The role of speaking styles in assessing intonation in foreign accent syndrome

Abstract

Purpose: This paper evaluates the role of different speaking styles in defining intonation patterns in speakers with foreign accent syndrome. The methodological investigation aimed at establishing to what extent scripted and unscripted speech influence the phonological realisation of intonation in disordered speech.

Method: Four individuals with foreign accent syndrome and four gender-, age- and original dialect-matched control speakers were asked to perform a series of scripted and unscripted speech tasks including short sentences, a reading passage, a picture description and a monologue task. The speech data were analysed within the autosegmental-metrical framework of intonational analysis in relation to inventory, distribution, realisation and functional use of intonational elements.

Result: Findings revealed that the unscripted speaking styles provided a more comprehensive picture of the inventory and distribution of intonation contours, whereas differences in the functional use were more prominently reflected in the scripted data sets, in particular the short sentences.

Conclusion: The findings highlight that the type of speaking style influences how intonation patterns are realised in disordered as well as healthy speech. A combination of scripted as well as unscripted data is thus required to obtain a comprehensive picture of the intonation abilities of a speaker with foreign accent syndrome.

The role of speaking styles in assessing intonation in foreign accent syndrome

Foreign accent syndrome (FAS) is a motor speech disorder in which changes to a speaker's pronunciation lead to the perception of a non-native accent in speech. The impression of accent change is commonly regarded to be the result of a combination of segmental as well as suprasegmental changes. At segmental level, extant literature reports errors relating to the production of vowels such as alterations in length and quality (e.g. Ardila, Rosselli, & Ardila, 1988; Blumstein, Alexander, Ryalls, Katz, & Dworetzky, 1987; Graff-Radford, Cooper, Colsher, & Damasio, 1986; Gurd, Bessell, Bladon, & Bamford, 1988; Ingram, McCormack, & Kennedy, 1992; Miller, Lowit, & O'Sullivan, 2006; Perkins, Ryalls, Carson, & Whiteside, 2010) and tenseness (e.g. Ingram et al., 1992; Katz, Garst, & Levitt, 2008; Whitaker, 1982). Frequent consonantal changes occur with regard to manner and place of articulation as well as voicing features (e.g. Ardila et al., 1988; Gurd et al.,1988; Kurowski, Blumstein, & Alexander, 1996; Laures-Gore, Contado Henson, Weismer, & Rambow, 2006; Miller et al., 2006; Scott, Clegg, Rudge, & Burgess, 2006). At suprasegmental level, alterations in intonation have been identified in particular to contribute to the speech changes. These include changes in pitch height and pitch range, resulting in inappropriate excursions (Avila, González, Parcet, & Belloch, 2004; Blumstein et al., 1987; Coelho & Robb 2001; Moonis et al., 1996) and exaggerated terminal contours (Ingram et al., 1992; Moen, 2006). Studies have further found evidence of issues with the functional use of intonation in speakers with FAS, reflected in inappropriate use of rising and falling intonation to indicate questions and statements (e.g. Berthier, Ruiz, Massone, Starkstein, & Leiguarda, 1991; Blumstein et al., 1987; Graff-Radford et al., 1986; Miller et al., 2006).

Superimposed on the speech stream and relatively difficult to capture, intonation has traditionally attracted less research interest than the segmental units of speech. In research on FAS studies that examined intonation patterns did so primarily by means of perceptual evaluation

and visual inspection of the pitch contour (e.g. Ardila et al., 1988; Blumstein et al., 1987; Katz et al., 2008). More recent research made use of advances in technology and intonational theory which offer an opportunity to go beyond this traditional way of describing intonation, and quantified intonation in FAS in a systematic manner that allowed to advance our understanding of intonational phenomena in FAS further (Kuschmann & Lowit, 2012; Kuschmann, Lowit, Miller, & Mennen, 2012; Verhoeven & Mariën, 2010). Verhoeven and Mariën (2010), for instance, analysed the intonation contours of a Dutch speaker with FAS in a detailed manner using a stylisation method. They found that the speaker used the full range of Dutch pitch contours but overused the rising pattern, which was interpreted as a strategy to control turn taking. Kuschmann et al. (2012) have described different aspects of intonation suggested by Ladd (1996) including inventory and distribution of intonational elements, their implementation and functional use to provide a fuller picture of the intonation system in FAS. The systematic analysis shed light on the underlying nature of intonational changes in FAS with regard to primary and secondary impairments, as well as compensatory mechanisms.

