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# Phonetic and phonological influences in non-native intonation: an overview for language teachers

Ineke Mennen

## 1. Introduction

Just as poor pronunciation can make a foreign language learner very difficult to understand, poor prosodic and intonational skills can have an equally devastating effect on communication and can make conversation frustrating and unpleasant for both learners and their listeners. Language teachers have lately become more aware of this and have shifted the focus of their pronunciation teaching more towards the inclusion of suprasegmentals alongside segmentals with a view of improving general comprehensibility (Celce-Murcia, Brinton and Goodwin 1996). It is therefore crucial for language teachers to be aware of current research findings in the area of foreign (second) language learning of prosody and intonation, the type of prosodic and intonational ‘errors’ second language (L2) learners are likely to make, and in particular where these ‘errors’ stem from. The focus of this paper will be on intonation in L2 learning, but some related prosodic phenomena such as stress and rhythm will be touched upon.

There is no doubt as to the importance of intonation in communication. Intonation not only conveys linguistic information, but also plays a key role in regulating discourse and is an important indicator of speaker identity, reflecting factors such as physical state, age, gender, psychological state and sociolinguistic membership. Intonation is also important for intelligibility (e.g. Laures and Weismer 1999; Maassen and Povel 1984). The use of an inappropriate intonation pattern may give rise to misunderstandings. Such misunderstanding can be major or minor depending on the context in which the intonation pattern is used. As there is no one to one correspondence between intonation and meaning, an appropriate meaning can often be found that fits with the ‘wrong’ intonation pattern. Furthermore, native listeners are used to a great deal of variation in the choice of intonation patterns, both within their regional variety as across varieties (e.g. Grabe, Kochanski, and Coleman, to appear).

Nevertheless, some patterns will clearly not be acceptable in some varieties, and the cumulative effect of continuously using slightly inappropriate intonation should not be underestimated. Given that we derive much of our impression about a speaker’s attitude and disposition towards us from the way that speaker uses intonation in speech, listeners may form a negative impression of a speaker based on the constantly occurring inappropriate use of intonation. For example, the relatively flat and low intonation of German learners of English may make them sound “bleak, dogmatic or pedantic, and as a result, English listeners may consider them uncompromising and self-opinionated” (Trim 1988, as quoted in Grabe 1998), an example which illustrates that impressions based on intonation may lead to ill-founded stereotypes about

national or linguistic groups. Finally, intonational errors may contribute to the perception of foreign-accent (Jilka 2000).

The aim of this paper is to present a summary of commonly occurring problems in non-native intonation, as well as provide a reanalysis of some past and current research findings in terms of a framework of intonational analysis that separates phonological representation from phonetic implementation. Section 2 describes possible influences in non-native intonation, it explains the importance of making a distinction between intonational influence at a phonological and at a phonetic level, and it briefly summarises the model of intonation used in this paper. In section 3, some intonational properties will be described which are likely to be affected in L2 speech production. Examples will be given of previous and current research with particular attention to phonological and phonetic influences in L2 intonation. Section 4 will discuss the implications of the reanalyses and new results for teaching and research.

## 2. Influences in non-native intonation

In a survey of major international journals in second language acquisition of the past 25 years carried out by Gut (personal communication), it was found that as few as 9 studies investigated intonation and tone. Only four of these studies were concerned with perception of intonation, the other five were production studies. A further search of conference proceedings and recent PhD theses revealed an additional tenfold of studies on L2 production of intonation. Most of the limited (and not very recent) studies of L2 production of intonation involve investigations of the errors made by learners from various language backgrounds when they acquire English as a L2 (Backman 1979; Buyschaert 1990; De Bot 1986; Grover, Jamieson, and Dobrovolsky 1987; Jenner 1976; McGory 1997; Ueyama 1997; Willems 1982). These studies provide evidence that transfer or interference from the L1 is an important factor in the production of L2 intonation.

