relationship between performance on a phonological awareness task and reading in deaf individuals (e.g. Colin, Magnan, Ecalle & Leybaert, 2007; Dyer, MacSweeney, Szczerbinski & Green, 2003; Harris & Beech, 1998), most do not (e.g. Hanson & Fowler, 1987; Kyle & Harris, 2006; Leybaert & Alegria, 1993). Kyle and Harris (2010) reported a strong relationship between phonological awareness and reading in deaf children; however, it is important to note that the direction of this relationship was in fact from reading to phonological awareness. This finding is important as it suggests that deaf children's phonological awareness skills develop as a consequence of learning to read rather than being a precursor of reading ability as is typically found in hearing children (see also Musselman, 2000; Goldin-Meadow & Mayberry, 2001). Moreover, a very recent meta-analysis of the relationship between phonological skills and reading (Mayberry, del Giudice & Lieberman, 2011) concluded there is little consistent evidence of the role of phonology in deaf individuals' reading.

The role of other cognitive and language skills in reading

Given the inconsistencies in the findings concerning the role of phonological skills in deaf children's reading, it is not surprising that researchers have looked at the contribution of other cognitive and language skills. Language skills, including vocabulary knowledge, are the strongest and most consistent correlate (e.g. Kyle & Harris, 2006; Moores & Sweet, 1990; Waters & Doehring, 1990) and longitudinal predictor (Easterbrooks, Lederberg, Miller, Bergeron & Connor, 2008; Harris & Beech, 1998; Kyle & Harris, 2010; 2011) of reading skills in deaf children. Indeed, Mayberry et al (2011) reported that language skills accounted

for 35% of the variance in deaf reading ability in their meta-analysis. This is unsurprising given the close relationship between reading and language in hearing children and the severe vocabulary delays exhibited by most deaf children (see Geers & Moog, 1989; Moores & Sweet, 1990; Kyle & Harris, 2006). Language delay has in fact been described as a hallmark of deafness (Musselman, 2000). In two longitudinal studies of reading development in deaf children from mixed language backgrounds (Kyle & Harris, 2010; 2011), we found that vocabulary and speechreading were the strongest predictors of later reading ability. Other researchers have also found speechreading to be a strong correlate of reading in deaf children (e.g. Arnold & Kopsel, 1996; Campbell & Wright, 1988; Harris & Moreno, 2006) and deaf adults (Mohammed, Campbell, Macsweeney, Barry & Coleman, 2006). Although it is plausible to assume that deaf children who use speech would rely more upon speechreading than signing deaf children, the relationship between speechreading and reading has in fact been observed in deaf children from a range of language backgrounds (Harris & Moreno, 2006; Kyle & Harris, 2010; 2011).

There is also evidence that good signing skills can facilitate reading in deaf children and adolescents as positive relationships have been found between signing skill and reading ability (e.g. Hermans, Knoors, Ormel & Verhoeven, 2008a; Padden & Hanson, 2000; Strong & Prinz, 2000). Strong and Prinz (2000) reported a medium correlation between ASL proficiency and English literacy skills whereby those with higher levels of ASL had better English literacy skills. The pertinent question remains as to exactly how the relationship between these two skills works? Goldin-Meadow and Mayberry (2001) argue that although good signing skills result in deaf individuals having good language skills, which could provide a base for reading, these on their own are not sufficient as children still need some way to connect the signs to the written words. Padden and Ramsey (2000) suggest that it is

not general ASL skills which relate to reading but specific skills which mediate the relationship between reading and ASL.

Theories of how deaf children learn to read

How can we assimilate the findings presented in this overview into a theory of reading development in deaf children? It is reasonable to assume that deaf children who use speech learn to read in essentially the same way as hearing children, i.e. through the use of a phonological code (see Perfetti & Sandak, 2000). However, it is possible that signing deaf children may also learn to read in broadly the same manner because research suggests that similar skills are important for their reading development. Let us consider what a deaf phonological code might look like: as deaf individuals do not typically have full access to spoken language, it is likely that any phonological code would be based upon phonological representations derived from speechreading input (see Hanson et al., 1983; Kyle & Harris, 2010; 2011). It has been argued that a phonological code is abstract and not modality specific which means it could be derived equally from auditory or visual speech (Alegria, 1996; Campbell, 1997). Evidence supporting this argument has been found in speechreading errors observed in deaf children's spelling (Dodd, 1980) and phonological judgments (Leybaert & Charlier, 1996) and because speechreading is a strong, longitudinal predictor of both reading development and phonological awareness in deaf children (Kyle & Harris, 2010; 2011).

