Universal and Language-specific Aspects of Intonation in English and Polish

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ABSTRACT

We compared nuclear accent production in English and Polish read speech. We investigated declaratives and three types of questions. We expected to find (a) cross-linguistic differences and (b) a cross-language generalisation which may be evidence for an intonational universal. The generalisation under investigation was a trade-off between syntactic or lexical question markers in the text and the production of high pitch. The expected cross-linguistic difference involved the production and distribution of nuclear accent types in different kinds of utterances.

1 INTRODUCTION

Gussenhoven [1] suggests that the intonation of any language involves universal and language-specific components. Following earlier work by Ohala [2], Gussenhoven argues that the phonetic implementation of fundamental frequency is affected by three biological codes: The frequency code, the effort code and the production code. These codes are said to be universal. In the present paper, we investigated the frequency code. The frequency code involves the distribution of relatively higher pitch in utterances. Research has shown that in many languages, high pitch is used to mark salient information and to emphasise questions. Chafe [3] and Wennerstrom [4] offer an evolutionary view of the relationship between high pitch and salient information. They suggest that the link stems from prelinguistic responses to important observations in the environment. This link may account for high pitch in questions. Questions are usually produced as demands for interaction and they are intended to attract the listener's attention. Therefore, the speaker may want to make them especially prominent in the stream of speech. Ohala [2], on the other hand, proposes a biological basis for the correlation between high pitch and questions: smaller larynxes produce higher pitch and since smaller creatures are often less powerful than larger creatures, high pitch can be used to signal submissiveness or a willingness to cooperate. This, in turn, explains the use of high pitch in questions: questions require cooperation from other speakers.

The language-specific component of intonation involves intonational phonology and morphology. In phonology and morphology, intonational meaning can be arbitrary. Form-function relationships may mimic the paralinguistic form-function relations in the universal component, but linguistic change can also produce arbitrary form-meaning relations [1]. In Belfast English, for instance, declaratives are produced with final rising pitch just as frequently as questions [5].

In the present paper, we offer a cross-linguistic study of language-specific and potentially universal aspects of English and Polish intonation. The language-specific aspect involves the production of nuclear accent shapes in four types of utterances comparable across the two languages. The potentially universal aspect involves the relationship between high pitch and questions. Haan [6], Brinckmann and Benzmüller [7] and Grabe [5] showed that the intonation of Dutch, German and English is characterised by a trade-off between lexical and/or syntactic markers of interrogativity in the text and the presence of rising pitch in IP-final position. If the text contains fewer question markers, the production of final rising pitch is more likely. This trade-off may well be universal, but at present, we have evidence only from Germanic languages. More work is needed. In the present study, we took a first step. We asked whether in Polish, the production of high pitch would be more likely if utterances contained fewer lexical or syntactic markers of interrogativity.

2 EARLIER WORK

Following work by Haan [6], Brinckmann and Benzmüller [7] and Grabe [5] investigated the distribution of nuclear accent patterns in declaratives, wh-questions, yes/no questions and declarative questions (questions without morphosyntactic or lexical question markers). Haan worked on Dutch, Brinckmann and Benzmüller worked on German and Grabe worked on data from several dialects of English. Haan showed that the production of intonation-phrase-final high pitch was affected significantly by the number of syntactic and/or lexical markers of interrogativity an utterance contained. High pitch was produced more frequently when there were fewer markers of interrogativity. Brinckmann and Benzmüller found comparable results. German speakers were more likely to produce high or rising f_0 at intonation phrase boundaries delimiting yes/no questions and declarative questions than at IP boundaries delimiting statements and wh-questions. Grabe showed that the pattern first

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uncovered in Dutch could also be observed in English. Moreover, the observation held for speakers from several dialects of English although the intonational phonological structures of these dialects differed, in some cases drastically.