Many similarities of errors were found in these studies, leading to assumptions about whether there are universal patterns in acquiring the intonational system of a second language. For example, Backman (1979) observed that the errors she found in her study of the English of Spanish learners showed remarkable similarities with errors Jenner (1976) found in his study on the English of Dutch learners. Errors in the production of L2 English intonation by speakers with different language backgrounds which appear similar across studies are:

- a narrower pitch range (Backman 1979; Jenner 1976; Willems 1982)
- problems with the correct placement of prominence (Backman 1979; Jenner 1976)
- replacement of rises with falls and vice versa (Adams and Munro 1978; Backman 1979; Jenner 1976; Lepetit 1989; Willems 1982)
- incorrect pitch on unstressed syllables (Backman 1979: too high; McGory 1997: too high; Willems 1982: no gradual rise on unaccented words preceding a fall)
- difference in final pitch rise (Backman 1979: too low; Willems 1982: too high [overshoot])
- starting pitch too low (Backman 1979; Willems 1982)

- problems with reset from low level to mid level after a boundary (Willems 1982)
- a smaller declination rate (Willems 1982)

Although it is true that some of the observed errors are similar, it should be emphasised that they all appeared in studies of English as a second language. So the similarities might be due to idiosyncrasies of the English intonational system. Furthermore, the similarities cannot be explained by developmental factors (due to the learning process) alone. For example, the fact that both Dutch and Spanish acquiring English intonation produce a smaller pitch range compared to native English speakers does not necessarily indicate that a reduction of pitch range is a universal tendency in L2 acquisition. The smaller pitch range in the data of the learners could simply be a case of transfer, since both Dutch (Jenner 1976) and Spanish (Stockwell and Bowen 1965) are reported to have a smaller pitch range than English. It is therefore more likely that there is more than one process involved in the acquisition of L2 intonation, a conclusion which has also been reached in other fields of L2 acquisition.

## 2.1 Cross-linguistic analysis of intonation

It should be noted that comparison of the findings described in the previous section is not an easy task. The studies differ considerably with respect to the proficiency level of the learners, the languages under investigation, the number of subjects, and the framework or methodology used in the study. These differences in methodology prevent us from coming to any reliable conclusions about the similarities and differences between the languages investigated in these studies and the process of L2 acquisition of intonation.

In order to establish intonational differences and similarities across languages which could cause the L1 and L2 intonation systems to influence one another, a generally agreed framework for analysing intonation needs to be used. Without such a model it is difficult to compare and interpret the importance of similarities and differences across languages in a reliable and uniform way. A model which has been used successfully to describe a wide range of languages (e.g. Jun 2004) and regional varieties (e.g. Grabe, Post, Nolan, and Farrar 2000; Fletcher, Grabe, and Warren forthcoming; Gilles and Peters 2004) is the model of intonational analysis developed by Pierrehumbert (1980) and Pierrehumbert and Beckman (1988). Mennen (2004) showed that this model can generate predictions about the degree of difficulty certain aspects of L2 intonation will present to L2 learners. Together with other studies that have begun to emerge using this model in studies of L2 intonation (Jilka 2000; Mennen 1998, 1999a, 1999b, 2004; Ueyama 1997; Jun and Oh 2000), it shows the enormous potential of this model for cross-linguistic studies.

The most important principle of Pierrehumbert's model is that it separates the phonological representation from its phonetic implementation, and intonation is viewed as consisting of a phonological and phonetic component. The phonological component consists of a set of high (H) and low (L) tones, which are further organised into pitch accents, boundary tones, and phrasal tones. The pitch accents have a starred tone to indicate their association with the stressed syllable, and can consist of a single tone (H\* or L\*) or a combination of two tones (e.g. HL\*, H\*L). Boundary tones are indicated as H% or L% and associate with phrase margins. Phrasal tones are indicated

as H- or L- (with a hyphen) and associate with the space between the last pitch accent and the boundary tone. The phonetic realisation of underlying tone sequences is usually defined along two parameters, the scaling (i.e. the f0 value) and the alignment (i.e. the temporal relation with the segmental string) of the tones (see further section 3.1).