The longitudinal results from Kyle and Harris (2010; 2011) suggest that reading development in deaf children is underpinned by both vocabulary knowledge and speechreading. This argument can be conceptualized using the Simple View of Reading (SVR: Gough & Tunmer, 1986), which posits that reading has two components: a linguistic component (e.g. vocabulary knowledge and language) and a decoding component (e.g. phonological skills).

Using this framework, I propose a model of reading development in deaf children (see Figure

1) in which the linguistic component of the SVR is captured by vocabulary knowledge and the decoding component encompasses the relationship between speechreading and phonological awareness. The role of vocabulary is depicted in the model at (1) because it was the strongest and most consistent predictor of reading ability in deaf children. The complex relationship between speechreading, phonological awareness and reading is depicted based upon the description in Kyle and Harris (2010). Speechreading provides the input for deaf children's phonological representations and is a strong initial predictor of reading progress (entered in the model at 2) because it directly taps the input for the phonological representations being used to support reading. For similar reasons, speechreading predicts phonological awareness (3). Phonological awareness is not initially predictive of reading ability; however, as reading develops, deaf children's underlying representations become more specified (thereby enabling them to make phonological judgments), and therefore reading ability predicts the development of phonological awareness (4). Phonological awareness and reading ability gradually develop a reciprocal relationship and thus tasks measuring phonological awareness rather than speechreading become associated with reading (5). This neatly fits in with the argument that deaf children develop their phonological skills through reading (Musselman, 2000; Goldin-Meadow & Mayberry, 2001). As this model is based upon research findings with deaf children from mixed language backgrounds, its applicability for separate language subgroups of deaf children is not yet fully tested.

Insert Figure 1 about here

Alternately, it is possible that deaf children who predominantly use sign language learn to read in a different way to deaf children who use speech and somehow bypass the direct

correspondence between letters and sounds. Hermans, Knoors, Ormel and Verhoeven (2008b) proposed that deaf children assimilate new written vocabulary into their existing sign language system and understand new words by creating associations between printed words and their sign equivalents. Other authors have suggested that fingerspelling could work as a bridge between sign language and reading (e.g. Emmorey & Petrich, 2011; Haptonstall-Nykaza & Schick, 2007; Padden & Ramsey, 2000). Padden and Ramsey (2000) observed that teachers were explicitly “chaining” fingerspelling, signs and written words together when teaching deaf children to read. These arguments tend to be interpreted within a bilingual framework whereby signing deaf children learn to read English as a second language once they are proficient in their first language (e.g. BSL or ASL). This is a contentious issue, the debate of which is beyond the scope of this chapter (see Mason & Ewoldt, 1996; Mayer & Wells, 1996, for a full discussion).

Spelling ability

Literacy is not just about reading; spelling is an equally important component. This chapter has focused on reading ability because compared to the body of research on deaf children’s reading development, there has been far less looking at the impact of deafness on spelling development. In general, although deaf children typically exhibit delays in their spelling ability, the delays are not as severe as those observed for reading (e.g. Harris & Moreno, 2004; Moores & Sweet, 1990). For example, Moores and Sweet (1990) found that a group of deaf 16-17 year olds exhibited an average reading delay of 5 years but a spelling delay of only 3 years. Broadly similar skills are known to be predictive of reading and spelling ability in hearing children (e.g. Juel, Griffith & Gough, 1986) but recent research has suggested this may not be the case for deaf children. In Kyle and Harris (2006; 2011), we found that although reading and spelling ability were highly related in deaf children, different

skills predicted each ability: speechreading and vocabulary predicted reading development but only letter knowledge was predictive of beginning spelling ability.

