Review: Children's comprehension of an unfamiliar speaker accent

Background: The effect of speaker accent on listeners' comprehension has become a key focus of research given the increasing cultural diversity of society and the increased likelihood of an individual encountering a clinician with an unfamiliar accent.

Aims: The aim of this paper is to review the studies exploring the effect of an unfamiliar accent on language comprehension in typically developing (TD) children and children with speech and language difficulties. The review aims to provide a methodological analysis of the relevant studies; by exploring the challenges facing this field of research and highlighting the current gaps in the literature.

Methods: A total of nine studies were identified using a systematic search and organised under: studies investigating the effect of speaker accent on language comprehension in (i) TD children, and (ii) children with speech and/or language difficulties.

Main Contribution: This review synthesises the evidence that an unfamiliar speaker accent may lead to a breakdown in language comprehension in TD children and children with speech difficulties. Moreover, it exposes the inconsistencies found in this field of research and highlights the lack of studies investigating the effect of speaker accent in children with language deficits.

Conclusions: Overall, research points towards a developmental trend in children's ability to comprehend accent-related variations in speech. Vocabulary size, language exposure, exposure to different accents and adequate processing resources (e.g. attention) seem to play a key role in children's ability to understand unfamiliar accents. The review uncovered some inconsistencies in the literature, which highlight the

methodological issues that must be considered when conducting research in this field. We explore how such issues may be controlled in order to increase the validity and reliability of future research. Key clinical implications are also discussed.

What this paper adds:

This review provides a critical summary of studies investigating the effect of an unfamiliar accent on language comprehension in typically developing children and children with speech difficulties, which may be useful to professionals working with these populations. It exposes the inconsistencies found in this field of research and highlights the lack of studies investigating the effect of speaker accent on language comprehension in children with language deficits. We suggest ways in which to overcome some of the methodological issues found in the literature and discuss key clinical implications.

Introduction

The current rise in immigration in the United Kingdom (UK) has led to an increased likelihood of people encountering an individual with an unfamiliar accent (Dunton *et al.* 2011). Results from a recent annual population survey carried out in the UK estimated that 7.8% of the individuals living in the UK in 2012 had non-British nationality, which is a significant increase from 5% in 2004 (Office for National Statistics 2013). This rise in immigration is evidenced in the growing multicultural makeup of today's healthcare and educational professionals. This trend has generated a growing interest in research exploring the potential effect of an unfamiliar accent on language comprehension, as individuals are now more likely to meet a clinician with an unfamiliar accent. O'Connor and Gibbon (2011) highlighted the relevance of this

issue in the field of paediatric speech and language therapy where assessment scores often rely on children's ability to follow an instruction spoken by the speech and language therapist (SLT). These authors argue that an SLT's accent may disrupt children's language comprehension and affect children's performance on assessment, which may lead to an underestimation of children's language abilities. The key focus of this paper is to review research exploring the effect of an unfamiliar speaker accent on children's comprehension of spoken language.

Previous research has investigated the effect of accent across the life span; however, most studies have focused on research with infants and adults. Studies have shown that infants as young as 5 months have the ability to discriminate phonetic contrasts and process some input variability (Nazzi *et al.* 2000). With regards to research with adults, studies have shown that adults (i) have significantly more difficulty comprehending unfamiliar non-native accents than unfamiliar native accents (Adank *et al.* 2009, Bruce *et al.* 2012), (ii) experience processing costs when listening to unfamiliar accents (Bruce *et al.* 2012, Munro and Derwing 1995), (iii) find unfamiliar accents more difficult to understand when they are spoken at a faster speaking rate (Anderson-Hsieh and Koehler 1988, Munro and Derwing 1995), and (iv) have significantly more difficulty understanding unfamiliar accents when they present with compromised language systems (i.e. aphasia), compared to healthy adult controls (see studies by Bruce *et al.* 2012 and Dunton *et al.* 2011). For further information on accent comprehension research with typically developing infants and healthy adults see Cristia *et al.* (2012). To our knowledge Cristia *et al.* (2012) have been the only authors to review studies exploring accent perception across the life span.

The current review builds on Cristia *et al.*'s (2012) review by focusing on one specific age-group (i.e. children) and their ability to comprehend different accents. In this paper comprehension refers to the ability to understand spoken English words and/or sentences used in

experimental tasks. Research findings are discussed and linked to children's processing of speech variability. In addition, the review identifies methodological issues that should be considered when conducting research in this field and explores how such issues may be controlled in order to increase the validity and reliability of future research.

Defining an accent

Accents arise from distinctive variations in pronunciation patterns across speakers from particular locations. They denote a person's language and country of origin as well as their social status and identity (Kolluru *et al.* 2014). Bruce *et al.* (2012) and Flege *et al.* (1995) explain that an accent results from the segmental (i.e. vowels and consonants) and suprasegmental (i.e. prosodic features such as rhythmic stress and intonation) variations in individuals' speech. In relation to segmental differences, Wells (1982) specifies four key segmental differences between accents: (i) phonetic realisation (i.e. the way in which phonemes are produced), (ii) phonotactic distribution (i.e. the environment in which particular phonemes occur), (iii) phoneme system (i.e. the number and identity of phonemes used), and (iv) lexical distribution (i.e. the selection of different phonemes for the same word by speakers of different accents).

The current literature differentiates between two types of accent: (i) a regional/native accent, and (ii) a foreign/non-native accent (Bent 2014, Floccia *et al.* 2009). With reference to the English language, a regional/native accent denotes an accent spoken by a native English speaker from a different region (e.g. a speaker native to Dublin, Ireland speaking English to individuals in Northern Ireland). Conversely, a foreign/non-

native accent refers to English spoken by an individual whose first language is not English (e.g. a speaker native to China speaking English) (Bruce *et al.* 2012).

Method

The review process included both electronic and manual searching strategies. The following inclusion criteria were used to identify studies (i) published in peer-reviewed journals, (ii) using child participants aged over 12 months, (iii) investigating comprehension (iv) testing comprehension with English speaking accents. It excluded those (i) using adult participants, (ii) focusing on word learning rather than word comprehension, (iii) investigating accent acquisition/production, and (iv) examining accent perception (i.e. the ability to detect different accents and discriminate their phonetic components). In line with these inclusion criteria, relevant studies of all years until July 2014 were identified using the EBSCO and Scopus databases. The initial stage involved the use of search terms such as "accent comprehension" and "unfamiliar accents" to identify as many relevant studies as possible. EBSCO and Scopus generated 156 and 59 references respectively.

Following the methodology used by Webster and Whitworth (2012), the next stage involved reviewing the abstracts of each of these papers to identify those that met the inclusion criteria of the review. Four studies were identified as meeting the inclusion criteria (i.e. Nathan and Wells 2001, Nathan *et al.* 1998, Van Heugten *et al.* 2014, White and Aslin 2011).

The third stage of the search involved manual search strategies. We identified the journals in which relevant papers were published, and conducted a further electronic search in each of these journals using more specific search terms (e.g. "children comprehension", "toddler

accent", "word recognition"). This stage generated twelve further studies, but only five met the inclusion criteria of the review (i.e. Barker and Meyer-Turner 2014, Bent 2014, Creel 2012, Mulak *et al.* 2013, O'Connor and Gibbon 2011).

The final stage involved critical appraisal of the nine studies identified during the search. Each study was reviewed to identify (i) the characteristics of participants, (ii) method, and (iii) the effect of accent on language comprehension (see table 1). Studies were reviewed under two categories according to children's speech and language abilities: (i) effect of an unfamiliar accent on comprehension of typically developing (TD) children, and (ii) effect of an unfamiliar accent on comprehension of children with speech and/or language difficulties. The studies were then evaluated with regards to their methodology and results.

The studies are presented in order of participants' chronological age, from youngest to oldest, beginning with studies targeting single word recognition, and progressing to studies investigating comprehension of connected speech.