The distinction between a phonetic and phonological component in intonation is important as it suggests that languages can differ at both these levels. As a result, the L1 and L2 intonation systems may influence one another both at the level of phonological representation as well as at the level of their phonetic implementation. A *phonological* influence would result from intonational differences in the inventory of phonological tunes, their form, and in the meanings assigned to the tunes. A *phonetic* influence would result from a difference in the phonetic realisation of an identical phonological tune (Ladd 1997). An example of *phonological* influence is the use of rises where native speakers would use falls and vice versa, found in many studies of L2 intonation (e.g. Adams and Munro 1978; Backman 1979; Jenner 1976; Lepetit 1989; Willems 1982). An example of *phonetic* influence is the finding of a different pitch range (e.g. Mennen, this paper) or a different slope of a rise (e.g. Ueyama 1997) compared to the monolingual norm.

These types of influence roughly correspond to the types of influence evidenced at the segmental level, where phonological influence would result from cross-linguistic differences at the phonemic level (such as the use of the vowel /u/ instead of the target L2 vowel /y/ when that vowel is not in the L1 vowel inventory), and phonetic influence resulting from differences in phonetic detail (such as differences in the implementation of the phonological voicing contrast: long-lag instead of short-lag voice onset times in the French productions of native speakers of English, such as those observed in Flege and Hillenbrand 1984).

Separating phonological representation from its phonetic implementation in non-native production of intonation makes it possible to determine the actual source of the L2 intonational error, beyond just establishing that it is due to interference from the L1. Once the source of the problem has been established it can be appropriately addressed by the language teacher and learner.

### 3. Possible difficulties in L2 intonation

In this section a description will be given of some intonational properties which are likely to be affected in L2 speech production. Particular attention will be given to distinguishing phonetic from phonological influences in L2 intonation, where this distinction may not have been made in previous studies, and where results may have been interpreted incorrectly because no distinction has been made between phonological and phonetic influences. This section is by no means an exhaustive description of all intonational properties which can be influenced by differences between the L1 and L2 intonation systems. It is intended purely as an illustration of why it is important to distinguish between phonological and phonetic influences, and where this becomes relevant for language teachers.

### 3.1. Alignment

Alignment refers to the temporal relation of H and L tones with the segmental string (i.e. the timing of a peak or valley with the vowels and consonants in speech). Recent research has suggested that alignment exhibits certain language and dialect-specific characteristics, more or less like those found for voice onset time (Caramazza, Yeni-Komshian, Zurif, and Carbone 1973; Flege and Hillenbrand 1984). That is, the same phonological category may be realised (aligned) differently in different languages or dialects. Differences in alignment have amongst others been found in cross-dialectal studies on Swedish (Bruce and Gårding 1978) and Danish dialects (Grønnum 1991), ethnic subvarieties of Singapore English (Lim 1995), and varieties of British English (Grabe, Post, Nolan, and Farrar 2000), and German (Atterer and Ladd 2004).

Cross-linguistic differences in alignment have not been investigated extensively. However, Ladd (1996) suggests that such differences can be found when comparing the intonation of languages. He illustrates this with an example of a certain type of fall, which he describes as "a local peak associated with the accented syllable, followed by a rapid fall to low in the speaking range, followed by a more gradual fall to the end of the phrase or utterance" (Ladd 1996: 128). This fall can occur in Italian as well as in English (or German). However, its realisation is different in these two languages. Where the peak in English (or German) is rather late (at or near the end of the stressed syllable), it is early in Italian. The following rapid fall in English (or German) takes place between the stressed and following unstressed syllable, whereas in Italian the fall starts well before the following syllable.