Summary of research into deaf children's literacy

Research suggests that the majority of deaf children are likely to read in the same way as hearing children in terms of them requiring phonological skills and that those with better phonological skills tend to be better readers (see Musselman, 2000 for a review); however, their phonological skills may differ in that they are mainly derived from visual rather than auditory speech. Recent evidence suggests that broadly the same skills are predictive of deaf children's reading as hearing children's reading: language knowledge and phonological skills. Good signing skills have been found to be associated with higher reading levels in signing deaf children but the mechanism for this relationship is not yet known or understood.

What methodologies have researchers employed to investigate literacy in deaf individuals?

This section will examine how researchers have investigated reading development and the different methodologies used. The relevant strengths and weaknesses of different methodological designs will be discussed along with suggestions for future research.

Large scale nationwide surveys of reading achievements

The most representative method of investigating reading achievements in deaf individuals are large-scale, nationwide, studies using standardized reading tests (e.g. Allen, 1986; Conrad, 1979; Trybus & Karchmer, 1977). Researchers in the US have tended to use the reading comprehension subtest from the Stanford Achievement Test (SAT) which is administered by schools. For example, Trybus & Karchmer (1977) examined the SAT scores for almost

7,000 deaf students in the US and found that the average 18 year old had a reading age of between 9 and 10 years. Furthermore, they found that only the top 10% were reading at or above the level expected for a 13 year old hearing student. Conrad (1979) conducted an empirical investigation of the reading achievements of deaf school leavers in England and Wales using the individually administered Widespan Reading Test. He reported strikingly similar findings as the mean reading age was equivalent to that of a nine-year-old hearing child. These large scale studies are very useful for portraying the reading levels of average deaf children; however, the disadvantage is that they tend to conceal individual differences and successes as some deaf children learn to read fluently and with comparative ease. They also tend to be cross-sectional in design and therefore they demonstrate the end point of reading achievement rather than providing insight into how reading develops.

Longitudinal studies of reading ability

Longitudinal studies, in which the same cohort of children is followed over time, are essential in order to understand how reading develops in deaf children and adolescents and how their large reading delays occur. In a recent longitudinal study (Kyle & Harris, 2010), we followed a group of 29 severely and profoundly deaf children over a period of 3 years. At the beginning of the study, the deaf children (from a range of language backgrounds) were all between 7 and 8 years old and they had a mean reading delay of 12 months. By the end of the study, 3 years later, the children had a mean age of 10 years 11 months and their reading delay had increased to almost 3 years. Longitudinal studies are important as they show us not only the end point but how they reached that end point. The deaf children, as a group, made slow but steady reading development equating to 0.3 grades each year, the same rate as reported 25 years earlier by Allen (1986). As demonstrated in Figure 2, the longitudinal design of Kyle and Harris (2010) reveals the huge individual variation in reading progress as

although a few deaf children made a full 36 months progress in reading (over a 3 year period), the majority made far less.

Insert Figure 2 about here

Longitudinal studies tend to be a less common design as they are very costly in terms of time and resources. As a result the sample sizes tend to be relatively small, which can make interpretation and generalizability of results difficult. One of the main challenges of longitudinal designs is participant retention for the duration of the study as they often suffer from high participant drop-out rates. In addition, the assessment battery needs to be appropriate for repeated use. Some tests have alternate versions which can be used at different time points, or depending upon the time interval between data points, it is usually acceptable for most standardized tests to be used again after approximately 12 months.

Selection of reading tests

Reading is not a simple unitary skill as it consists of many different components which are all necessary to achieve fluent and effortless reading. Collating the results from existing separate studies suggests that deaf children experience difficulties in almost all reading components including word recognition and identification (e.g. Waters & Doehring, 1990); single word reading (e.g. James, Rajput, Brinton & Goswami, 2008; Kyle & Harris, 2006, 2010); grammatical and syntactic knowledge (e.g. Lillo-Martin, Hanson, & Smith, 1991); and text comprehension (e.g. Allen, 1986; Kyle & Harris, 2011). There are many different reading tests that can be used to assess the various reading components. This makes it essential to know exactly which aspect of reading is being measured by the selected reading

test, particularly as deaf children typically exhibit more severe reading delays on tests of comprehension than word reading and different skills are known to be important for different reading components (see Kyle & Harris, 2006; 2010). Some standardized reading tests can be suitable for use with deaf children (with appropriate adjustments to the administration procedures). However, when interpreting the results, it is important to remember that the norms have been derived from hearing children and there are no reading tests designed especially for use with deaf children in the UK.