3 METHOD

3.1 STIMULI

We constructed a set of Polish stimuli, comparable to those used in Grabe's study of English. Grabe's stimuli were taken from the Intonational Variation in English Corpus (IViE) [8], a publicly available corpus of prosodically annotated data from seven urban dialects of English spoken in the British Isles. The corpus contains data in five speaking styles; the data used for the purposes of the present study were taken from the read sentences. These included four utterance types: declaratives (e.g. *You remembered the lilies*), yes/no questions (e.g. *May I lean on the railings?*), wh-questions (e.g. *Where's the manual?*) and declarative questions (e.g. *You remembered the lilies?*). Data from six speakers were prosodically annotated.

The set of Polish stimuli consisted of statements, general questions with 'czy' (comparable to yes/no questions in English), wh-questions and general questions without 'czy' (comparable to questions without morphosyntactic question markers in English). Each Polish sentence was built to follow, as closely as possible, the syllabic frame of the corresponding IViE sentence, and it belonged to the same sentence category as its IViE counterpart. The number of syllables in the corresponding English and Polish utterances was equal. Efforts were made to keep at least the final syllables phonetically similar to those in the English sentences, because these were likely to be the domain of the nuclear melody. Note, however, the following differences between the English and the Polish phonetic and phonological systems:

1. The IViE sentences were deliberately composed entirely of voiced segments to facilitate auditory and acoustic analyses. Fully voiced Polish stimuli could not be designed. Polish speakers devoice the final consonant of the utterance, especially when it is followed by a pause. Even if the last phoneme of an isolated sentence is vocalic, it is often produced with creaky voice, especially when the melody declines. For instance, some of the English sentences ended in <-ing> (e.g. the place name *Ealing*). In Polish, the sequence <-ing> is untypical. Therefore, we used words of foreign origin, e.g. *doping* or *trening*. These words are relatively well grounded in the Polish lexical system. Orthographically, <-ing> endings were identical to their English prototypes, but in the Polish stimuli, speakers devoiced the final segment.

3.2 PARTICIPANTS

The English stimuli were produced by six speakers from each of the seven dialects. The speakers were 15-16 years of age. Each speaker read eight different declaratives and three examples each of wh-, yes/no-, and declarative questions. The utterances were read in random order and presented without context. Individual stimuli, rather than one single list, were presented to the subjects.

Six Polish speakers were recorded. They were 25-30 years of age. The group consisted of three female and three male subjects. They were asked to read the sentences in the same, quasi-random order in which the IViE sentences had been read. The speech signal was recorded in an anechoic chamber, using a CD recorder. The recording procedure was comparable to the one used for English speakers. Then the recordings were digitised and labelled intonationally.

3.3 PROSODIC ANNOTATION

We combined two approaches to intonation transcription: the IViE system, developed for the transcription of the IViE corpus [9] and the approach to transcription taken in the *PoInt* Database project [10]. This project provided the first prosodically annotated corpus of Polish speech data. In essence, our transcription was phonetic-descriptive rather than phonological. In the English and in the Polish utterances, we annotated the pitch movement equivalent to the nuclear melody. In English, the nuclear syllable is the last accented syllable in the intonation phrase, regardless of the position of that syllable in the utterance. In Polish, the unmarked position of the nucleus is the penultimate syllable of the phrase, or the last syllable if the last word is monosyllabic. This prominence may move towards the beginning of the phrase in emotional speech or in 'marked' utterances, when the speaker intends to change the default focus of a sentence. While such situations did not occur in the analysed data from Polish, questions concerning the location of the nuclear melody emerged. In some of sentences, a very strong prominence occurred early in the phrase. This prominence was especially strong in wh-questions. Although this early prominence may point to an early nucleus placement followed by a further, postnuclear accent, or the presence of two focus accents in one utterance [11], in the present study, we restricted our analyses to the IP-final accent.