The intonational analysis by Verhoeven and Mariën (2010) was based on conversational data, whereas Kuschmann et al. (2012) analysed a series of short sentences which were read out by the speakers with FAS. The use of different types of speech styles (i.e. scripted and unscripted speech) to analyse intonation and other aspects of speech is common practice but frequently raises concerns pertaining to the comparability of findings. This is reflected in the on-going debate in the literature as to which type of speech data is most appropriate to capture intonational patterns (Hirst & Di Cristo, 1998; Xu, 2010). Although scripted speech remains the most commonly used speaking style for research on intonation due to the higher level of control over speech output compared to unscripted modes, concerns have been raised for some time over its adequacy in investigating the complexity of intonation patterns as well as the degree to which

findings reflect natural speech behavior. This is why a stronger emphasis should be put on natural speech data (Rischel, 1992). The issue on task differences and the debate on how best to assess particular speech parameters is not new. However, whilst there is a sizeable amount of research across a range of speech features in healthy as well as clinical populations, there have been no comprehensive reports on intonation across different modalities. Instead, features linked to intonation, such as phrasing, pausing and pitch modulation have been investigated. For example, early studies on healthy speakers focused on differences in pausing behavior between reading and conversation, or different types of spontaneous samples (e.g. picture description vs. radio interviews). Results show that pause type and position differed significantly between samples. That is, in scripted tasks, pauses were more likely to be silent and occurred at grammatical boundaries whereas in spontaneous (i.e. unscripted) speech a higher percentage of filled pauses at ungrammatical phrase locations was found (Barik, 1979; Duez, 1982; Goldman-Eisler, 1968; Grosjean & Deschamps, 1973; Howell & Kadi-Hanifi, 1991). Pauses in spontaneous speech also tended to have a higher frequency and longer duration (Levin, Schaffer, & Snow, 1982). Similar results in relation to pausing behaviour were reported in studies investigating speakers with motor speech disorders (Brown & Docherty, 1995; Leuschel & Docherty, 1996).

In addition, research reports lower F0 levels in spontaneous speech than reading (e.g. Hudson & Holbrook, 1982; Johns-Lewis, 1986; Koopmans-Van Beinum, 1992). Hirschberg (1995, 2000) furthermore found a stronger association between pitch contour type and sentence type in reading. However, investigations pertaining to F0 performance in speakers with motor speech disorders did not show the same task effects. For instance, Leuschel and Docherty (1996) found fewer changes in F0 production between tasks in their speakers with dysarthria, and Brown and Docherty (1995) report different or more inconsistent directions of change.

It is evident from the above mentioned studies that there are clear differences between speaking styles. However, there remain a number of unanswered questions in relation to intonation. In particular, research methodology has progressed significantly since these early studies and the autosegmental metrical (AM) approach (Pierrehumbert, 1980) is now the preferred method of characterising intonation from a phonological perspective (see method for more information on this approach). Whilst previous research provides some information on how individual speech parameters might change across tasks, there is currently no information on the interaction of task choice and intonation. Although there have been a number of recent reports on disordered intonation using the AM approach by the authors (Kuschmann & Lowit, 2012; Kuschmann, Lowit, Miller, & Mennen, 2012; Lowit & Kuschmann, 2012; Lowit, Kuschmann & Kavanagh, 2014), which established levels of intonational breakdown for scripted as well as unscripted tasks, there has been no comparative study investigating whether certain intonation behaviours are more prevalent in specific tasks. This knowledge would be particularly important for disordered speech where clinicians need to know which task is best suited to assess particular speech parameters.

The current study is an exploratory investigation that seeks to better understand the influence of speaking styles on the intonational abilities of individuals with disordered speech such as FAS - a motor speech disorder that to a large extent is characterised by intonational changes. Different aspects of intonation are compared across a range of scripted and unscripted speech tasks in healthy speakers as well as participants with FAS to provide the basis for future investigations into the suitability of these tasks for the assessment of different aspects of intonation.

Methods

Ethical approval for this study was obtained from the University as well as local NHS Ethics Committees prior to the start of data collection.

Participants

Four speakers with FAS (FAS) and four age-, gender- and dialect-matched control speakers (CON) took part in the speech production experiment (see table 1; FAS: 49–61 years, M = 56 years, two female, two male; CON: 46– 61 years, M = 55, two female, two male). All participants were right handed. The speakers with FAS had a confirmed neurogenic origin for FAS, although a psychogenic element cannot be ruled out. Speaker FAS 1, 2 and 4 were diagnosed with a left-hemispheric CVA, FAS 3 was reported to have had a brain stem infarct. Speakers were monolingual speakers of British English. The original dialects of the speakers with FAS were established through case history as well as interviews with relatives. Control speakers were closely matched to the dialectal variety spoken by the speakers with FAS prior to the neurological incident. This was important as intonation realisation is sensitive to dialectal variation. Information about the perceived accents of the speakers with FAS had been obtained by a variety of sources including the responsible speech and language therapist, friends and family members. Formal and informal assessment confirmed that the participants had no uncorrected visual or auditory impairment, no depression and no history of speech and language difficulties apart from their current speech issues. Reading and cognitive abilities were adequate to complete the reading tasks and follow task instructions.