Methodologies used to look at spelling ability

It is not always possible for researchers to use standardized spelling tasks with deaf individuals because most assessments use an oral spelling-to-dictation method. For example, if the target word is “car”, the experimenter might say the word “car”, and then say it in a sentence to ensure there is no ambiguity over the word, i.e., “my dad drives a blue car”, and then repeat the word “car” again. This method of oral administration is inappropriate for deaf children as it is difficult to determine whether spelling errors are because the child does not know how to spell the word or simply because of a misunderstanding about the target word. Researchers have resolved this issue by developing experimental picture based spelling tasks in which individuals are shown pictures and asked to write the label (e.g. Burden & Campbell, 1994; Harris & Moreno, 2004; Kyle & Harris, 2006; 2011). Although this disambiguates the target word, it limits the test stimuli to words that can be easily represented pictorially such as concrete nouns rather than verbs and plural nouns. However, it is possible to assess deaf children’s knowledge of particular aspects of spelling such as plurals through specially designed experimental tasks. For example, Breadmore, Olson and Krott (2012) designed a picture based test of children’s plural noun spelling in which children were shown a picture of a singular noun “person” along with the printed word “person” and then a picture of “people” and asked to write the corresponding plural noun.

Methodologies used to investigate the use of a phonological code

Researchers have used a range of different experimental paradigms to investigate whether deaf children and adolescents use a phonological code. Although evidence for phonological coding can be investigated in reading, spelling and memory, this discussion will focus on methodologies used to look for evidence of phonological coding in reading and spelling.

Lexical decision tasks, in which participants are shown letter strings and have to judge whether the letter strings are real words, are the main paradigm used to explore whether deaf adolescents use a phonological code. The hallmark of a phonological code is that individuals are faster and more accurate at judging a real word when it has a regular spelling pattern (e.g. book vs. pint). Little evidence of regularity effects has been found with deaf participants (e.g. Burden & Campbell, 1994; Waters & Doehring, 1990) although phonological manipulations in terms of rhyming (Hanson & Fowler, 1987) and homophony (Beech & Harris, 1997) have indicated the use of a phonological code. For example, Hanson and Fowler (1987) presented pairs of letter strings and asked deaf participants to indicate if the pair consisted of two real words. They were faster in making a decision when the word pairs were both orthographically and phonologically similar (*SAVE-WAVE*) than when the pairs were only orthographically similar (*HAVE-CAVE*) indicating that they were accessing the phonological properties of the words.

Another paradigm used to investigate the type of strategy employed by deaf readers during silent reading is a letter cancellation task. Letter cancellation tasks require participants to read a passage for comprehension and cross out a target letter. If readers miss target letters that are either silent (e.g. the letter “e”) or pronounced in an unusual way, it suggests that they are using a phonological strategy when reading (e.g. Dodd, 1987; Gibbs, 1989). For example, Dodd (1987) found that deaf adolescents missed significantly more silent “e”s than those

which were pronounced. Lexical decision and letter cancellation tasks are fairly unnatural and ecologically invalid paradigms as they do not match the task demands of reading. Using a reading aloud task, which is closer to the actual reading process, Leybaert and Alegria (1993) found that orally-educated deaf adolescents accessed phonological representations during reading as they read aloud pseudo-homophones as accurately as hearing children, a process which necessitates phonological coding.

The sheer number of studies with different cohorts employing a range of methodologies and designs to assess the use of reading strategies by deaf children clearly demonstrates that there is not a best method to do so. Much of the discrepancy in results can be explained by experimental factors such as the age of participants; levels of reading ability; levels of speech intelligibility; and specific task design and therefore it is essential to control for these factors. Few studies have directly looked at deaf children's use of coding strategies during reading and there is an opportunity for further research using eye tracking paradigms.