Table 1. Summary of studies included in the review

Area Researched	Author & Year	Participants	Accent		Experimental Task	Effect of accent on comprehension
Word recognition	White and Aslin (2011)	24 x English-learning typically developing 1;6 – 1;8 year olds	**Familiar:** Standard vowel (e.g. "dog") **Unfamiliar:** Shifted vowel (e.g. "dag")	Novel	Preference Looking Procedure (word-to-picture matching)	Infants recognised word mispronunciation (i.e. accented word), only after brief exposure with same vowel shift
	Creel (2012)	**Exp.1:** 48 x monolingual English-speaking typically developing 3;6 – 6;1 year olds **Exp.2:** 64 x monolingual English-speaking typically developing 3;2 – 5;7 year olds **Exp.3:** 32 x monolingual English-speaking typically developing 3;1 – 5;2 year olds	**Familiar:** American-English with standard pronunciations **Unfamiliar:** Novel accent (Altered pronunciation of vowels in exp. 1 and 2, and both vowels and consonants in exp. 3)	Novel	Measured looking times in 4-choice word-to-picture matching (pointing) task	Mispronunciations had no effect on comprehension accuracy, but lead to more uncertainty and slower processing.

Area Researched	Author & Year	Participants	Accent		Experimental Task	Effect of accent on comprehension
Word recognition	Bent (2014)	33 x monolingual American-English speaking typically developing 4;0 – 7;7 year olds	**Familiar:** American-English **Unfamiliar:** Korean	Non-native	Word repetition	Non-native stimuli were identified with significantly less accuracy than native stimuli
Word comprehension	Mulak *et al.* (2013)	32 x Australian-English learning, typically developing: - 16 x 1;3 year olds - 16 x 1;7 year olds	**Familiar:** Australian-English **Unfamiliar:** Jamaican	Non-native regional	Eye tracked word-to-picture matching	Both 1;3 and 1;7 year olds understood named words spoken in their native accent. Only 1;7 year olds understood words in the non-native regional accent.
	Van Heugten *et al.* (2014)	**Exp.1, 2:** 16 x monolingual English-learning typically developing 1;8 year olds **Exp.1, 3, 4, 5:** 16 x monolingual English-learning typically developing 2;1 year olds	**Familiar:** Canadian-English **Unfamiliar:** Australian-English	Regional	Preference Looking Procedure (word-to-picture matching)	2;1 year olds understood Australian accented words, regardless of type of prior exposure given. 1;8 year olds had greater difficulty understanding Australian accented words
	Barker and Meyer Turner (2014)	24 x monolingual English-speaking typically developing 2;6 – 3;6 year olds	**Familiar:** American-English **Unfamiliar:** Malayalam (India)	Non-native	Four choice word-to-picture matching (pointing) task	Significant difficulty with non-native accent in comparison to native accent

Area Researched	Author & Year	Participants	Accent		Experimental Task	Effect of accent on comprehension
Word comprehension	Nathan *et al.* (1998)	48 x monolingual typically developing: - 24 x 3;10 – 4;07 year olds - 24 x 6;08 – 7;06 year olds	**Familiar:** London **Unfamiliar:** Glaswegian	Regional	Word repetition & definition	Both groups had significant difficulty with unfamiliar accent, but the younger group had significantly more difficulty than the older group.
	Nathan and Wells (2001)	36 x monolingual English-speaking children: - 18 x typically developing 5;01 – 6;04 year olds - 18 x 5;03 – 6;05 year olds with speech difficulties	**Familiar:** London **Unfamiliar:** Glaswegian	Regional	Auditory lexical decision task (i.e. does this word match this picture?)	**Typical children:** No difficulty with unfamiliar accent **Children with speech difficulties:** Significant difficulty with unfamiliar accent
Sentence comprehension	O'Connor and Gibbon (2011)	50 x typically developing: - 25 x 7;0 – 8;0 year olds - 25 x 9;0 – 10;0 year olds	**Familiar:** Cork **Unfamiliar:** Tyrone	Regional	Sentence comprehension task using a modified version of the Token Test (i.e. carrying out spoken instructions)	**Older group:** No difficulty with unfamiliar accent **Younger group:** Significantly more difficulty with unfamiliar accent
Story comprehension	Barker and Meyer Turner (2014)	24 x monolingual English-speaking typically developing 2;7 – 3;6 year olds	**Familiar:** American-English **Unfamiliar:** Malayalam (India)	Non-native	Auditory story comprehension task, with 10 comprehension questions	Children performed significantly better with non-native accent

Insert table 1 about here

Review of studies

Studies investigating the effect of accent on language comprehension in typically developing children

The review provides evidence that TD children's language comprehension may be affected by an unfamiliar accent. Mulak *et al.* (2013) investigated young children's ability to recognise familiar high-frequency words spoken in (i) their native Australian accent, and (ii) a Jamaican accent, which the authors refer to as a "*non-native regional accent*" (p. 2068). The study included 32 participants divided into two age groups: 15 month olds and 19 month olds. Using eye-tracking technology, the authors measured children's fixation time on target images versus distractor images for familiar words spoken in the two accents. The authors found that while both groups understood familiar words spoken in their native Australian accent, only the 19 month old children were able to understand words spoken in the Jamaican accent, exceeding chance level. Mulak *et al.* (2013) also identified a correlation between expressive vocabulary size and the performance of 15 month olds with the Jamaican accent (i.e. the smaller the vocabulary size the greater the difficulty understanding the unfamiliar accent). This finding may be explained by the fact that as vocabulary size increases, phonological representations become more refined (Snowling and Hulme 1994), which may result in enhanced ability to process speech variability (i.e. accent) (this will be discussed further in the section *Developmental trend*). The authors concluded that the ability to recognise a familiar word despite natural phonetic variations that do not affect the word's identity, such as

accent-related variations, emerges at approximately 19 months of age. This ability is referred to as *phonological constancy* (Best *et al.* 2009); a crucial factor in the comprehension of accented speech.

White and Aslin (2011) also identified an effect of accent on the ability of 24 children aged 18 to 20 months to understand words spoken in two different accents. Parental questionnaires indicated that test vocabulary was familiar to children. These authors used a native English accent (from the same geographic region as the participants) and an artificial/novel accent (i.e. shift in vowels). The same speaker produced the native English accent with standard pronunciations (e.g. "dog") and the novel accent with a vowel mispronunciation (i.e. "dag"). White and Aslin (2011) employed a similar paradigm to Mulak *et al.* (2013). Namely, word recognition was assessed by measuring children's looking time when given a choice of two pictures in response to words presented in the two accent conditions. In keeping with the adult literature (e.g. Clarke and Garrett 2004), the authors found that the children's difficulty with the novel accent disappeared when an exposure phase to the novel accent (lasting approximately one minute) was introduced prior to the test phase. Additionally, children were able to generalise the learned vowel shift to phonologically similar target items not heard in the exposure phase. According to White and Aslin (2011) this ability is important for efficient accent adaptation. The children were unable to recognise words in the test phase when a different vowel shift or standard pronunciations were presented to them in the exposure phase. Therefore, based on these results, an exposure phase can eliminate an accent effect, but only when children are exposed to and tested with the same vowel shift (i.e. accent). These results are in contrast to Mulak and colleagues' (2013) research, which, despite not directly investigating the role of pre-test exposure in accent comprehension, found that 19 month old participants did not

require a prior exposure phase in order to recognise words spoken in an unfamiliar Jamaican accent. The different unfamiliar accents used in each study (i.e. a natural non-native accent and novel accent) may account for these differences in results.