The shapes of the nuclear melodies observed were transcribed with the labels H, L and M. Labels were assigned from left to right. The pitch level preceding the nuclear syllable was taken into account when labels were assigned. A bitonal accent was transcribed as HL if the nuclear syllable was high and followed by a low, and if the low was equivalent to a low turning point immediately preceding the nuclear syllable. The transcription was LH if the nuclear syllable was low-high and if the high was equivalent to a high turning point immediately preceding the nuclear syllable. The transcription was HM if the low following the nuclear syllable was not as low as the low turning point preceding the nuclear syllable. The transcription was LM if the high following the low nuclear syllable was not as high as an earlier high. ML was used if the nuclear syllable was lower than the preceding high in the utterance and followed by a low, etc. If the accent was tritonal, one label was given to the nuclear syllable, one to the turning point and one to the IP-final pitch level. Again, the pitch level of prenuclear turning points in the utterance was taken into account.

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4 RESULTS

Our findings provided further evidence for the postulated combination of universal and language-specific components in intonation. We will begin with a summary of our language-specific findings.

4.1 NUCLEAR ACCENT TYPES IN ENGLISH AND POLISH

Our Polish speakers produced a smaller range of nuclear accent types than our English speakers (but note that we had data from seven English dialects). We found six nuclear accent types in Polish: HL, ML, LL, LH, LM, MH. In English, we found 13 types: HL, ML, LL, LH, LM, MH, HH, HM, LHL, LHM, HLH, MLH, MHL. We observed five types in Belfast, nine in Bradford, eight in Dublin and six in Leeds, Cambridge, London, and Newcastle. All nuclear accent types found in Polish were also observed in English. There was complete overlap between the 'standard' Polish data and the English data from Bradford, but the Bradford speakers produced three additional types. We found bitonal types HH and HM in English, but not in Polish. However, as we know from other studies, HH and HM accents *do* occur in Polish spontaneous speech [12]. Finally, we observed tritonal accents in English, but not in Polish. Again, tritonal accents in Polish occur, but rarely and mostly in emotional speech. As yet, it is not clear whether tritonal accents are part of the Polish intonation phonological system or whether they are stylistic variants of bitonal accents [10].

4.2. DISTRIBUTION OF NUCLEAR ACCENT YPES

Table 1 shows the distribution of the nuclear accent types in Polish. Table 2 illustrates, in percent, the distribution of nuclear accent types in the Cambridge English data in the IViE corpus. This is the dialect of English in the corpus which is closest to an English 'standard' and similar to the one described in textbooks on English intonation. In Tables 1 and 2, we have highlighted the patterns that we observed most frequently for a particular sentence type. The distribution of nuclear accent shapes in the other dialects of English is given in [5].

Tables 1 and 2 illustrate a number of differences in the distribution of nuclear accent shapes in standard varieties of English and Polish. The clearest difference involves the absence of tritonal accents in Polish. We also found differences in the distribution of bitonal accents, but these were not particularly striking. Polish declaratives predominantly ended in ML, the nuclear accent that seems to dominate in Polish declaratives more generally [10, 12]. Cambridge English declaratives predominantly ended in HL, but ML was also observed. Rising declaratives were observed in both languages. In English, these involved a fall-rise; in Polish, they involved a rise. In southern standard varieties of English, falling-rising declaratives are common [13]. Preliminary analyses based on a larger corpus of Polish data show that declaratives with rising nuclear accent are not unusual in Polish either [10].

In wh-questions questions, speakers from both languages used falling or rising contours. In Polish, two female and two male speakers were consistent in their choices: two of them always produced LH; the other two produced ML. This finding may reflect individual differences in speaking style or individual differences in the interpretation of the utterances. Steffen-Batogowa [14] suggests that the variations of the melody in Polish statements may be related to the emotional load of the message. For instance, the high final tone is said to be perceived by listeners as a signal of irritation, disbelief, etc. Our speakers may have attached certain emotional values to the sentences and these may be responsible for their choices. In recent studies of Karpinski et al. [10], two factors were found to coincide with the occurrence of rises in Polish statements: (a) a speaker's uncertainty about what s/he is saying or is about to say; (b) a speaker‘s intention or wish to continue speaking.