There is more consistency in the methods used to study phonological coding in deaf children's spelling. The most common method is to examine their spelling errors to see if the errors are phonetically acceptable, which suggests the use of a phonological code (e.g. Hanson et al., 1983; Harris & Moreno, 2004; Leybaert & Alegria, 1995). For example, Harris & Moreno (2004) found that less than 20% of deaf children's spelling errors were phonetically acceptable errors such as "baterre" or "battary" for the target word "battery", compared with at least 60% of hearing children's errors.

Methodologies used to investigate reading-related skills

Another way of looking at how deaf children read is to examine which language and cognitive skills are associated with or predict reading development. There are many different experimental tasks that have been used to measure phonological awareness, most of which

require a judgment of rhyme similarity (e.g. Campbell & Wright, 1988; Colin et al., 2007; Harris & Beech, 1997). It is important to use picture based tasks when assessing phonological awareness in deaf individuals, especially those who sign, as the usual oral testing format is inappropriate. For example, Campbell and Wright (1988) created a picture-based rhyme judgment task in which deaf adolescents were shown pairs of pictures (*VASE-CASE* or *DOG-FROG*) and asked to judge whether they rhymed. A disadvantage to using picture based phonological awareness tasks is that it limits the complexity of the phonological manipulation that can be assessed. For example, it is very difficult to unambiguously, pictorially represent the stimuli for a spoonerisms test, in which children would typically be orally presented with two words “KING JOHN” and asked to swap the onsets of each word to form two new words “JING KOHN”.

In contrast to phonological awareness, other reading-related skills, such as language skills and vocabulary knowledge, are often measured using a range of standardized assessments. The only way to really gain an understanding of the relative predictive power of different reading-related skills is to assess several of them in the same group of deaf children; however, few studies have compared the relative predictive power of these cognitive skills in the same cohorts. In two longitudinal studies of reading development in deaf children from mixed language backgrounds (Kyle & Harris, 2010; 2011), children were assessed for vocabulary knowledge, speechreading (silent lipreading), phonological awareness and short term memory. The results were virtually identical from both cohorts: vocabulary and speechreading were the strongest predictors of later reading ability whereas neither short term memory nor phonological awareness was predictive (once the effects of earlier reading ability were controlled). In addition to exploring the relative predictive power of reading related skills, there is also a need for more research directly comparing and contrasting predictors of reading development for deaf children from different language backgrounds. The best method

of exploring the importance of reading-related skills for reading is through longitudinal studies (e.g. Colin et al., 2007; Harris & Beech, 1997; Kyle & Harris, 2010; 2011). These are superior to cross-sectional, correlational studies as they show the direction of the relationship between skills and can determine whether the predictors of reading ability change with increasing levels of proficiency.

Another way to examine the relationship between reading and reading-related skills is to conduct a meta-analysis of the existing research. To date there has only been one meta-analysis of the research investigating deaf children's reading (Mayberry et al., 2011).

Mayberry and colleagues computed effect sizes for 25 studies (out of an initial 230 publications) that investigated the relationship between phonological skills and reading ability. They calculated that phonological skills only had a small to medium effect (0.35) and accounted for 11% of the variance in reading ability.

Alternately, deaf children's reading development can be investigated by identifying good and poor deaf readers and comparing their performance on reading-related skills. Because some deaf children learn to read comparatively easily, it is important to gain an understanding of what skills enable them to become good readers. Harris and Moreno (2006) compared two groups of deaf children who were either reading within 10 months of their chronological age (good readers) or at least 15 months behind chronological age (poor readers). The good readers were more accurate on tasks measuring orthographic awareness and speechreading, and showed more evidence of phonological coding during spelling. Another study of good and poor readers (Kyle & Harris, 2010), highlighted the importance of language exposure as deaf children with small reading delays tended to have better levels of hearing, earlier diagnoses, and were more likely to use speech and have deaf parents than those children with large reading delays.

What are the issues when conducting literacy research with signing deaf children and how can we resolve them?