Research by Van Heugten *et al.* (2014) also found contrasting results to White and Aslin (2011) in relation to exposure to an unfamiliar regional accent in 20 and 25 month old children. These authors found that 20 month old Canadian children had difficulty understanding the unfamiliar accent even when provided with exposure to that accent before testing. Additionally, prior exposure to the unfamiliar accent did not make any significant difference to 25 month old children's ability to comprehend an unfamiliar accent. The authors conducted a series of four experiments with 25 month old children and two experiments with 20 month old children to examine the developmental trajectory of children's comprehension of words spoken in an unfamiliar regional Australian-English accent. Children's knowledge of test vocabulary was measured by a parental questionnaire: 20 month old participants had a word comprehension rate of 88.3% and 25 month old participants had a word comprehension rate of 96.3%. Similarly to Mulak *et al.* (2013) and White and Aslin (2011), these authors used a preferential looking paradigm. However, prior to the testing phase, children were exposed to approximately two minutes of a story narrated by different speakers (female bilingual speaker of Cantonese and Australian-English, female Canadian-English speaker, male Cantonese speaker) across the five experiments; each experiment beginning with a different speaker/exposure phase. Results revealed that 20 month olds performed significantly better with their native Canadian-English accent compared to the unfamiliar Australian-English accent, even with prior exposure to the unfamiliar accent. The performance of 25 month olds was above chance level with the unfamiliar accent in all experiments. Furthermore, when comparing all the 25 month olds' performances across all experiments, there was no significant difference in their word recognition (i.e. prior exposure to different

accents, voices and languages did not significantly impact their ability to comprehend the unfamiliar Australian accented words). Like Mulak *et al.* (2013), Van Heugten *et al.* (2014) suggested that vocabulary size may be linked to young children's ability to process accent variability and may explain the difference observed between the two age groups in their experiment. This is particularly relevant given the differing vocabulary comprehension rates found between the younger and older age groups (i.e. 88.3% and 96.3% respectively).

The studies discussed thus far indicate that, by 12 months, young children have begun to develop phonological constancy and the ability to recognise familiar words spoken in unfamiliar accents. However, this ability is fragile and sometimes dependent upon a brief period of exposure.

Creel (2012) used a novel accent to investigate the effect of accent on the comprehension of familiar words in 3 to 5 year old children. Creel (2012) employed a word-picture matching task, where children were asked to select the target picture from a choice of four pictures. Similarly to White and Aslin (2011), Creel's novel accent involved a native American-English speaker altering her vowel pronunciations (e.g. "fish"-[fɪʃ] pronounced as [fɛʃ]) or consonant pronunciations (e.g. "keys"-[kiz] pronounced as [kiʃ]). Creel (2012) measured participants' response *accuracy* and concluded that 3 to 5 year old children could recognise familiar words delivered in a novel accent. Creel (2012) also examined children's *response times* by measuring their visual fixation patterns using an eye-tracking paradigm. The author noted that the 3 to 5 year old children in her study (i) were significantly slower to select the target picture, and (ii) explored non-target pictures more before selecting the correct picture when words were presented in the novel accent. However, in contrast to Van Heugten *et al*. (2014) and Mulak *et al*. (2013), age was not a factor; participant age was not correlated with accuracy scores or response time.

Creel (2012) concluded that, despite the non-significant effect on *accuracy*, 3 to 5 year old TD children displayed increased uncertainty and processing time when exposed to an unfamiliar accent. This finding is consistent with the adult literature (e.g. Bruce *et al.* 2012, Munro and Derwing 1995) and may be explained by the Stackhouse and Wells (1997) speech input processing model. The model suggests that familiar and unfamiliar accents are processed through different pathways within children's phonological system. Namely, when processing a familiar accent, speech input goes directly from the level of speech/non-speech discrimination to the phonological recognition level, bypassing phonetic discrimination. However, when processing an unfamiliar accent, the variability in speech input may require processing at this level of phonetic discrimination. Hence, the phonetic discrimination of speech input is not bypassed, which leads to additional processing time. Continuing to implement measures of processing speed in future research with children may allow researchers to answer the question of *how*, rather than simply *does*, an accent impact spoken language comprehension. Indeed, the effect of accent on comprehension may be masked by excluding measures of processing time. Video-recording is a widely applicable approach that can be used to provide this information (e.g. White and Aslin 2011). However, eye-tracking equipment may be more useful for future research; it is more technologically advanced, and gives more detailed and accurate results on language processing compared to video-recording (Dussias 2010). Eye-tracking technology allows researchers to learn about subtle differences in children's response to distracter stimuli, not just the target stimuli, and this can occur in real time analyses (Allopenna *et al.* 1998).

In contrast to Creel (2012), Barker and Meyer-Turner (2014) found an accent effect on children's word comprehension *accuracy*. The study involved 24 TD monolingual American-English speaking children (mean age 3;2 years). Participants were divided into two experimental

groups: one group heard words presented in their native accent (i.e. American-English), while the other group heard words presented in a non-native accent (i.e. Indian). Authors described the test vocabulary as "*age-appropriate*" (p. 7). Each child was encouraged to point to the picture that matched a spoken word from a choice of four pictures. The authors found that the group in the non-native accent condition achieved significantly lower performance scores than the group in the native accent condition.

Equally, Nathan *et al.* (1998) found an accent effect in older child participants. Two groups of 24 monolingual English speaking children aged 4 and 7 years participated in a single word repetition and definition task, in which they were required to repeat and define ten high-frequency words and ten low-frequency words. Words were presented in two accent conditions: (i) the unfamiliar regional (i.e. Glaswegian) accent condition, and (ii) the native (i.e. London) accent condition. The authors (i) concluded that their participants experienced significantly more difficulty comprehending words spoken in the unfamiliar accent compared to their native accent, and (ii) identified a developmental trend, whereby the older group displayed significantly fewer errors compared to the younger group.

Furthermore, Nathan *et al.* (1998) determined that while both 4 and 7 year olds made errors of *incorrect* lexical access based on phonetic confusions (e.g. mistaking "bear" for "beer" thus defining the Glaswegian realization of "bear" as "my dad drinks it"); the 4 year old children made more errors of *failed* lexical access (i.e. failed to respond or gave a made-up definition, such as defining "church" as "eating"). In other words, younger children were more likely to fail to access any word at all, rather than access another phonetically similar word.

Creel (2012) posited that, when processing unfamiliar accents, children must recognise that they are hearing a variant form of a familiar word even if they have never heard that variant before. Therefore, in order to understand unfamiliar accents, young children need a well-

developed phonological system that allows them to map the accented words and sounds they hear onto their own phonological representation (i.e. the child's mental representation of the sounds that comprise words in spoken language) (Nathan *et al.* 1998). According to Nathan *et al.* (1998) this is where children's difficulty with accented words lies. The authors argue that, due to their smaller lexicon and limited exposure to different accents, younger children do not have fully established and detailed phonological and lexical representations compared to the older 7 year old children. Consequently, these children experience greater difficulty mapping infrequently heard word forms onto their own phonological representations resulting in blocked lexical access (Nathan *et al.* 1998).

Bent (2014) used a similar word repetition task to Nathan *et al.* (1998) to investigate the effect of an unfamiliar non-native Korean accent on the word recognition of 33 TD monolingual children (aged 4 to 7 years). Children were presented with pre-recorded single words in each accent, one at a time, and were required to repeat the word they heard. The familiar native accent used was American-English. The task consisted of highly familiar words, half of which were lexically easy and half of which were lexically hard based on their neighbourhood density and frequency. Responses were recorded and written by the researcher and an accuracy score (i.e. percentage of correct repetitions) was calculated for each child in each accent condition. In contrast to all the other studies reviewed, speech shaped noise at +5 dB SNR was added to the auditory stimuli to prevent ceiling level scores. Results showed that stimuli presented in the native accent were significantly easier to recognise than stimuli presented in the non-native accent. Additionally, the word recognition accuracy scores for the lexically easy words in both accents and the accuracy scores for the lexically hard words in the native accent were positively correlated with age and vocabulary scores

(combining expressive and receptive vocabulary measures). This supports the hypotheses put forward by Nathan *et al.* (1998), Mulak *et al.* (2013) and Van Heugten *et al.* (2014) that the effect of an unfamiliar accent may be reduced with age and a larger vocabulary.

However, Bent (2014) found that the accuracy scores for the lexically difficult words presented in the non-native accent were not correlated with age and vocabulary scores in children. That is, an increase in age and vocabulary size did not alleviate the added difficulties associated with mapping unfamiliar variants of low frequency words to recognizable words in their lexicon. In contrast to Nathan *et al.* (1998), Bent (2014) also found that more children failed to access the correct lexical item rather than assume they heard another word (i.e. give a phonetic response). In addition, phonetic responses did not decrease with age, as proposed by Nathan *et al.* (1998). Bent (2014) suggested that this difference in findings may be due to (i) the differences between processing native accent and non-native accent variations, and (ii) the additional cognitive processes involved with processing speech mixed with noise. An accent effect could be negligible in quiet testing conditions (Adank *et al.* 2009), and hence, in order to reduce ceiling effects, future researchers may consider introducing adverse listening conditions in the form of noise-embedded speech to accent comprehension studies. This method is more reflective of everyday communication, where quiet conditions are not always available. However, there are additional cognitive processes (e.g. increased selective attention) involved in listening to speech mixed with noise (Darwin 2008), and this would have to be taken into consideration in future studies. Indeed, research from the adult literature found that speech mixed with noise had an adverse effect on accent processing (Adank *et al.* 2009).