At the time of testing, the participants were at least 15 months post-onset, and at least 6 months post speech and language therapy. After the neurological incident all four speakers with FAS presented with speech difficulties including slurred speech (FAS 1 and 3), breathing and phonation problems (FAS4) or mild word finding difficulties (FAS2). Blocks of speech and language therapy focused on oromotor activities to improve articulation (FAS 1 and 3), breathing

(FAS 4) and word finding (FAS2). The treatment protocols did not focus on the new accents or aspects of intonation and prosody. As part of the study FAS 2 to 4 were screened for dysarthria and apraxia of speech using subtasks from the Frenchay Dysarthria Assessment (Enderby & Palmer, 2008) and the Apraxia Battery for Adults – 2nd edition (ABA-2; Dabul, 2000). Results of the assessment showed issues with respiratory and phonatory support and control in all three speakers tested (see supplementary material). However, only FAS2 showed signs of a mild form of apraxia of speech as indicated by occasional non-phonemic vowel changes, a small number of schwa insertions in word-initial position and, at times, difficulties with initiating speech.

--- table 1 about here ---

Speech tasks and materials

The participants were asked to complete a battery of commonly used speech tasks that elicited scripted as well as unscripted speech data.

Scripted materials

The scripted tasks included reading short sentences and a text passage. The controlled sentence structure limited the participants' options as to how to interpret and thus realise the material. Specifically, a set of ten sentences with four experimental conditions was devised to investigate speakers' abilities to highlight particular words in a variety of sentence positions (see Data Analysis below for more information on the functional aspect that was investigated). The sentences were controlled for length, syntactic structure and word stress patterns. To optimise pitch tracking and subsequent analysis, words primarily contained sonorant segments. (An overview of the sentences can be found in Kuschmann & Lowit, 2012). The reading passage was an adaptation of the well-known *Grandfather Passage* (Darley, Aronson, & Brown, 1975; see appendix A). The passage was modified to investigate information status, which is the functional aspect of intonation of importance to the present study (see Data Analysis below). The

modification was necessary to enable the assessment of an equal number of new and given items. In addition, target items were controlled for sonorance to facilitate pitch tracking. The passage further contained a variety of sentence lengths to be able to investigate the impact of phrasing on the realisation of intonation patterns.

Unscripted materials

The unscripted speech tasks consisted of a picture description and a monologue, and aimed at eliciting semi-spontaneous speech. The picture description task consisted of a series of four pictures (Kauschke & Siegmüller, 2002), which centre around a restricted number of items featuring in several pictures. The monologue task required the participants to describe how to prepare a cup of coffee or tea (Miller et al., 2007). Due to the simple, automatic nature of the topic, it was anticipated that the task would result in comparatively long utterances with a minimum of interruptions to the speech flow for language processing. In addition, similar to the picture description task, specific words were referred to repeatedly.

Recording procedure

Speech recordings were made in a quiet room in the participants' home or at nearby university facilities using a portable DAT recorder (TASCAM DA-P1) and a condenser microphone (Beyerdynamic MPC 65 V SW). Microphone-to-mouth distance was 50 cm.
For each task verbal and written instructions were provided. The sentence reading task was presented in a PowerPoint presentation using a question-answer design. The sentences were randomised and separated by filler sentences of differing length to prevent participants from being accustomed to one particular intonation pattern or sentence structure. Participants performed a number of practice sentences to familiarise themselves with the structure of the experiment before starting the actual testing. For each question-answer pair auditory and visual prompts were provided to ensure correct processing of the linguistic structure. In addition, the

word to be accented was underlined to maximise the chances of eliciting the intended intonation pattern. The reading passage was printed in large print. Participants were encouraged to read through the passage once before reading it out. Similarly, for the picture description task they were instructed to look at all four pictures before describing them in detail. The monologue task instructions prompted the participants to explain in depth how they would make a cup of coffee or tea.

Data annotation

Overall, a total of 276 sentences along with 24 sound files of at least 30 seconds length (i.e. reading passage, picture description and monologue for eight speakers) were analysed for the purposes of this study. The speech recordings were converted to .wav files by Kay Elemetrics Multispeech System, at a sampling rate of 44.1 kHz. The analysis of the speech data was conducted using PRAAT speech analysis software (Version 5.0.11, Boersma & Weenink, 1992 – 2014).