This section will examine potential issues that can arise when conducting reading research with deaf signing children and discuss possible ways to address or resolve these issues. Some of these issues cannot necessarily be resolved but rather are factors that must be taken into consideration.

Assessing literacy skills in a second language

One of the most important issues that researchers need to be aware of when investigating literacy with signing deaf individuals is that they are assessing reading skills in a language (e.g. English) that is not the participant's first language (e.g. BSL). Whilst this is unavoidable, as there is no written component for sign languages, it must be acknowledged that this is different to measuring reading skills in hearing individuals, or deaf individuals who use speech, whereby one usually assesses written and spoken knowledge of the same language. This issue introduces a bilingual element into the assessment of reading skills for signing deaf children.

Reading tests have different task demands for signing deaf children

Reading tests have different task demands for deaf children from diverse language backgrounds. Standardized tests of word reading or reading accuracy are typically productive tasks; to understand the impact of this, it is helpful to consider how a hearing child completes a word reading task. A hearing child can decode unfamiliar words by applying grapheme to phoneme correspondence rules; they do not have to know the word or the meaning of it in order to produce it. A hearing child can attempt to decode the word into its

parts, retrieve the associated sounds, assemble and synthesize them and produce an answer. It is likely that deaf children who rely upon speech, however inefficiently, use the same route to reading as hearing children. In contrast, the demands for a signing child are different as they have to recognize the word and access the semantic properties in order to produce the correct sign; they have no way of producing a correct response without knowing the meaning of the word. Therefore reading accuracy is a different task for deaf children who sign compared to those who use speech and researchers need to be aware of this issue when exploring deaf children's reading skills at the word level. This does not affect reading comprehension to the same extent because both groups of deaf children can use context to infer the meaning of unfamiliar words.

Ensuring test items are suitable for use with deaf signing children

Few tasks are standardized on deaf children and therefore most assessments of reading and reading-related skills were originally designed for use with hearing children. These tests cannot always be easily used with signing deaf children without some modification. For example, there are often items on a word reading test for which there is no sign equivalent. This includes items for which there is no specific sign, e.g. there is no BSL sign for the English word "was", instances of plural words such as "children", whereby the BSL sign for the singular form "child" and the plural form "children" is the same, and also different forms or tenses of verbs for which there is only one sign, e.g. the BSL sign for "sing" and "singing" is the same. The challenge is therefore how to score answers on these types of items. Some researchers specify what they have done but many do not. James and colleagues (2008) clearly detail their administration and scoring method for a word reading test. They give an example of a test item "babies" and state that for the item to be marked as correct, the child must indicate plurality. This is an interesting case: if researchers accept the sign "baby" for the word "babies" from deaf signing children but will only accept the spoken form "babies"

from non-signing children, then the signing deaf children could have an advantage which could result in over-inflated scores. There is no definitive way to score these answers so it is essential to be consistent and transparent about the scoring procedure; validity can be increased by conducting reliability checking on the scoring procedure. Another way to address the issue could be to devise a reading test specially designed for use with deaf individuals so that it assesses reading for words that do have equivalent signs. However, any such test would need extensive verification to ensure the content is valid and not oversimplified or too narrow.

Devising picture based tasks

Most of the tasks measuring reading-related skills in hearing children are delivered using an oral format. This is obviously not appropriate for deaf children as researchers cannot be certain that participants have unambiguously understood the target item. Instead, researchers frequently devise picture based assessments, especially when measuring phonological awareness (e.g. Harris & Beech, 1998; Kyle & Harris, 2006; James et al, 2008) and memory (e.g. Harris & Moreno, 2004; Kyle & Harris, 2006). See Figure 3 for an example of an item from a picture based phonological awareness task from Kyle and Harris (2006). Children were shown the top picture “*train*” and then shown the bottom two pictures “*rain*” and “*star*” and asked to point to the one which sounded the same at the end. When designing picture based tests, it is essential that all items are represented unambiguously, which does limit the choice of items (see the discussion under the section about spelling methodologies for more details).