Polish yes/no questions ended predominantly in LH. In a recent study, Durand et al. [15] state that the main characteristics of Polish 'czy' questions is a double climbing binary foot at the beginning and at the end of the sentence. He coded the intonation of the final binary foot in the analysed utterances as BT (Bottom-Top) or BH (Bottom-High), which is consistent with our results. English speakers used falling or rising contours in wh-questions.

Polish declarative questions ended in LH or MH. Cambridge English declarative questions predominantly ended in LH but in about 10% of utterances, HL was produced.

Table 1. Distribution of nuclear accent types in standard Polish, in percent. The nuclear melody is shown in the first column. DEC = declarative, WH = wh-question, Y/N = yes/no question, DECQ = declarative question).

	DEC	**WH**	**Y/N**	**DECQ**
ML	**79.2**	**50.0**	5.6	
HL	10.4			0.0
LL	4.2	5.6		0.0
LH	2.1	38.9	**66.7**	**94.4**
MH	2.1	5.6	27.8	5.6
LM	2.1			

Table 2. The distribution of the nuclear accent types in the data from Cambridge English.

	DEC	**WH**	**Y/N**	**DECQ**
ML	16.7	22.2		
HL	**75.0**	**44.4**	**64.7**	11.8
LH		11.1	23.5	**58.8**
MH				23.5
HLH	6.3	11.1	11.8	5.9
MLH	2.1	11.1		

More generally, we found that our English speakers produced the widest range of contour types in declarative questions. In five of the seven dialects, we observed five or more nuclear accent types. In Polish, we found the opposite.

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In declarative questions, only two contour types were observed (LH and MH). Polish speakers produced the widest range of contour types in declaratives. This finding may reflect cross-linguistic differences in grammatical structure. English word order is somewhat stricter than Polish word order [16]. Therefore, Polish speakers and listeners may rely more heavily on the use of high pitch in questions.

4.3 CROSS-LANGUAGE GENERALISATIONS

The data also provided evidence of a cross-language generalisation. Just as Dutch, German and English speakers, Polish speakers produced high pitch at the end of utterances more frequently when the utterances contained fewer markers of interrogativity. This finding is illustrated in Figure 1.

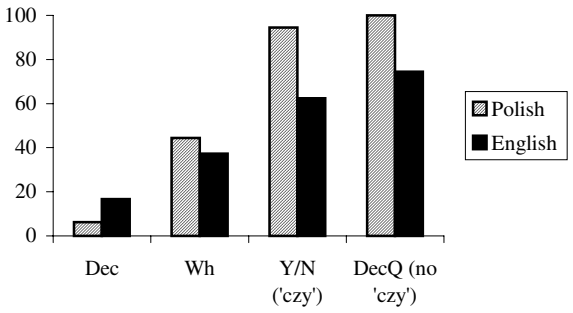

Figure 1. Incidence of rising nuclear accent types in English and Polish.

Figure 1 shows the incidence of a final rise in f_0 (LH or MH), plotted against the four utterance types. The figure illustrates a trade-off between the presence of lexical and/or syntactic markers of interrogativity in the text and the production of high pitch. English and Polish speakers were more likely to produce rising nuclear accents when the text contained fewer lexical or morphosyntactic question-markers.

5 CONCLUSION

We compared nuclear accent production in four types of utterances in English and Polish. Our findings support descriptions of intonation that combine universal with language-specific properties. We found evidence of cross-linguistic differences. In the four utterances types investigated, English and Polish speakers produced (a) different nuclear accent types and (b) different distributions of these types. We also found evidence of a cross-language generalisation. English, a Germanic language and Polish, a Slavic language, share a prosodic property. In both languages, the distribution of intonation patterns is affected by lexical and syntactic structure of the text.

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