The speech samples were analysed from a phonological perspective using the AM framework of intonational analysis (Pierrehumbert, 1980). In this approach, intonational patterns are annotated in terms of sequences of H(igh) and L(ow) target tones. The two main categories are pitch accents and boundary tones, which are either associated with stressed syllables or phrase boundaries. For the purposes of the present study, a variety of features were labelled including an orthographic transcription of syllables, prominent syllables (P) and phrase boundaries (%). Based on this information the phonological annotation was conducted using the following structural labels for pitch accents: H* (high level tone), L* (low level tone), H*L (falling tone), !H*L (downstepped falling tone), L*H (rising tone) and L*HL (rise–fall). De-accentuation - the absence of a pitch accent on a word that was expected to be accented - was labelled DE.

Data analysis

Based on these data, speaking style comparisons and, where appropriate, group comparisons were conducted in relation to inventory, distribution, realisation and function of intonation. The inventorial analysis determined which pitch accents the speakers had at their disposal; the distributional analysis established the frequency of use of these elements. In terms of realisation, phrasing and accentuation were assessed by determining the mean length of intonation phrases (IPs), as well as the pitch–accent-syllable ratio, which reflects the overall frequency of pitch accentuation within IPs. For the functional analysis, the use of pitch accents to indicate information status - the marking of new and given information - was evaluated. Structuring discourse by means of new and given information is important for effective communication as it directs the listener's attention to the relevant information in the utterance. New information represents the informative part of an utterance; given information relates to the part of the utterance that can be inferred from the preceding context (Halliday, 1967). In English, information status is signalled by assigning a pitch accent to new information, and de-accenting given information in post-focal position (Chafe, 1994; Cruttenden, 2006; Gussenhoven, 2004). NB: In intonation theory, the concept of information status is closely related to the concept of focus. Both functions are used to highlight certain information (i.e. words or phrases) within an utterance. The crucial difference is that in some cases information can be in focus, and thus be highlighted by means of intonation, even if it does not represent new information.

Statistical analysis

Non-parametric statistics were employed to assess whether group performances differed significantly with regard to distribution, implementation and function of intonation. Differences between groups were established using Mann-Whitney U test, with significance being determined at $p < .05$.

Intra- and inter-rater reliability

Intra- and inter-rater reliability was completed on 10% of the data. Samples included sentences, picture descriptions and reading passages from both control speakers and speakers with FAS. Agreement was established for prominent syllables, phrase boundaries and pitch accents. Intra-rater reliability measures were carried out by the first author; inter-rater reliability measures were conducted by a trained speech-language pathologist with experience in prosodic transcription following a specified labelling protocol. Reliability scores of intra-and inter-rater agreement for each transcription category and text style examined are listed in table 2. As can be seen, reliability for intra-rater transcription was consistently over 92%, indicating a very high degree of agreement. Inter-rater agreement was above 77%, reflecting good agreement (e.g. Pitrelli, Beckman, & Hirschberg, 1994).

--- table 2 about here ---

Results

The following sections present the findings for inventory, distribution, realisation and function of intonation, both in relation to differences across elicitation tasks as well as those between control speakers and speakers with FAS. For presentation purposes, the results displayed in figures are pooled. Please note that some of the results of the sentence data were included in an earlier study by the authors (Kuschmann et al., 2012).

Inventory

In the scripted data sets, the falling pitch accents (H*L, !H*L) and the high pitch accent H* were used by all speakers (see appendix B). The remaining pitch accents L*H, L*HL and L* featured in both text styles but were only used by some speakers. Specifically, rising pitch accent L*H and rise-fall accent L*HL were associated with the inventories of the speakers with FAS, whereas the low level pitch accent L* was more consistently employed by the CON group.

The unscripted data sets showed similar results. Pitch accents H*L, !H*L and H* were again employed by all speakers in both groups (see appendix B). In addition, pitch accents L*H and L* were common, with the former being employed more consistently by the FAS and the latter by the CON group. On the other hand, L*HL was only observed in two speakers with FAS, and only in the PICT data.

A quantitative inventorial comparison of the four text styles showed that an average of three to five different types of pitch accents were elicited in the scripted text styles per speaker, whereas this number increased to four to six pitch accents in the unscripted data sets (table 3). This finding was observed for both groups. It shows that a richer inventory of pitch accents was elicited in the unscripted text styles.

--- table 3 about here ---

Distribution

The distributional analysis of pitch patterns across the four text styles showed that both speaker groups used the different pitch accents to a similar extent (figure 1 and 2). In all sets the falling pitch accent H*L represented the most frequently used pitch pattern, followed by H* and !H*L. Distributional differences between text styles primarily occurred in relation to the rising pitch accent L*H, which was used more frequently in the unscripted text styles than the scripted ones. Although L*H was generally more prevalent in the FAS group than the control group, the difference between groups only reached significance in the MONO data set (SENT: U=7.0, z =-.296, p=.767; PASS: U=6.0, z =-348, p=.568; PICT: U=4.0, z =-1.16, p=.248; MONO: U= .5, z =-2.18, p=.029).