Insert Figure 3 about here

Tasks must contain appropriate language/vocabulary levels for deaf signing children

Deaf children typically have language delays, and indeed reading is itself often a language learning task for deaf children. If the language level of a test measuring reading or reading-related skills is not appropriate, deaf children's performance on that task might simply reflect their language level rather than the skill that is purported to be measured. For example, when assessing reading comprehension, if the comprehension questions contain complex grammatical structures, then a deaf child might perform poorly not because they could not understand the text itself but because they could not understand the question about the text. Similarly, when designing tasks to measure reading-related skills, such as speechreading, the lexical content of test items needs to be appropriate to ensure that the task is an assessment of speechreading ability rather than vocabulary (see Kyle, Campbell, Mohammed, Coleman & MacSweeney, 2013). Otherwise, for example, a deaf child may be able to speechread the item but be unable to select the correct picture from an array simply because s/he does not know what the item is. Likewise, it is essential for children to know the vocabulary involved in a phonological awareness task in order to be able to make phonological judgments about the items. Researchers often address this issue by pre-testing children on the items or pictures to ensure that the items are familiar and that they have the correct label for each item (see James et al., 2008; Harris & Moreno, 2004; Kyle & Harris, 2006).

Appropriate response method

Many tests of reading and reading-related skills require verbal responses which is obviously not an appropriate format for deaf children. For example, historically most speechreading

tests required the participants to repeat aloud or write down what they saw (e.g. Conrad, 1979). This makes it difficult to determine whether errors are due to poor speechreading or poor speech intelligibility. A more deaf friendly method for assessing speechreading and other reading-related tasks would be to devise picture matching tasks or tasks in which children can point to the answer (see Kyle et al., 2013).

Heterogeneity of deaf population

A final issue to consider when conducting literacy research with deaf children is the huge heterogeneity in their language skills, language backgrounds and audiological factors. Although people talk about “oral” or “signing” deaf children, it is difficult to categorize their language skills into these discrete categories. Deaf children’s language preferences tend to be on a continuum ranging from signing through to speech but with most children somewhere in the middle combining sign and speech to a greater or lesser extent. It is important to note that although this issue of language heterogeneity is not unique to reading research, it is of great consequence because of the close relationship between language and reading. There are many factors which contribute to heterogeneity within the deaf population and in turn can affect reading skills. Therefore, researchers need to collect a range of background data about deaf participants in order to interpret findings in light of group characteristics. These include, but are not limited to, age of diagnosis; type of amplification aids and age fitted; family history of deafness; preferred language; exposure to sign and spoken language; and competency in sign and spoken language.

In conclusion, research suggests that deaf and hearing children show both similarities and differences in their reading development and in the skills that are important for literacy. Language skills play a key role and deaf children with good phonological skills tend to be better readers. Evidence suggests that speechreading provides the input for deaf children’s

phonological codes and based upon recent findings, I have proposed a model of deaf reading development. Many different experimental tasks have been devised to assess reading and reading-related skills using a range of methodologies. Further longitudinal and relatively large-scale and representative studies are needed to clarify some of the outstanding issues. There are many factors that need to be considered when conducting literacy research with signing deaf children, some of which can be resolved by adapting tasks to be suitable, and by collecting sufficient background data through which findings can be interpreted.

Biographical information:

Fiona Kyle is a Lecturer in the Division of Language and Communication Science at City University London. She has been conducting research into deaf children's literacy development for over twelve years. Her research focuses on identifying predictors of literacy development in deaf children, and investigating the relationship between phonology, speechreading and reading in deaf and hearing children.

Keywords:

Deafness; reading; spelling; phonological awareness; speechreading; longitudinal; literacy.

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Figure 1: Proposed model of reading development in deaf children