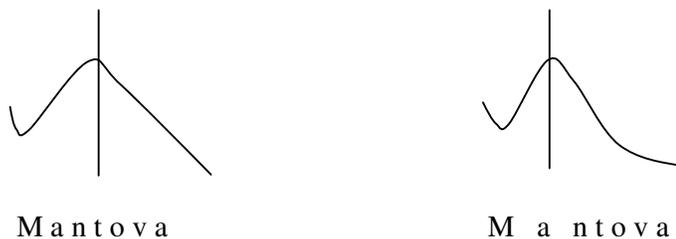


Figure 1. A schematic representation of alignment differences between non-native (left) and native (right) production of the Italian word 'Mantova', with a late peak in the non-native as compared to the native production.

As a consequence, English or German learners of Italian, may use their native alignment pattern when producing an Italian falling tune. In other words, the learner gets the phonological association right (i.e. the H\* peak associates with the stressed syllable), but fails to produce the correct phonetic detail (i.e. the correct alignment). Figure 1 gives an example of such a mistake. As Italians would place the fall somewhere in the antepenultimate syllable, a delay of this fall may be interpreted by native Italians as a mistake in the placement of word stress, i.e. they may perceive this as stressed on the penultimate, rather than on the antepenultimate syllable. So what in fact is a phonetic error is interpreted by native listeners as a phonological error. It is therefore important for language teachers to establish what the source of the error is, as well-meant exercises to teach non-native speakers the correct stress placement may in

this particular example not be effective, as the error is not misplaced word stress but rather a misalignment of the falling contour with the stressed syllable.

It is for this reason that care needs to be taken when interpreting results on L2 intonation (especially when they are based on auditory observations only), which report errors in stress placement or replacement of rises with falls (e.g. Lepetit 1989; Backman 1979; Jenner 1976). Some of these errors, may actually be phonetic errors (alignment errors), rather than phonological errors (misplaced stress). For example, Backman (1979), in her study on intonation errors of Venezuelan Spanish adult learners of American English, reports that the L2 learners often had problems with stress placement. However, visual inspection of some of the sample contours presented in her paper, suggests that the Spanish learners tend to have an earlier alignment of rise-falls in their L2 American English. In their utterances the F0 reaches its peak very early (*before* the accented syllable), and falls just before and during the beginning of the accented syllable. This may have caused the American judges to conclude that the stress was placed incorrectly (too early), since Americans would expect the falling pitch to occur much later.

There are very few studies which attempt to determine the extent to which the native alignment pattern carries over into the pronunciation of a second language. Mennen (2004) investigated how Dutch non-native speakers of Greek realised cross-linguistic differences in the alignment of a phonologically identical rise. Dutch and Greek share the same phonological structure in prenuclear rises (L+H), but the phonetic properties of the rise differ. Although in both languages the rise starts just before the accented syllable, in Dutch the peak is reached within the accented syllable whereas in Greek the peak is consistently aligned after the onset of the first postaccentual vowel. It was found that even after many years of experience with the L2 and despite their excellent command of the L2, the majority of the Dutch speakers carried over the phonetic details of their L1 rise into their pronunciation of L2. Four out of five speakers aligned the rise considerably earlier than the native Greek speakers, as shown in Figure 2 and 3. Nevertheless, one speaker managed to align the rise as late as the native Greek speakers.