--- figure 1 and 2 about here ---

Accentuation and Phrasing

Accentuation

The pitch-accent syllable ratio remained relatively stable across text styles. Results, however, show differences in performances between groups. Control speakers produced about one pitch accent every four syllables irrespective of the text style (see table 4), whereas the speakers with FAS displayed a consistently higher frequency of accents with one pitch accent every three syllables. However, the gap between the two groups narrowed in the MONO data set. This was reflected in the statistical results, which showed that groups differed significantly with regard to the frequency of pitch accents in the scripted as well as the PICT data sets (SENT: U=.00, z =-2.32, p=.020; PASS: U=.00, z =-2.35, p=.019; PICT: U=.00, z =-2.32, p=.020), but not in the monologue task (MONO: U=3.00, z =-1.49, p=.137).

--- table 4 about here ---

Phrasing

Table 5 shows that phrases in the scripted data sets were on average longer than those in the unscripted data sets. At the same time, it was found that across all text styles the speakers with FAS generally divided their utterances into smaller phrasing units than the control speakers. The largest divide between groups was observed for the SENT data where phrases produced by the speakers with FAS were about one third shorter than those of the control speakers. Across the remaining data sets the difference in phrase length between groups gradually decreased, and was least pronounced in the MONO data set. This observation was confirmed by the statistical analysis which revealed significant differences in phrase length for the scripted (SENT: U=.00, z =-2.32, p=.020; PASS: U=.00, z =-2.30, p=.021) but not for the unscripted data sets (PICT: U=2.5, z =-1.59, p=.110; MONO: U=6.00, z =.58, p=.561).

--- table 5 about here ---

Function: Marking of information status

Figure 3 shows that, irrespective of the text style, new information was assigned a pitch accent by both control speakers and speakers with FAS. The similarities in performance were reflected in the statistical results which did not yield significant differences between the two groups (SENT: U=8.00, z =0.00, p=1.00; PASS: U=4.00, z =-1.51, p=.131; PICT: U=4.00, z =-1.51, p=.131; MONO: U=6.00, z =-1.00, p=.317).

However, clear differences between groups and text styles were observed with regard to the marking of given information. In the scripted data sets de-accentuation of given information was the primary pattern for the control speakers, whereas the speakers with FAS predominantly assigned pitch accents to these items. This difference was statistically significant (SENT: U=.00, z =-2.32, p=.020; PASS: U=.00, z =-2.34, p=.019). For the unscripted data sets, a narrowing of the performance gap between the groups was observed - due to control speakers de-accenting fewer items -, although differences between the two speaker groups remained significant (PICT: U=.00, z =-2.37, p=.018; MONO: U=1.00, z =-2.02, p=.043).

Discussion

The aim of this study was to investigate the influence of text styles on intonation behaviour in speakers with FAS. To achieve this, four different types of speech samples were elicited including short sentences, a reading passage, a picture description and a monologue. These were subsequently examined with regard to their intonational characteristics - inventory, distribution, realisation and function. Given the lack of previous research using the current methodology and the inconsistencies reported in the clinical population regarding task differences in pitch performance, no predictions could be made in terms of the anticipated behavior of the current FAS participant group. Instead we attempt to provide possible explanations for the observed performances and discuss the methodological and clinical implications of these findings. A more detailed discussion of the intonational findings and how they relate to

intonation performances previously reported in the literature can be found in Kuschmann et al. (2012).

Inventory: The results showed that overall text styles featured a similar range of pitch accents being used throughout, and consistently by both speaker groups. However, two pitch accents - L*HL and L* - were more closely associated with either scripted or unscripted data. Specifically, the rise-fall L*HL was more likely to occur in the scripted data sets, and the low pitch accent L* in the unscripted sets. The presence of L*HL in the data sets was likely to be the result of a speaker-specific preference as it predominantly featured in FAS1 and FAS3's inventories. On the other hand, L* use was observed across both groups. A detailed analysis revealed that it was often associated with stretches of speech that expressed an afterthought, adding or correcting previous information and its use was thus context and speaking style dependent.

A further observation was that the range of pitch accents employed within data sets was wider in the unscripted data, in particular in the picture description, for both groups. This finding suggests that speakers' inventorial make-ups were influenced by the type of text style investigated, with the unscripted data sets yielding a more varied inventory than the scripted data sets. Thus, the unscripted text styles used in this study seemed to provide a more comprehensive picture of the pitch accents speakers have at their disposal than scripted speech.