There has been one study in which an accent effect was not found on single word comprehension, in TD 5 year old children (Nathan and Wells 2001). Although these children were included in the aforementioned study as a control group, it is worth noting that the accent in which

the single words were produced did not alter their ability to understand them (the details of this study in relation to the experimental group- children with speech difficulties- will be discussed in the section on *children with speech and/or language difficulties*). The researchers used an auditory lexical decision task with pictures, where the children were presented with a picture and were required to determine if the picture matched a pre-recorded word. In contrast to the findings reported in their 1998 study, which involved 4 and 7 year old children, the TD 5 year olds in this 2001 study, who lived in London, performed similarly with both regional accents (London and Glaswegian) and therefore, accent had no significant effect on their single word comprehension. While we might expect the 5 year olds to show less of an accent effect than the 4 year old children in their previous study (due to their larger vocabulary size and increased exposure to other accents), we would not expect them to show less of an effect than the 7 year old children. It is also worth noting that both studies examined single word comprehension using TD participants from the same area, the same accents and a subset of the same words, but using different testing procedures. Therefore, we might attribute the discrepancy in results to these testing procedures, which placed different cognitive and linguistic demands on the children's processing systems. Specifically, the word repetition and definition task used by Nathan *et al.* (1998) required a wide lexical search; while the auditory lexical decision task used by Nathan and Wells (2001) which consisted of pictures provided more context and reduced the lexical search needed to complete the task (Nathan and Wells 2001). Furthermore, it is likely that the word repetition task used by Nathan *et al*. (1998) involved bottom-up auditory factors only, while the auditory lexical decision task used by Nathan and Wells (2001) involved both top-down lexical factors and bottom-up auditory factors. In other words, children could access phonological representations from the visual stimuli and match these to the phonetic information received from the auditory input.

The interaction between the processing of unfamiliar accents and the demands of a particular research task must also be considered in studies using preferential looking paradigms. These paradigms are used in many of the studies involving participants aged less than 30 months (Mulak *et al.* 2013, Van Heugten *et al.* 2014, White and Aslin 2011) as they help to overcome the challenges inherent in conducting research with young children who have difficulty following specific task instructions. However, similarly to the experimental tasks employed by Nathan and Wells (2001), the use of pictures in preferential looking paradigms may also allow for both top-down lexical factors and bottom-up auditory factors to match variant word forms to stored lexical items. Hence, different task designs (i.e. experimental tasks using pictures and experimental tasks not using pictures) may place differing demands on the child's language processing system and, produce dissimilar results.

The studies discussed thus far explore the effect of accent on children's single word comprehension. However, current literature also addresses the effect of accent in connected speech, specifically in sentence (i.e. O'Connor and Gibbon 2011) and story comprehension (Barker and Meyer-Turner 2014). These studies are discussed separately as the level at which comprehension is investigated could make a difference to results. Specifically, sentence and conversation levels provide more context than single words alone, which may facilitate comprehension. Equally, the processing of additional supra-segmental features of connected speech may increase the difficulty in understanding unfamiliar accents.

O'Connor and Gibbon (2011) investigated the effect of an unfamiliar accent on sentence comprehension in 50 TD, English-speaking children from southern Ireland. Participants were divided into a younger (i.e. 7 – 8 years old), and older age group (i.e. 9 – 10 years old). Children performed a sentence comprehension task modelled on the Token Test (McGhee *et al.* 2007). They were required to carry out pre-

recorded instructions presented in (i) a familiar southern Irish accent (Cork accent), and (ii) an unfamiliar northern Irish accent (Tyrone accent). The two speakers used were female SLTs in training of similar age and voice quality. Instructions increased in sentence length and had relatively simple and predictable syntax (e.g. "Point to the big purple rectangle and the yellow circle").

Similarly to Bent (2014) and Nathan *et al.*'s (1998) findings in relation to single word comprehension with 4 and 7 year old children, O'Connor and Gibbon (2011) found a developmental trend in children's ability to process sentences presented in an unfamiliar accent. The younger age group (i.e. 7 – 8 years of age) had significantly greater difficulty comprehending sentences produced in the unfamiliar Tyrone accent compared to those produced in the familiar Cork accent. This difference was not evident in the older group (i.e. 9 – 10 years of age). The authors hypothesised that 7 to 8 year old children's difficulty understanding sentences spoken in an unfamiliar accent may be due to their reduced processing capacities and limited language exposure.

Barker and Meyer-Turner (2014) explored the effect of a non-native accent on children's story comprehension in an attempt to capture a more realistic and complex listening environment compared to comprehension of single words and decontextualised sentences. The study involved 24 TD monolingual American-English speaking children (mean age 3 years). Participants were divided into two experimental groups: one group heard a pre-recorded narration of a story book presented in their native accent (i.e. American-English speaker); the other group heard the same story in a non-native accent (i.e. Malayalan speaker from India). Both groups were then required to answer ten story comprehension test items presented in a native accent. The authors described the test vocabulary as "*age-appropriate*" (p. 13). Children responded by pointing to the picture that represented the correct answer from a choice of four pictures (e.g. "Touch the picture that shows where Jim went to find frog").

Interestingly, this study revealed that children performed significantly better with the non-native accent condition compared to the native accent condition.

This finding from Barker and Meyer-Turner (2014) is in contrast to previous research on both single word and sentence comprehension. The authors hypothesised that the raw saliency and/or novelty of the non-native accent held the children's interest and facilitated their allocation of attentional resources to the narration of the story. In contrast, the 3 year old children's familiarity with the narrator's native accent may have resulted in low interest in the narrative, therefore leading to decreased allocation of attentional resources to this auditory task. Therefore, according to Barker and Meyer-Turner, the children in the non-native accent condition had better knowledge of the story and thus answered the comprehension questions more accurately than the children in the native accent condition. However, these results should be interpreted with caution as there may be a number of other explanations for the authors' findings. For instance, differences in the speakers' volume and intonation (falling and rising pitch) during story telling could have impacted on the children's attention to the story, and hence their performance on the task. The authors did carry out acoustic analysis on the speaker's story excerpts (i.e. speaking rate, fundamental frequencies and vowel duration); however they did not examine the effect of the differences in these parameters between speakers on the children's performance. For instance, closer inspection of the values provided by these authors showed that the difference in speaking rates between the non-native and native accented narrators was as high as 18% in some sentences, where the non-native accented speaker exhibited a slower rate than the native accented speaker.

Speech rate is an important confounding variable to consider in research exploring the effect of accent on comprehension of connected speech. Research with adults suggests that speaking rate (measured in syllables per second) is an important factor in the comprehension of unfamiliar accents, with faster rates increasing the impact of an unfamiliar accent on language comprehension (e.g. Anderson-Hsieh and Koehler 1988, Munro and Derwing 1995). O'Connor and Gibbon (2011) also theorised that the speech rate of the unfamiliar accent used in their study, which was 10% faster than the familiar accent, may have played a role in their younger participants' (i.e. 7 years) difficulty with the unfamiliar accent. Evidently, the effect of speech rate on children's comprehension of accented connected speech requires more examination. This will be addressed further under *methodological issues*.