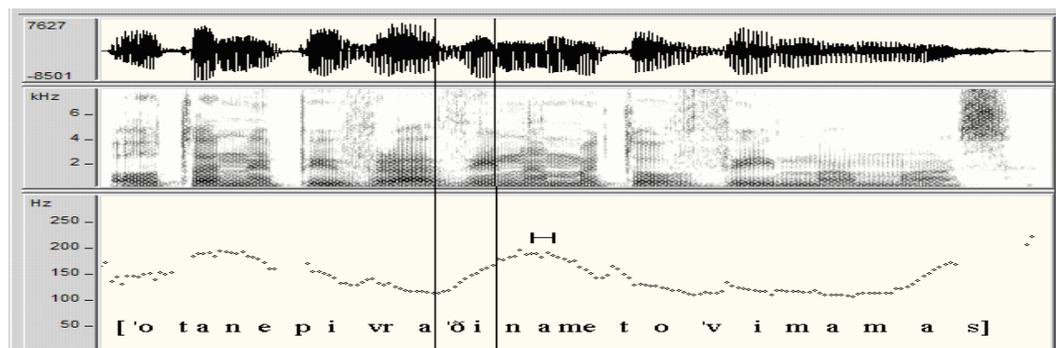


Figure 2. Waveform, spectrogram and F0 contour of [ˈo tan e pi vr a ˈði na me to ˈvi ma ma s] “When we slowed down our step” read as part of a statement by a native Greek speaker. The vertical lines delimit the beginning and end of the accented syllable of the prenuclear test word. The position of the peak is indicated by H and is aligned after the onset of the first postaccentual vowel.

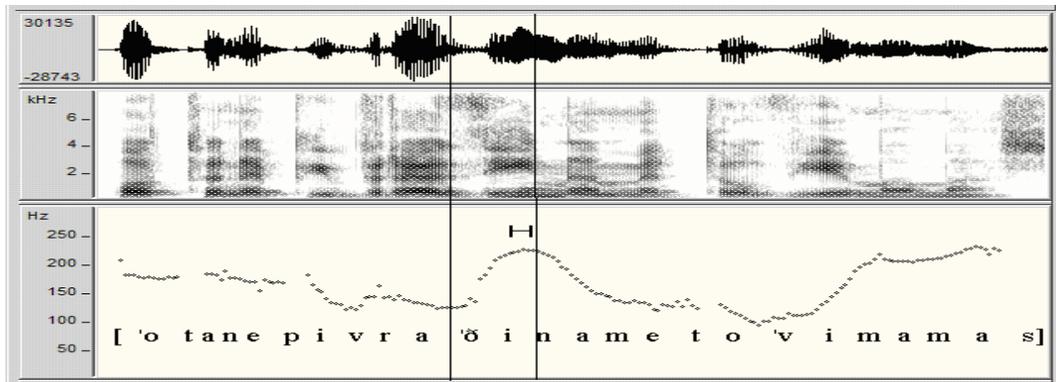


Figure 3. Waveform, spectrogram and F0 contour of [ˈotan epivraðiname toˈvima mas] “When we slowed down our step” read as part of a statement by a non-native speaker of Greek. The vertical lines delimit the beginning and end of the accented syllable of the prenuclear test word. The position of the peak is indicated by H and occurs within the accented syllable, unlike in native Greek.

Given that the subjects in this study were all very experienced with the L2 and were considered to be near-native, the findings suggest that it may be difficult – although not impossible – to learn the phonetic implementation of underlying tone sequences and that this may be acquired rather late in the acquisition process. It is conceivable that L2 learners may acquire phonological properties of intonation earlier than their phonetic implementation (as suggested by Mennen 1999, 2004; Ueyama 1997). Such implementation difficulties were also found in a study of German speakers of English who carried over native German patterns of alignment into their L2 English (Atterer and Ladd 2004), suggesting that this may be a more common phonetic error than previously thought.

As it is suggested in the literature that temporal properties of speech may influence the intelligibility of utterances produced by non-native speakers (Tajima, Port, and Dalby 1997), it is well possible that an adjustment of peak alignment will lead to improved intelligibility and less foreign-accented speech. However, perception studies would need to be carried out to establish the relative contribution of alignment patterning on intelligibility and the perception of foreign-accent.

### 3.2. Word stress and nuclear placement

It is generally accepted that L2 learners often have difficulty with the correct placement of word stress, especially in the initial stages of the learning process (e.g. Adams and Munro 1978; Archibald 1992; Fokes and Bond 1989; Wenk 1985). Also, studies on the teaching of L2 prosody suggest (although based to a large extent on impressionistic observations) that word stress needs to be given special attention in the classroom (e.g. Anderson-Hsieh, Johnson, and Koehler 1992; Buyschaert 1990).