Distribution: The distributional analysis showed a similar use of pitch accents across text styles with the exception of the rising pitch accent L*H which was used the least in the set of sentences and the most in the monologue. There was also a tendency for the speakers with FAS to employ this accent more consistently than the control speakers. Rising pitch patterns can be considered as continuation markers, representing a speaker's intent to continue the turn (Verhoeven & Mariën, 2010). The fact that the increase in the use of L*H occurred in the

unscripted data sets shows that all speakers were sensitive to employing the rising pitch accent more in those text styles where the marking of continuation was of higher relevance to effective communication. The more frequent use of L*H in the FAS samples might be a compensatory mechanism that was employed to overcome speech production problems associated with FAS such as long pauses (Verhoeven & Mariën, 2010).

Similar to the inventorial analysis, there were thus context dependent, functional differences in pitch accent use observable in both groups. In addition, the speakers with FAS displayed differences which pointed towards a compensatory strategy which would be an important issue to recognise in their clinical management.

Realisation: With regard to accentuation, results showed that there was little variation in relation to pitch-accent frequency across text styles. However, speakers with FAS consistently accented more words per IP than the control speakers irrespective of text style. This difference was significant for the scripted text styles as well as the picture description but not for the monologue, indicating a narrowing of the performance gap in unscripted speech. This finding has implications for assessment as scripted text styles may be more likely to flag up difficulties with accentuation in clinical populations.

In terms of phrasing, the results revealed that scripted materials resulted in the production of longer intonation phrases than the unscripted data, which is in line with previous reports on phrase length and pausing (e.g. Levin et al., 1982). This pattern was observed for both groups and is not entirely surprising: the use of scripted speech entails predetermined grammatical structures in which pauses are imposed by punctuation. In unscripted speech, however, no such linguistic frame is provided. The participant is required to think about the content as well as the structure of what they intend to say, which involves higher processing demands.

Similar to the accentuation results, the speakers with FAS differed significantly from the control speakers in the scripted tasks but not the monologue, suggesting that they could not match the increased demand on phrase length for the read materials. These findings do not necessarily point to one text style being better suited over another in characterising the realisation of intonation patterns. Instead they highlight the importance of comparing speakers' performance across a range of tasks in order to avoid over- or underestimating their abilities.

Function: The functional realisation of new information was the same across all data sets, with new information being pitch-accented. On the other hand, the marking of given information was influenced by the type of text style. In the scripted data set, de-accentuation of given information dominated, whereas accentuation prevailed in the unscripted data sets of the control speakers. This is in line with intonational research, which shows that given information in post-stress position is expected to undergo de-accentuation (e.g. Cruttenden, 2006; Gussenhoven, 2004). However, as other variables such as phrasing and speaker intention also influence pitch patterning, de-accentuation may not always be an option, in particular in unscripted speech. However, participants with FAS had problems producing de-accentuation across all text styles, a fact that has also been reported for other speakers with motor speech disorders (e.g. Lowit & Kuschmann, 2012; Lowit et al., 2014). Due to the pattern displayed by the control speakers, these difficulties were more noticeable in the scripted samples as in the unscripted material where the control speakers tended to accent given information as well. The results thus suggest that there is a clear link between information status and accentuation patterns in scripted speech, which becomes less mandatory in unscripted data. Consequently, scripted text styles appear to be better suited to assess functional aspects of intonation.

It should be noted that although speaker FAS 2 exhibited some signs of mild AOS such as occasional difficulties initiating speech, sporadic non-phonemic vowel changes as well as

infrequent schwa insertions in word-initial position, the results of the intonational analyses indicate that she performed in line with the rest of the group. This suggests that her intonation patterns were not affected by the occasional speech changes associated with AOS.

In summary, the analysis of the four different scripted and unscripted data sets revealed that they had an influence on the manifestations of the different aspects of intonation. More precisely, the text styles differed as to their ability to capture the range of intonational characteristics investigated in this study. Whilst scripted data was more effective in capturing the functional use of intonation (i.e. the marking of information status) unscripted text styles were more likely to provide a more comprehensive picture of the categorical inventory speakers had at their disposal. This finding suggests that the two types of text styles complement each other in yielding clinically relevant information. It also corroborates the position that systematic experimental control is indispensable when investigating the underlying mechanisms of speech production (Xu, 2010). Scripted speech may not have the same richness of information, as evidenced in the inventorial results, but it allowed controlling and manipulating the factors contributing to the functional use of intonation.

In addition, the type of text style had an effect on the magnitude of performance differences between clinical and healthy speakers. For all styles investigated, the performance gap between control speakers and speakers with FAS narrowed in the unscripted data sets. Consequently, analysing only one type of text style could distort the manifestation of the intonational abilities in FAS speech. If one were to look at unscripted data sets only, one may not get the full picture of the intonational limitations in FAS. On the other hand, looking at scripted speech only might indicate performance changes in the disordered speakers that have limited functional relevance.