Studies investigating the effect of accent on language comprehension in children with speech and/or language difficulties

Thus far, to the best of our knowledge, there has only been one published paper examining the effect of an unfamiliar speaker accent on single word comprehension in children with speech difficulties and none specifically in children with language delay. Nathan and Wells (2001) conducted a study with 18 children aged 5 to 6 years with speech impairments. Participants were monolingual and from the London region. The authors did not differentiate the diagnoses of children with speech impairments (e.g. articulation disorder, phonological delay/disorder). Speech difficulties were defined as a score (based on percentage of consonants correct) of at least 1 SD below the mean on a word repetition task. The language skills of all participants were also measured, with the speech disordered group scoring significantly lower than the control group. As previously detailed in the *typically developing children* section, the researchers used (i) a familiar accent (i.e. London), and (ii) an unfamiliar

regional accent (i.e. Glaswegian) in an *auditory lexical decision task*, where children were presented with a picture and were required to determine if the picture matched a pre-recorded word. Nathan and Wells (2001) found that children with speech difficulties performed similarly to the control group on the lexical decision task in the familiar accent condition. However, groups differed in their performance with the unfamiliar regional accent, with the children with speech difficulties having significantly more difficulty comprehending the unfamiliar accent than the familiar accent.

Nathan and Wells (2001) also attempted to explore how variations in speech input (i.e. unfamiliar accents) impact the child's phonological system using the Stackhouse and Wells (1997) speech processing model. To address this, the authors employed two auditory discrimination tasks, and found that the children with speech difficulties had deficits at the low levels of input processing, specifically, phonetic discrimination and phonological recognition. Put simply, these children experienced difficulty (i) processing unfamiliar speech sounds, and (ii) identifying these speech sounds as part of their own language. Deficits at these levels may lead to added difficulties processing unfamiliar accents compared to TD children.

While the Nathan and Wells (2001) study indicates that children with speech impairments have a specific difficulty understanding an unfamiliar regional accent, future research should examine the effect of accent on language comprehension of children with different types of speech impairments, such as articulation disorder and phonological delay. It is also worth noting that the children's language test results revealed associated language difficulties in the speech-disordered group. Therefore, it is difficult to rule out language skills as a confounding variable in the accent comprehension results of the speech disordered participants. In addition, we cannot be certain that another unfamiliar accent (e.g. non-

native accent akin to Barker and Meyer-Turner 2014), would be more problematic for children with speech difficulties than for TD children, particularly if examined using a different task procedure (e.g. akin to Bent 2014).

Developmental trend

The review identified discrepancies in studies investigating accent-processing ability across childhood. Nonetheless, the reviewed studies provide evidence of an accent effect on children as young as 15 months. Current research also suggests a developmental trend, whereby younger TD children have more difficulty processing an unfamiliar accent compared to older TD children (Nathan *et al*. 1998). For approximately the first year of life infants have a sophisticated ability to discriminate the phonology, or perceive the phonetic contrasts, of all languages, allowing them to process some input variability (Nijland, 2009). However, between 6 and 12 months of age, as infants gain more experience with their native language and its phonological structure, they lose some sensitivity to non-native languages and this discrimination ability gradually narrows to the phonology of their native language (Jusczyk and Luce 2002). Moreover, during infancy children's phonological representations are more holistic (i.e. whole words are the smallest unit) (Fowler 1991). However, as children develop their input processing skills and their vocabulary increases, their representations are restructured to become more segmental (i.e. sub-lexical components, such as syllables and initial phonemes are the smallest units) (Snowling and Hulme 1994). According to Goswami (2000) this process is word-specific, and can be influenced by word frequency and familiarity, neighbourhood density and vocabulary size. Indeed, the studies reviewed here identify vocabulary size as a key predictor of accent effect in children. Specifically, the larger the vocabulary the smaller the effect of accent on comprehension. The

reviewed studies also linked the differences in young children's ability to process and understand unfamiliar accents to exposure to other languages and accents, developing phonological systems and processing capacity (e.g. attention). With regards to the latter, Dunton *et al.* 2011 suggested that processing an unfamiliar accent may require increased attention by the listener to the auditory stimuli. In order to accommodate speech variability (i.e. accent) children require (i) representational specificity (i.e. phonological distinctiveness), and (ii) stable and flexible representations (i.e. phonological constancy) (Best *et al.* 2009). Reduced abilities in these domains can result in difficulty mapping the acoustic signal to phonetic and phonological structures. Hence, younger children whose phonological system is still developing may experience phonological processing difficulties (Fowler 1991) when exposed to unfamiliar speech variability (i.e. difficulty comprehending unfamiliar accents).

Interestingly, Floccia *et al.* (2009) also identified a developmental trend in children's ability to perceive and categorise accents, as their meta-phonological abilities develop throughout childhood. Finally, an accent effect was also evident in children aged 5 to 6 years with speech difficulties when presented with an unfamiliar regional accent in an auditory lexical decision task.

Methodological issues in current research

This review identifies a number of methodological issues in current research, which is inherent in accent comprehension research. Namely: (1) definition and measurement of an "unfamiliar accent", (2) selection of experimental accent, (3) measures of accent differences, (4) use of accent familiarisation period, and (5) speech rate as a confounding variable.

1. Definition and measurement of an "unfamiliar accent"

Akin to the adult literature, four of the studies in this review use the terms *familiar* and *unfamiliar* when describing the experimental accents. However, the literature lacks a clear definition of what constitutes an unfamiliar accent or how to measure familiarity as a variable. For instance, O'Connor and Gibbon (2011) chose their phonetically distinct accents based on what was likely to be familiar and unfamiliar to participants, without further measurement of familiarity. Similarly, Nathan *et al.* (1998) did not measure the familiarity of the accents used in their study and stated that "*one reason for choosing a Glaswegian accent [unfamiliar accent] was that it has a number of salient differences compared to the London accent [familiar accent]*" (p. 350). Therefore, it appears that these accents differed more in their phonetic and phonotactic/phonological characteristics rather their familiarity to participants. While London and Glaswegian accents differ in their phonetic realisation and phonology, an individual from London may be familiar with the Glaswegian accent, due to long-term exposure through interaction with those from Glasgow, such as friends or relatives. In fact, exposure to multiple talkers with non-native accents has been shown to eliminate the accent effect in adults (Baese-Berk *et al.* 2013). Exposure through the media may also influence accent familiarisation. Evidence from sociolinguistic studies suggests that media can play a role in altering the production of accents (Stuart-Smith *et al.* 2013). However, Smith *et al.* (2014) showed that both long and short-term exposure to regional accents through the media did not fully eradicate the processing costs of listening to an accent that is not one's own. Therefore, it is likely that even children with long-term familiarisation to another accent through media exposure will still experience some processing difficulties with that accent.

Participants' level of familiarity with an accent may be estimated using background questionnaires or parental reports (e.g. gathering information from parents about their child's level of exposure to other accents). Bent (2014), for instance, questioned parents on the frequency of their child's exposure to different accents. At present, there is no standard or optimal method of collecting information on participants' level of familiarity with or exposure to accents. However, this type of information gathering may be a useful tool when assessing children's familiarity with different accents, and may also help researchers control for participant background as a possible confounding variable.

Rating scales provide an alternative method of measuring accent familiarity in accent research. Rating scales are commonly used to rate the degree of accentedness (see studies by Bent 2014, Clarke and Garrett 2004, Munro and Derwing 1995). In relation to accent familiarity, accent rating scales could be completed by a representative sample of participants (from the same area as the familiar accented speaker), in order to obtain a quantifiable measure of the participants' familiarity with the experimental accents. The people included in this representative sample should not participate in the accent comprehension task; they should simply rate the familiarity of the accents used in the experimental task. For instance, the representative sample could rate their familiarity with an accent using a Likert scale ranging from 1 to 7 (1=very unfamiliar and 7=very familiar), and answer the question *how familiar is accent X to you*?

Overall, the notion of degree of accent familiarity represents a feature of speech that is difficult to measure and control. Hence, the terms *familiar*/*unfamiliar* may need to be re-evaluated due to the inherent difficulties in measuring such a subjective and person-specific aspect of speech.

2. Selection of experimental accent

The studies reviewed here selected different accents as the unfamiliar accent in their experimental tasks; namely, (i) non-native accents, (ii) regional accents, and (iii) novel accents. However, accent comprehension results may be influenced by the type of accent used. For instance, the contradictory results between Nathan and Wells (1998) and Bent (2014) may be explained by the differences in processing native accents compared to non-native accents. Indeed, there is evidence in the adult literature that a non-native accent is significantly more difficult to comprehend than a familiar and unfamiliar regional accent (Bruce *et al.* 2012).