Alongside difficulties with prominence within a word, L2 learners also seem to experience difficulty with the correct placement of prominence at the sentence level (e.g. Backman 1979; Jenner 1976). Just as a language can have phonemic contrasts, like a contrast between a voiced and a voiceless stop (/d/-/t/), the prominence system within a language is also a system of contrasts. A word is produced with more acoustic salience, or prominence, in order to contrast that word with other less prominent words.

Just as phonemes serve to distinguish one word from another word, a system of prominence allows a speaker to contrast the relative importance of words.

Both Jenner (1976) and Backman (1979) report that language learners often move the most prominent word of the sentence (the main or nuclear accent) too far to the left in their L2 utterances. Again, it is not clear whether this is caused by a phonetic or a phonological error (as explained in the previous section). Most of the test sentences Backman (1979) presents in her study consist of monosyllabic words only. If the Spanish learners of English have aligned the rise-fall in a sentence like "I'm late" too early, with the peak occurring just before the onset of the word "late", native Americans may have perceived this as a prominence on "I'm". This may have led to the perception of a shift of the nuclear accent to the left.<sup>1</sup> For this reason, these results have to be interpreted with caution.

Another reason for questioning the results obtained in the above mentioned studies, is the fact that the use of acoustic cues to signal stress may be different across languages. Beckman (1986), for example, suggested that even though languages use the same parameters to signal stress, their relative importance is language specific. For example, Americans use all four perceptual cues to stress (F0, duration, amplitude, and spectral coefficient) to the same extent, whereas Japanese use F0 cues to a much greater extent than other cues to stress (Beckman 1986). As a consequence, when listening to American English, Japanese will rely mainly on F0 cues, and may disregard other cues to stress which should influence their perception of stress.

In production there also seem to be cross-linguistic differences in the cues used to signal stress. For example, Adams and Munro (1978) found a difference in the production of sentence stress between native and non-native speakers of English. Adams and Munro found that the "real difference between the stress production of the two groups lay not in the mechanisms they used to signal the feature [stress], but rather in their distribution of it.." (p. 153). In a similar study Fokes and Bond (1989) found that much the same is true for word stress.

If it is true that the acoustic correlates of stress differ across languages, results of studies relying on native speakers' judgements of stress placement by non-native speakers have to be interpreted with caution. Native judges may presuppose certain acoustic cues to stress other than the ones produced by non-native speakers. It is therefore possible that the non-native speakers described in these studies do not actually produce errors in stress *placement*, but merely differ in the relative importance of the cues used to produce stress. A study by Low and Grabe (1999) seems to support this explanation. Their results indicate that the widely reported claim (based on native British English listener judgements) that British English and Singapore English differ in stress placement is not true. Their experimental data suggest that the apparent word-final stress in Singapore English (as opposed to the word-initial stress in British English) in words like *flawlessly*, is not the result of a difference of lexical stress placement. Instead, it seems that Singapore English and British English differ in the phonetic realisation of stress, with more phrase-final

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<sup>1</sup> Unfortunately, it is not possible to inspect Jenner's (1976) data, as in his study no acoustic data are presented to support his conclusion.

lengthening, and a lack of "deprominencing" in F0 in Singapore English than in British English. As a result, Low and Grabe argue that "the location of stress (or even its presence) cannot be judged impressionistically in any cross-linguistically valid way." It may therefore not always be helpful to give L2 learners exercises to practice L2 stress placement as in some cases learners may already be producing stress in the appropriate position in the word or sentence. However, they may not be producing stress using the same cues as native speakers do. It is therefore important to establish whether the difficulty the learner experiences is caused by a phonological influence from the L1 (i.e. misplaced word or sentence stress) or by a phonetic error (i.e. use of different cues to signal stress).