The findings therefore highlight the importance of using a variety of task types for a comprehensive assessment of intonation, not merely for the purpose of capturing a naturalistic sample of speech, but in order to gain a full view of the nuances of intonation behavior in both healthy and disordered speech, and to ensure that performance limitations and potential compensatory behaviours are accurately identified.

Conclusion

This study has identified a number of differences in intonational performance across speech tasks which may be of clinical relevance for an accurate characterisation of a speaker's intonational difficulties. This can complement perceptual descriptions of intonation performance to obtain a more comprehensive picture of the nature of intonational changes in FAS. Due to the rarity of the disorder the study is small in scope, which can be considered a limitation. However, it does provide evidence for the importance of investigating both scripted and unscripted tasks when assessing intonation. This finding is likely to have a wider impact on the investigation of motor speech disorders from a methodological point of view. Whilst we acknowledge that speakers with other speech disorders might not exhibit the exact same similarities and differences across tasks as described for the current participants, the control group data highlight that the procedural and clinical issues emerging from this study may be of relevance to a wider range of speech disorders than FAS. Our exploratory study thus provides an argument for further research into this issue to corroborate the results of the existing research, and to establish more firmly which speech aspects can be expected to differ and how on the basis of more participants and speech disorders. This in turn will help elucidate more general issues related to speech production such as the role of task complexity for instance, and how this relates to intonation performance. A task suited to investigate intonation may not be the best basis for capturing intelligibility or articulatory accuracy, and tasks thus need to be compared across a wider variety of speech

parameters than have been reported to date. Information resulting from such studies can inform assessment practice, and could ultimately provide speech-language pathologists with guidance on which speech aspects are linked to limitations in functional communication and should therefore be a priority for treatment.

Declaration of interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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Appendices

Appendix A

Modified Grandfather Passage (NB: New items are underlined; given items are in italics.)

You wish to know all about my grandfather. Well, he is the best *grandfather* in the world. He is ninety years old. I think that *ninety* is quite an age. Yet he still thinks as swiftly as ever. He used to be a lawyer. And, of course, he was the best *lawyer* in town. He dresses himself in a blue coat with white buttons. I love this *coat* and when I was younger I used to count the *buttons*. A long beard clings to his chin. I know granny doesn't like the *beard*, but he prefers it that way. When he speaks, his voice is now a bit cracked. But I remember the impressive *voice* he had when talking to his clients. Every day, he plays skillfully and with zest upon a small organ. I like to hear him playing the *organ*. He slowly takes a short walk in the open air each day. My granny often joins him on the *walk* because she likes the fresh *air*. Unless it's winter; because it can be quite icy round here in *winter*. Every day he looks after his roses. He has been growing *roses* in his garden for 40 years now. When I visit him we usually sit in the *garden* and have a chat. We often talk about London, because he used to work in *London*. Weren't it for the weather it would be the best city in the world. But when it comes to nice *weather* he much prefers Venice.

Appendix B

Inventory and distribution of pitch accents per speaker and text style in percent (CON = control speaker, FAS = speaker with foreign accent syndrome, SENT = sentences, PASS = reading passage, PICT = picture description, MONO = monologue, H*L = falling tone, !H*L = downstepped falling tone, L*H = rising tone, H* = high level tone, L* = low level tone, L*HL = rise-fall)

	SENT						PASS					
	H*L	!H*L	L*H	H*	L*	L*HL	H*L	!H*L	L*H	H*	L*	L*HL
CON1	69	6	3	19	3	0	56	13	8	21	2	0
CON2	49	10	1	40	0	0	55	13	13	19	0	0
CON3	74	11	1	12	2	0	54	23	0	22	0	1
CON4	68	17	0	14	1	0	59	20	0	21	0	0
mean	65.0	11	1.3	21.3	1.5	0	56.0	17.3	5.3	20.8	0.5	0.3
FAS1	72	12	0	15	1	0	48	18	19	12	0	3
FAS2	32	7	43	18	0	0	24	11	39	26	0	0
FAS3	61	10	6	22	0	1	44	21	6	28	0	1
FAS4	78	6	0	16	0	0	54	11	1	33	0	1
mean	60.8	8.8	12.3	17.8	0.3	0.3	42.5	15.3	16.3	24.8	0	1.3
	PICT						MONO					
	H*L	!H*L	L*H	H*	L*	L*HL	H*L	!H*L	L*H	H*	L*	L*HL
CON1	34	25	25	15	1	0	40	27	18	13	2	0
CON2	55	9	0	27	9	0	38	24	10	28	0	0
CON3	41	30	12	12	5	0	44	26	0	18	12	0
CON4	71	10	2	15	2	0	31	28	18	10	13	0
mean	50.3	18.5	9.8	17.3	4.3	0	38.3	26.3	11.5	17.3	6.8	0
FAS1	25	36	14	21	0	4	47	23	22	8	0	0
FAS2	19	5	47	24	5	0	33	11	30	19	7	0
FAS3	63	4	4	25	2	2	30	28	18	10	13	0
FAS4	37	10	23	23	7	0	30	3	30	37	0	0
mean	36	13.8	22	23.3	3.5	1.5	35	16.3	25	18.5	5	0