The effect of the selected accent on results is also be evidenced when comparing findings by Creel (2012) and Barker and Meyer-Turner (2014). Both studies adopted the same testing procedure (4 choice word-to-picture matching task), but used different experimental accents – a novel accent and a natural non-native accent. While Creel (2012) found that a novel accent did not significantly impact children's accuracy of word retrieval; the same was not true for Barker and Meyer-Turner (2014), who used a non-native accent. Novel accents have been adopted in studies with both children (Creel 2012, White and Aslin 2011) and adults (Adank and Janse 2010, Baese-Berk *et al.* 2013). Creel (2012) argues that the differences in vowel and consonant changes of a novel accent are present in non-native accents and thus results could be replicated in a real accent. In addition, the use of novel accents in research can help to eliminate or minimize speaker variability (e.g. difference in voice and speech rate). However, one must note that novel accents can also contain less phonetic and phonological variability (e.g. a single vowel or consonant change) and be less ecologically valid than natural accents. The experimental accent selection process of future research should include consideration of the advantages and disadvantages inherent in using natural and novel accents in accent comprehension studies.

3. Measures of accent differences

Accents differ in a number of characteristics, including phonetic realisation, phonology, intonation patterns, acoustic properties, perceived accentedness (i.e. how strong or weak an accent is) and comprehensibility (i.e. how easy or difficult an accent is to understand) (Anderson-Hsieh and Koehler 1988). Therefore, to investigate children's ability to understand two different accents it is crucial to correctly measure and define the similarities and the differences between those accents. Floccia *et al.* (2009) explain that, for instance, different accent strengths may result in different levels of difficulty with an unfamiliar accent. Accordingly, future researchers should attempt to quantify the degree of accentedness in accent related studies. Once again, rating scales can be useful tools in measuring perceived differences between accents (Southwood and Flege 1999). Currently, a 9-point interval scale is the most commonly used scale in accent research (see studies by Munro and Derwing 2001, Piske *et al.* 2001, Southwood and Flege 1999). An alternative is to use a visual analogue scale (e.g. Flege *et al.* 1995), which has the advantage of allowing finer distinctions to be recorded. Additionally, the visual analogue scale has shown improved validity and reliability over equal-appearing-interval scales in rating aspects of speech in children with cleft lip and palate (Baylis *et al.* 2014). At present, a standardised methodology for developing accent rating scales has not yet been developed and it is still unknown which type of scale is the most valid and reliable (Piske *et al.* 2001).

A more objective method to quantify the differences between accents involves comparing the phonetic features of an accent. For example, in Van Heugten *et al.'s* (2014) study, the differences between a Canadian-English accent and Australian-English accent are described

both phonetically and prosodically. Currently, many researchers cite Wells (1982) to describe the vowel system, consonantal features and intonation of native English accents (Nathan and Wells 2001, O'Connor and Gibbon 2011). New technologies are being designed to identify and compare features and patterns of an accent, including the measurement of acoustic qualities of accents and coding of linguistic data (see work by Huckvale 2006, McMahon *et al.* 2007). However, speaker similarities are not always accurately represented through these quantitative measures alone (Schmale and Seidl 2009). Therefore, a combination of techniques, involving both quantitative phonetic and phonological measures and qualitative perceptual ratings, may be the best way to measure the differences and similarities between accents in future research.

As previously mentioned, novel accents can also be used to address the differences between accents used in accent comprehension research. Novel accents allow a single speaker to produce both the familiar and unfamiliar accents, which can reduce many of the speaker dissimilarities across experimental accents, such as speech rate and voice quality. Equally, a novel accent removes the authenticity of natural accents. Despite Creel's (2012) argument that results using a novel accent should be replicated in a task using a natural accent, some of the consonant changes used in Creel's (2012) novel accent do not mimic natural accent variations in English (e.g. "broom"-[brum] pronounced as [krum]). Nevertheless, future research could explore the role of novel accents in (i) controlling accent and speaker differences, and (ii) investigating the specific accent-related sound changes that influence accent comprehension.

4. Use of accent familiarisation period

While not all studies in this review have included an accent familiarisation period prior to the experimental phases, those that do differ in their delivery of this accent exposure phase. Nathan and Wells (2001), who exposed children to a speaker narrated story, advocate the use of a familiarisation period prior to the experimental task, suggesting that children should be exposed to a few minutes of a short story in each accent, to allow them to "tune-in" to the phonology of those accents. A period of adaptation is also reflective of the clinical setting, where clinicians spend time talking to the client establishing rapport before introducing the assessment procedure. Research from the adult literature also found that a short pre-exposure phase may reduce the processing costs associated with the comprehension of unfamiliar accents (Baese-Berk *et al.* 2013, Clarke and Garrett 2004, Smith *et al.* 2014). As previously discussed, findings from studies with younger participants (aged 25 months and below) have produced conflicting results in terms of short-term exposure to unfamiliar accents. It is clear that pre-test familiarisation periods may be an important factor to consider and examine further in future studies with children.

5. Speech rate as a confounding variable

Speech rate has been identified as a potential confounding variable in research in accent comprehension. As previously discussed, research with adult participants indicated that speaking rate is an important factor in the comprehension of unfamiliar accents (Anderson-Hsieh and Koehler 1988, Munro and Derwing 2001). Research has shown that speech rate may impact speech intelligibility. For example, Chan and Lee (2005) found that fast speech rates had a negative impact on speech intelligibility with healthy adults. Yet, most research with the paediatric population has not controlled this variable. Although speech rate is difficult to control, unless synthesised speech is used, adult literature provides two

possible ways of addressing this methodological concern: (i) subjectively controlling speech rate (i.e. asking speaker to consciously alter their speech rate), and (ii) digitally manipulating speech samples. Each method has its shortcomings. Subjectively controlling speech rate may change the speaker's natural accent features thus introducing further confounding speaker variables. In addition, various attempts are needed to achieve the desired rate, which may lead to speaker fatigue and reduce the naturalness of the speech sample. However, with this method, voice quality remains unaffected. Conversely, using synthesised speech, by digitally expanding or compressing speech samples, makes it easier to match speech rates of various speakers and reduces the number of recordings needed. Digital manipulation may introduce changes in quality or speech naturalness to speech samples. However, some argue that these changes are small to negligible (Adank *et al.* 2009, Clarke and Garrett 2004, Mulak *et al.* 2013, Munro and Derwing 2001).

As mentioned in the section *measures of accent differences,* novel accents may also be used to eliminate speech rate as a confounding variable. Specifically, a single speaker can produce both the familiar and unfamiliar accent, hence it is more likely that the speech rates will be matched in both accents. However, there can still be some variability in vowel or sentence duration, as shown by researchers who have adopted this method (Adank and Janse 2010, Creel 2012, White and Aslin 2011). Future research should attempt to control speech rate, while considering the strengths, limitations and ecological validity of each method.

Clinical implications

The current review provides evidence that an unfamiliar accent has an impact on TD children's language comprehension. In addition, children with speech impairments have more difficulty comprehending single words in an unfamiliar regional accent compared to their own familiar accent, due to difficulties at the level of phonological recognition and phonetic discrimination. Furthermore, evidence from adult research suggests that individuals with a compromised language system have particular difficulty processing an unfamiliar accent (Bruce *et al.* 2012, Dunton *et al.* 2011). Therefore, it is possible that children with compromised language systems will also experience comprehension difficulties when presented with unfamiliar accented speech, particularly when their phonological system is still developing. This finding has clinical relevance in the field of paediatric speech and language therapy, as clinicians will need to consider the effect their accent may have on children's language comprehension and speed of processing in everyday interactions, as well as how it may impact their performance on language assessments. If children are underperforming on language comprehension tasks due to tester related factors such as accent, SLTs may be underestimating children's language abilities and incorrectly identifying the presence and/or severity of language delays.