### 3.3. Pitch range

There is growing evidence that pitch range – besides other common influences such as anatomy/physiology, regional background, emotional state, and many others – is influenced by a speaker's language background (e.g. Van Bezooijen 1995; Scherer 2000). It is thought that cultures or languages have their particular 'vocal image', which reflects socio-culturally desired personal attributes and social roles, and that speakers choose a pitch (within their anatomical/physiological range) that approximates the vocal image they want to project (Ohara 1992). Listeners are very sensitive to these features, as evidenced by a wealth of research that relates the independent contribution of pitch to a class of character types (e.g. Ladd, Silverman, Tokmitt, Bergmann, and Sherer 1985, Patterson 2000), showing amongst others that the wider their pitch range the more positively speakers are characterised.

There is no doubt that people hear differences in pitch range between a variety of languages. There is strong anecdotal evidence that people perceive differences between for example English and German – with English sounding higher and having more pitch variation than German (which is believed to be spoken with a relatively low and flat pitch). English speech (especially female) is often perceived as 'überspannt and zu stark 'aufgedreht'' (over the top) by German listeners (Eckert and Laver 1994: 145). This belief has even found its way into the German film industry, which uses German dubbing actors with a lower pitch and narrower pitch range than those of original English actors (Eckert and Laver 1994). Such beliefs are also expressed in language descriptions and manuals. For example, Gibbon (1998) refers to a smaller pitch range in German compared to English. Conversely, Germans feel that the pitch of an English speaker's voice wanders meaninglessly if agreeably up and down (Trim 1988).

Languages are believed to differ both in the average pitch height at which they are spoken and in the range of frequencies that are usually used. Ladd (1996) refers to these dimensions of variation in terms of *level* (i.e. the overall pitch height) and *span* (i.e. the range of frequencies). Cross-linguistic comparisons of level - and to a lesser extent span - have been carried out for a wide range of languages (e.g. Braun 1994). These studies provide some evidence for the existence of language-specific differences in pitch range, and the reported differences are usually explained by assuming an influence of socio-cultural factors on pitch.

Intriguingly, while there are very few studies on bilingual production of pitch range, there is a suggestion that bilingual speakers vary their pitch range according to the language they are speaking. For example, Braun (1994) and Gfroerer and Wagner

(1995) report a different level in the languages of German/Turkish bilinguals (with a higher pitch in their Turkish than in their German), and Jilka (2000) reports a difference in span but not in level for German/American bilinguals (i.e. with a wider span in their American English).

Cross-linguistic comparisons of pitch range in L1 and L2 intonation have all been based on long term distributional measures (statistical moments), and there appears to be no agreement in these studies as to what constitutes pitch range. For level, measures of mean  $f_0$  and median  $f_0$  have been used. For span, measures used include maximum minus minimum  $f_0$ , four standard deviations around the mean, the difference between the 95th and 5th percentile (90% range), and the difference between the 90th and 10th percentile (80% range). More recent work by Patterson (2000) suggests that there are some problems using long term distributional properties of  $f_0$ , since they assume an even distribution of  $f_0$  around the mean and their results may be affected by spurious measures (e.g. octave errors). These measures also showed a lack of correlation with listener judgments of speaker characteristics and therefore lacked perceptually validity (Patterson 2000). Furthermore, the majority of cross-linguistic studies of pitch fail to control for factors influencing  $f_0$  (including regional accent, physiology/anatomy, type of speech materials), making it impossible to tease out the influence of the language itself.

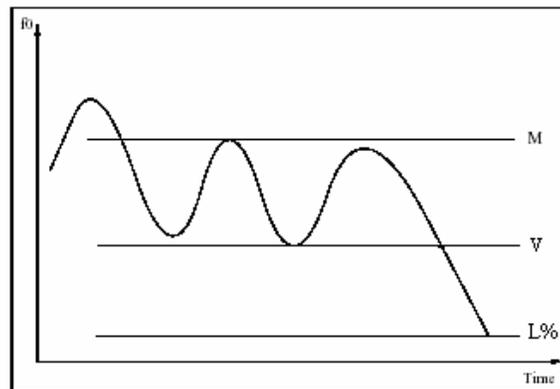


Figure 4. The three selected target points in each sentence of the passage. From these points span and level were calculated. Span is defined as the average of a speaker's M minus the average of a speaker's V (in semitones). Level is calculated as the average of a speaker's L% (in Hertz).