Tables

Table 1

Information on the participants including age, gender, time post onset, regional dialect and perceived accent

Speaker	Age in years	Gender	Time post onset in months*	Original dialect	Perceived accent
FAS1	61	f	16	North-East England (Newcastle)	French, Italian
FAS2	49	f	26	Scottish East Coast (Fife)	Italian, South African
FAS3	61	m	63	Southern British (Essex)	Italian
FAS4	54	m	15	North-West England (Manchester)	Italian
CON1	60	f	---	North-East England (Newcastle)	---
CON2	46	f	---	Scottish East Coast (Fife)	---
CON3	61	m	---	Southern British (Essex)	---
CON4	53	m	---	North-West England (Manchester)	---

NB: CON = control speaker, FAS = speaker with foreign accent syndrome, f = female, m = male, * at time of testing

Table 2

Inter- and Intrarater agreement in percent for the transcription data of different text styles

Categories	SENT %	PASS %	PICT %	overall
Intra-rater				
IP boundaries	96.2	100	93.5	95.6
Prominent syllables	97.8	95.4	93.7	95.6
Pitch accents/tones	93.4	91.6	93.2	92.7
overall	95.8	95.7	93.5	---
Inter-rater				
IP boundaries	95.6	93.8	94.1	94.5
Prominent syllables	88.4	77.0	80.5	82.0
Pitch accents/tones	86.0	76.7	70.6	77.8
overall	90.0	82.5	81.7	---

NB: SENT = sentences, PASS = reading passage, PICT = picture description, MONO = monologue, IP = intonation phrase

Table 3

Overview of number of different types of pitch accents per speaker group and text style

	SENT	PASS	PICT	MONO	total (per group)
FAS	16	19	21	17	73
CON	18	16	19	18	71
total (per text style)	34	35	40	35	

NB: The numbers sum up the different types of pitch accents elicited by all speakers in a group.

(SENT = sentences, PASS = reading passage, PICT = picture description, MONO = monologue,

CON = control speakers, FAS = speakers with foreign accent syndrome)

Table 4

Pitch accent to syllable ratio per text style and speaker

	SENT	PASS	PICT	MONO	mean
FAS1	2.9	2.7	2.8	3.3	2.9
FAS2	2.8	3.5	3.5	3.6	3.3
FAS3	3.4	3.5	3.3	3.8	3.5
FAS4	3.5	3.6	3.4	3.3	3.5
mean	3.2	3.3	3.3	3.5	3.3
CON1	4.3	4.1	4.3	4.0	4.2
CON2	4.2	4.1	4.0	3.3	3.9
CON3	4.1	4.4	4.4	3.9	4.2
CON4	4.3	4.4	4.4	3.9	4.3
mean	4.2	4.3	4.3	3.8	4.2

NB: SENT = sentences, PASS = reading passage, PICT = picture description, MONO = monologue, CON = control speaker, FAS = speaker with foreign accent syndrome

Table 5

Mean IP length in syllables per text style and speaker

	SENT	PASS	PICT	MONO	mean
FAS1	4.7	4.1	4.5	5.2	4.6
FAS2	7.9	5.9	5.9	5.7	6.4
FAS3	7.5	5.7	4.9	6.7	6.2
FAS4	4.9	6.1	6.1	4.5	5.4
mean	6.3	5.5	5.4	5.5	5.7
CON1	9.7	6.2	6.8	6.5	7.3
CON2	9.7	6.6	5.4	4.6	6.6
CON3	9.0	7.7	6.1	6.1	7.2
CON4	9.8	7.1	7.3	6.1	7.6
mean	9.6	6.9	6.4	5.8	7.1

NB: SENT = sentences, PASS = reading passage, PICT = picture description, MONO = monologue, CON = control speaker, FAS = speaker with foreign accent syndrome

Figure captions

Figure 1

Distribution of pitch accents in the scripted data sets per group (CON = control speakers; FAS = speakers with foreign accent syndrome) in percent

Figure 2

Distribution of pitch accents in the unscripted data sets per group (CON = control speakers; FAS = speakers with foreign accent syndrome) in percent

Figure 3

Accentuation for new and post-focally given information per text style and group (CON = control speakers; FAS = speakers with foreign accent syndrome, SENT = sentences, PASS = reading passage, PICT = picture description, MONO = monologue) in percent