Both clinicians with unfamiliar accents and clients have a role in minimising the potential effect of the clinician's accent on client's comprehension. Clinicians may adopt strategies such as (i) slowing down speech rate, which has been shown to reduce accent processing time and improve accent comprehension in adults (Anderson-Hsieh and Koehler 1988, Munro and Derwing 1995), and (ii) modifying their own accent to accommodate clients (Levy and Crowley 2012). However, at present, there is no definitive evidence to suggest that the accent modification method facilitates accent comprehension. Additionally, clients may employ strategies such as (i) asking the clinician to slow down speech rate, (ii) asking for clarification, and (iii) requesting repetition. The findings from this review also have implications for professionals

responsible for diagnosing receptive language delays (e.g. educational and clinical psychologists) and/or involved in the education of children. However, further research is required before these professionals can be advised on how to deal with the likely effect of accent on children's language comprehension.

Despite the possible difficulties associated with unfamiliar accents presented in this review, research has shown that it can also be beneficial for children to be exposed to an unfamiliar accent. Children in Barker and Meyer-Turner's (2014) study performed significantly *better* with an unfamiliar accent than with own native accent in a narrative comprehension task, thereby suggesting that unfamiliar accents can potentially improve children's attention during story-telling. Additionally, exposure to multiple variants of a word (i.e. accents) may help refine and stabilise a child's phonological system (Nathan *et al.* 1998) and help the development of more mature perceptual representations in children with phonological impairment (Munson *et al.* 2005).

Gap in current research and suggestions for future research

This review highlighted the limited research available into the comprehension of accents in the paediatric population. There is only one study examining accent comprehension with children with speech impairments (unspecified type) (Nathan and Wells 2001), and while this speech disordered group, as a whole, had associated language difficulties, language ability was not the focus of the paper. There has been no study focusing specifically on children with language difficulties, controlling for participants' language skills. Evidently, the effect of an unfamiliar accent on language comprehension in children with compromised language is a current gap in the literature. Given that an unfamiliar accent is

considered to increase the processing cost in a single word comprehension task (Creel 2012), it is important to know whether an accent effect exists in children with language impairments, and in particular, whether this effect is greater in children with language impairments compared to TD children.

Bruce *et al.* (2012) showed that adults with aphasia found a non-native accent significantly more difficult to comprehend than familiar and unfamiliar regional accents. It would be interesting to determine whether a similar pattern is observed in TD children, and children with speech and/or language impairments, especially considering that Floccia *et al.* (2009) provide evidence that by the age of seven, children have a greater awareness for the characteristics of foreign accented speech than for regionally accented speech. Additionally, Creel (2012) showed that 3 to 5 year old children were slower to process a novel accent; similar results were produced in the adult literature with natural accents (Bruce *et al.* 2012, Munro and Derwing 1995). However, more research is needed to explore the processing costs associated with children's comprehension of native and non-native accents. Despite the evidence that speech variability impacts processing of speech input, knowledge of *how* children process this variability is limited.

The role of exposure on the ability to understand accents has been investigated in children aged 25 months and below; however it is still unclear how older children adapt to accents, particularly with regards to short-term versus long-term exposure. Therefore, it is still uncertain whether adaptation strategies to unfamiliar accents vary with cognitive and linguistic development (Cristia *et al.* 2012).

Finally, all participants in the studies reviewed were monolingual English speakers, but bilingualism is another important factor to consider with accent comprehension in children. Bilingual children are exposed to two phonological systems. The developmental course of their

sound categorisation also differs from monolingual children's (Creel 2012). In addition, it has been shown that bilinguals have more flexibility in their phonetic-to-lexical mapping and can adapt to a novel accent better than monolinguals (Webber *et al.* 2014). Additionally, Baese-Berk *et al.* (2013) found that adults exposed to multiple non-native talkers were able to adapt to a novel accent, suggesting that exposure to this type of systematic variability improves word comprehension. Therefore, bilingual children may comprehend and process accents differently and experience less difficulty processing accent-related variations in speech compared to monolingual children. Although it would be interesting to conduct further research with this population, one must consider the complexity of bilingual children with regards to accent comprehension, such as the large variability in their second language (L2) learning (e.g. age of initial exposure to L2, amount of exposure to L2, number of years speaking L2, influence of L1 and L2 etc.).

Conclusion

Despite some inconsistencies found in the literature, current research provides evidence that an unfamiliar speaker accent may lead to a comprehension breakdown in both TD and speech disordered children. Learning to understand a range of different accents appears to be a gradual process that requires time to fully master (Van Heugten *et al.* 2014). This review highlighted young children's developing phonological system and growing lexicon as predictors of improved ability to process accent-related variations in speech. It also highlighted the developmental trend in children's ability to understand unfamiliar accents, with older children exhibiting less difficulty with accented speech than younger children. Furthermore, Creel (2012) argues that an unfamiliar accent increases uncertainty and slows down speech processing even

when it has no effect on comprehension accuracy scores. Overall, researchers propose that children's processing of accent-related variations in speech may be facilitated by (i) an increased lexicon, (ii) exposure to different accents, and (iii) adequate processing resources (e.g. attention).

This review also highlighted the methodological issues present in current research, namely: (i) imprecise definition and measurement of an "unfamiliar accent", (ii) selection of different experimental accents, (iii) inadequate measurements of accent differences, (iv) use of accent familiarisation period, and (v) speech rate as a confounding variable. We have explored how such issues may be controlled in order to increase the validity and reliability of future research. Lastly, the review highlights the need for further research in the field of accent comprehension in children. We have suggested some key areas for further research and identified a major gap in the literature, particularly in relation to research investigating the effect of accent on the comprehension of children with language impairments.

References

ADANK, P., EVANS, B., G., STUART- SMITH, J. and SCOTT, S. K., 2009, Comprehension of familiar and unfamiliar native accents under adverse listening conditions. *Journal of Experimental Psychology: Human Perception and Performance*, **35**(**2**), 520–529.

ADANK, P. and JANSE, E., 2010, Comprehension of a novel accent by young and older listeners. *Psychology and Aging*, **25**(**3**), 736–740.

ALLOPENNA, P.D., MAGNUSON, J.S. and TANENHAUS, M.K., 1998, Tracking the time course of spoken word recognition using eye movements: evidence for continuous mapping models. *Journal of Memory And Language*, **38,** 419–439.

ANDERSON-HSIEH, J. and KOEHLER, K., 1988, The effect of foreign accent and speaking rate on native speaker comprehension. *Language Learning*, **38**(**4**), 561–613.

BAESE-BERK, M., BRADLOW, A. R., WRIGHT, B. A., 2013, Accent-independent adaptation to foreign accented speech. *Journal of the Acoustical Society of America*, **133**(**3**), EL174–EL180.

BARKER, B. A. and MEYER-TURNER, L., 2014, Influences of foreign accent on preschoolers' word recognition and story comprehension. *Applied Psycholinguistics*, [online] 1–22 (available at: http://journals.cambridge.org/download).

BAYLIS, A., CHAPMAN, K. and WHITEHILL, T. L., 2014, Validity and reliability of visual analog scaling for assessment of hypernasality and audible nasal emission in children with repaired cleft palate. *The Cleft Palate-Craniofacial Journal*, [online] (available at: http://www.cpcjournal.org/doi/abs/10.1597/14-040?url_ver=Z39.88-2003&rfr_id=ori%3Arid%3Acrossref.org&rfr_dat=cr_pub%3Dpubmed&)

BENT, T., 2014, Children's perception of foreign-accented words. *Journal of Child Language*, **41**(**6**), 1334–1355.

BEST, C. T., TYLER, M. D., GOODING, T. N., ORLANDO, C. B. and QUANN, C. A., 2009, Development of phonological constancy: toddlers' perception of native- and Jamaican-accented words. *Psychological Science*, **20**, 539–542.

BRUCE, C., TO, C. and NEWTON, C., 2012, Accent on communication: the impact of regional and foreign accent on comprehension in adults with aphasia. *Disability & Rehabilitation*, **34**(**12**), 1024–1029.

CHAN, A. H. S. and LEE, P. S. K., 2005, Intelligibility and preferred rate of Chinese speaking. *International Journal of Industrial Ergonomics*, **35**, 217–228.