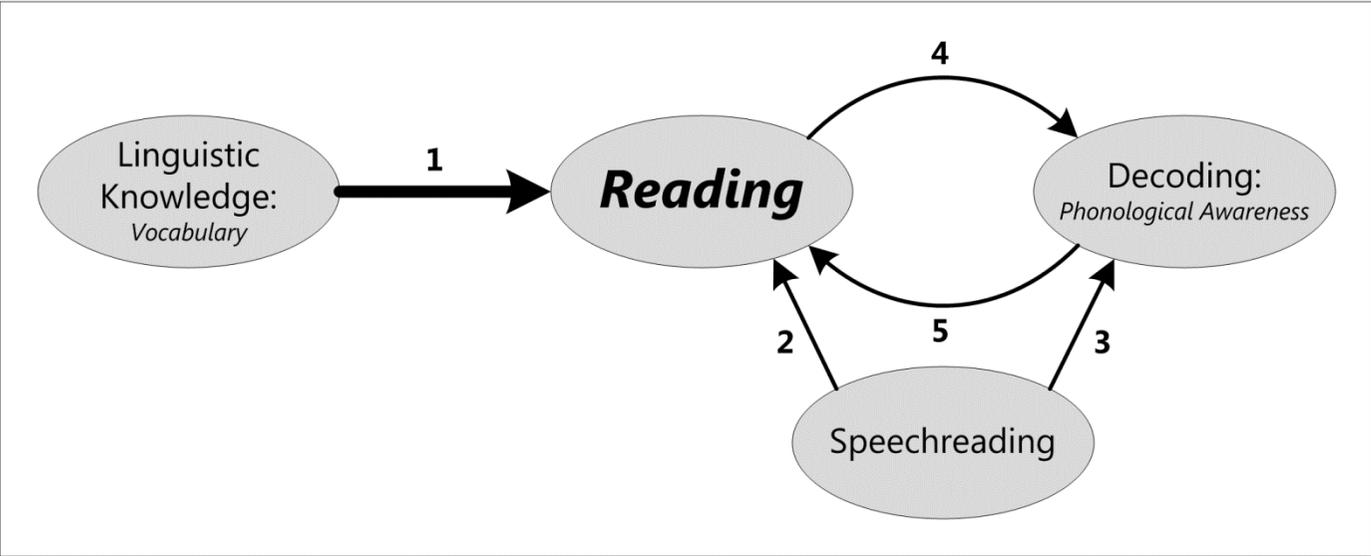


Figure 2: Graph showing the huge individual variation in reading progress (in months) over a 3 year period (created from data reported in Kyle & Harris, 2010)

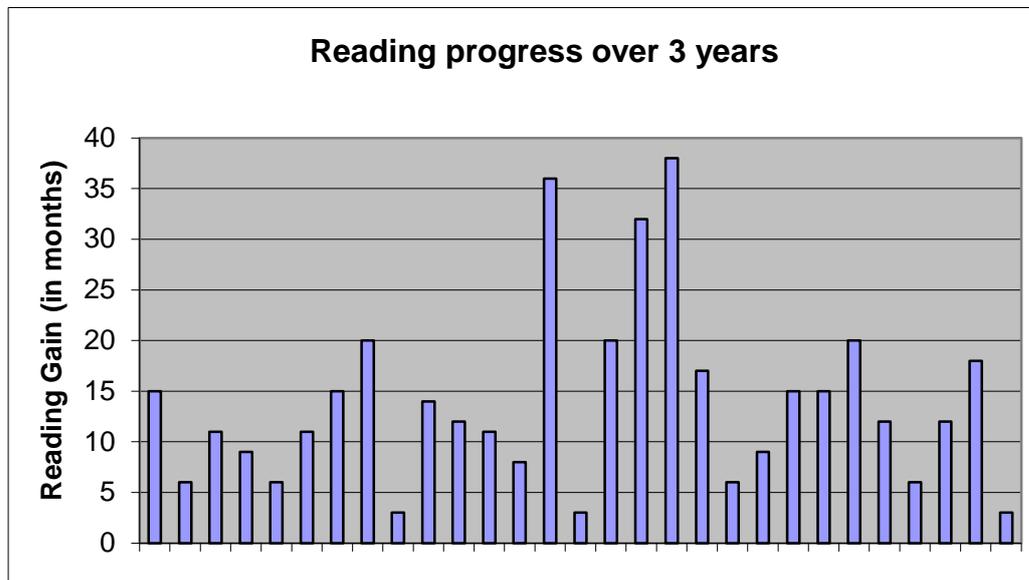


Figure 3: An item from the picture-based phonological awareness task in Kyle and Harris (2006) requiring a judgement of rhyme similarity