CLARKE, C. M. and GARRETT, M. F., 2004, Rapid adaptation to foreign-accented English. *Journal of the Acoustical Society of America*, **116**(**6**), 3647–3658.

CREEL, S. C., 2012, Phonological similarity and mutual exclusivity: on-line recognition of atypical pronunciations in 3–5-year-olds. *Developmental Science*, **15**(**5**), 697–713.

CRISTIA, A., SEIDL, A., VAUGHN, C., SCHMALE, R., BRADLOW, A. and FLOCCIA, C., 2012, Linguistic processing of accented speech across the lifespan. *Frontiers in Psychology*, **3**, 1–15.

DARWIN, C., 2008, Listening to speech in the presence of other sounds. *Philosophical Transactions of the Royal Society B: Biological Sciences*, **363**(**1493**), 1011–1021.

DUNTON, J., BRUCE, C. and NEWTON, C., 2011, Investigating the impact of unfamiliar speaker accent on auditory comprehension in adults with aphasia. *International Journal of Language Communication Disorders*, **45**(**1**), 63–73.

DUSSIAS, P. E., 2010, Uses of eye tracking data in second language sentence processing research. *Annual Review of Applied Linguistics*, **30**, 149–166.

FLEGE, J., MUNRO, M. and MACKAY, I., 1995, Factors affecting degree of perceived foreign accent in a second language. *Journal of the Acoustical Society of America*, **97**(**5**), 3125–3134.

FLOCCIA, C., BUTLER, J., GIRARD, F. and GOSLIN, J., 2009, Categorization of regional and foreign accent in 5- to 7-year-old British children. *International Journal of Behavioral Development*, **33**(**4**), 366–375.

FOWLER, A. E., 1991, How early phonological development might set the stage for phoneme awareness. In S. A. Brady, D. P. Shankweiler, S. A. Brady and D. P. Shankweiler (eds.), *Phonological Processes in Literacy: A Tribute to Isabelle Y. Liberman* (Hillsdale, NJ, England: Lawrence Erlbaum Associates, Inc), pp. 97–117.

GOSWAMI, U., 2000, Phonological representations, reading development and dyslexia: towards a cross-linguistic theoretical framework. *Dyslexia*, **6**, 133–151.

HUCKVALE, M., 2006, The new accent technologies: recognition, measurement and manipulation of accented speech. In P. Zhang, T.-W. Xie, S. Lin, J.-H. Xie, A.C.

Fang and J. Xu (eds), *Research and Application of Digitized Chinese Teaching and Learning* (Beijing: Language and Culture Press), pp. 28–37.

JUSCZYK, P. W. and LUCE, P. A., 2002, Speech perception and spoken word recognition: past and present. *Ear & Hearing*, **23**(**1**), 2–40.

KOLLURU, B., WAN, V., LATORRE, J., YANAGISAWA, K. and GALES, M. J., 2014, Generating multiple-accent pronunciations for TTS using joint sequence model interpolation. In *Fifteenth Annual Conference of the International Speech Communication Association*.

LEVY, E. S. and CROWLEY, C. J., 2012, Beliefs regarding the impact of accent within speech-language pathology practice areas. *Communication Disorders Quarterly*, **34**(**1**) 47–55.

MCGHEE, R. L., EHRLER, D. J. and DISIMONI, F., 2007, *Token Test for Children – 2nd Edition (TTFC – 2)* (Texas: PRO-ED Inc).

MCMAHON, A., HEGGARTY, P., MCMAHON, R. and MAGUIRE, W., 2007, The sound patterns of Englishes: representing similarity. *English Language and Linguistics*, **11**(**1**), 113–142.

MULAK, K. E., BEST, C. T., TYLER, M. D., KITAMURA, C. and IRWIN, J. R., 2013, Development of phonological constancy: 19-month-olds, but not 15-month-olds, identify words in a non-native regional accent. *Child Development*, **84**, 2064–2078.

MUNRO, M. J. and DERWING, T. M., 1995, Processing time, accent, comprehensibility in the perception of native and foreign accented speech. *Language and Speech,* **38**(**3**), 289-306.

MUNRO, M. J. and DERWING, T. M., 2001, Modeling perceptions of the accentedness and comprehensibility of L2 speech. *Studies in Second Language Acquisition,* **23**(**4**), 451–468.

MUNSON, B., EDWARDS, J. and BECKMAN, M. E., 2005, Phonological knowledge in typical and atypical speech-sound development. *Topics in Language Disorders,* **25**(**3**), 190–206.

NATHAN, L. and WELLS, B., 2001, Can children with speech difficulties process an unfamiliar accent? *Applied Psycholinguistics,* **22**, 343–361.

NATHAN, L., WELLS, B. and DONLAN, C., 1998, Children's comprehension of unfamiliar regional accents: a preliminary investigation. *Journal of Child Language,* **25**, 343–365.

NAZZI, T., JUSCZYK, P. W. and JOHNSON, E. K., 2000, Language discrimination by English learning 5-month-olds: effects of rhythm and familiarity. *Journal of Memory and Language*, **43**, 1–19.

NIJLAND, L., 2009, Speech perception in children with speech output disorders. Clinical *Linguistics & Phonetics*, **23**(**3**), 222–239.

O'CONNOR, C. and GIBBON, F., 2011, Familiarity of speaker accent on Irish children's performance on a sentence comprehension task. *Journal of Clinical Speech and Language Studies*, **18**, 1–17.

OFFICE FOR NATIONAL STATISTICS (ONS), 2013, *Population by Country of Birth and Nationality Report, August 2013* (available at: http://www.ons.gov.uk/ons/rel/migration1/population-by-country-of-birth-and-nationality/2012/population-by-country-of-birth-and-nationality-report.html).

PISKE, T., MACKAY, I. R. A. and FLEGE, J. E., 2001, Factors affecting degree of foreign accent in an L2: a review. *Journal of Phonetics*, **29**, 191–215.

SCHMALE, R. and SEIDL, A., 2009, Accommodating variability in voice and foreign accent: flexibility of early word representations. *Developmental Science*, **12**(**4**), 583–601.

SMITH, R., HOLMES-ELLIOTT, S. PETTINATO, M. and KNIGHT, R. A., 2014, Cross-accent intelligibility of speech-in-noise: long-term familiarity and short-term familiarization. *Quarterly Journal of Experimental Psychology*, **67**(**3**), 590–608.

SNOWLING, M. and HULME, C., 1994, The development of phonological skills. *Philosophical Transactions: Biological Sciences*, **346**(**1315**), 21–27.

SOUTHWOOD, M. H. and FLEGE, J. E., 1999, Scaling foreign accent: direct magnitude estimation versus interval scaling. *Clinical Linguistics and Phonetics*, **13**(**5**), 335–349.

STACKHOUSE, J. and WELLS, B., 1997, *Children's Speech and Literacy Difficulties I: A Psycholinguistic Framework* (London: Whurr Publishers).

STUART-SMITH, J., PRYCE, G. TIMMINS, C. and GUNTER, B., 2013, Television can also be a factor in language change: evidence from an urban dialect. *Language*, **89**(**3**), 501–536.

VAN HEUGTEN, M., KRIEGER, D. R. and JOHNSON, E. K., 2014, The developmental trajectory of toddlers' comprehension of unfamiliar regional accents. *Language Learning and Development*, [online] 1–25 (available at http://www.tandfonline.com/doi/abs/10.1080/15475441.2013.879636).

WEBBER, A., DI BETTA, A. M. and MCQUEEN, J. M., 2014, Treack or trit: adaptation to genuine and arbitrary foreign accents by monolingual and bilingual listeners. *Journal of Phonetics*, **46**, 34–51.

WEBSTER, J. and WHITWORTH, A., 2012, Treating verbs in aphasia; exploring the impact of therapy at the single word and sentence levels. *International Journal of Language and Communication Disorders*, **47**(**6**), 619–636.

WELLS, J. C., 1982, *Accents of English Volume 1: An Introduction* (Cambridge: C.U.P.).

WHITE, K. S. and ASLIN, R. N., 2011, Adaptation to novel accents in toddlers. *Developmental Science*, **14**, 372–384.