An alternative way to measuring span and level is to link measures of span and level to specific turning points (i.e. local minima and maxima) in the  $f_0$  contour (Patterson 2000). Patterson (2000) showed that such measures better characterise pitch range than the more commonly used long term distributional measures. Specifically, the linguistic measures were shown to be more perceptually valid in that they correlated better with listener judgments of speaker characteristics. Scharff (2000) recorded a small set of materials, which was subsequently analysed by Mennen (this paper) and presented here for the first time. Span and level were investigated – using Patterson's (2000) method – in three groups of speakers: a group of twelve monolingual native speakers of German (from the area of Stuttgart), a group of ten monolingual native speakers of English (from the area of Newcastle upon Tyne), and a group of twelve German non-native speakers of English (who all lived in or around Newcastle upon

Tyne). All speakers were female between the ages of twenty and forty and they were all non-smokers. The non-native speakers were advanced speakers of English and had a length of residence in Britain of over 5 years. They were all asked to read a phonetically balanced passage (“The North Wind and The Sun”/ “Der Nordwind und die Sonne”) in their respective language(s).

Following Patterson (2000) measurements were taken at 3 selected target points in each sentence of the passage. These target points were: all non-initial accent peaks (M); all post-accentual valleys, i.e. the low pitch of unaccented words (V); and all sentence-final lows (L%). The target points are exemplified in Figure 4. From these measures the span and level were calculated for each speaker. Span was defined as the difference between the average of a speaker’s non-sentence initial peaks and their average of postaccentual valleys (i.e. M minus V). The span measures were expressed in semitones (ST) since it is suggested that this best captures pitch range variation (Nolan, Asu, Aufterbeck, Knight, and Post 2002). Level was defined as the average of a speaker’s sentence final lows (L%), and was expressed in Hertz (Hz) rather than ST (since ST are not a suitable scale for measuring level due to its logarithmic nature).

Table 1. The means of span (in ST and Hz) and level (in Hz) measurements for each of the native speakers.

SPEAKERS	LANGUAGE	SPAN		
		SPAN ST	Hz	LEVEL Hz
1	German	6.26	98.8	170.2
2	German	5.71	74.1	182.6
3	German	4.23	52.7	159.3
4	German	4.82	61.0	166.7
5	German	5.44	72.0	182.3
6	German	5.98	79.0	182.6
7	German	6.20	75.7	149.2
8	German	5.96	75.4	184.0
9	German	5.57	69.5	149.9
10	German	4.59	54.3	141.6
11	German	5.71	58.4	134.1
12	German	4.53	51.9	161.9
13	English	4.73	69.5	215.5
14	English	7.48	98.0	157
15	English	4.70	65.7	188.0
16	English	8.43	101.5	147.0
17	English	9.43	137.4	175.3
18	English	7.66	94.13	160.0
19	English	7.95	87.6	145.0
20	English	6.57	81.6	162.7
21	English	7.92	108.9	172.0
22	English	6.74	79.5	146.0
Overall	German	5.42	68.6	163.7
Overall	English	7.16	92.39	166.9

Figure 5 gives the information from table 1 as a visual representation of the span and level measurements for all the twenty two speakers in a scattergraph. From this figure it can be seen that level and span measures seem to be independent with there clearly being speakers that have a narrow span yet with a spread of differing levels (e.g. speakers 10 and 13). Likewise there are speakers that have very similar levels with a wide range of spans (e.g. speakers 3 and 18). Nevertheless, there is a clustering of the native German speakers at the lower end of the x-axis (representing span) in the figure, with the native English speakers clustering mostly at the higher end of the x-axis. There are some exceptions to this pattern. Two native English speakers (13 and 15) cluster at the lower end of the x-axis (similar to the majority of the native German speakers) but they also cluster at the higher end of the y-axis with a very high level. This suggests that native English speakers either have a wider pitch span, and/or a higher level than the native German speakers.

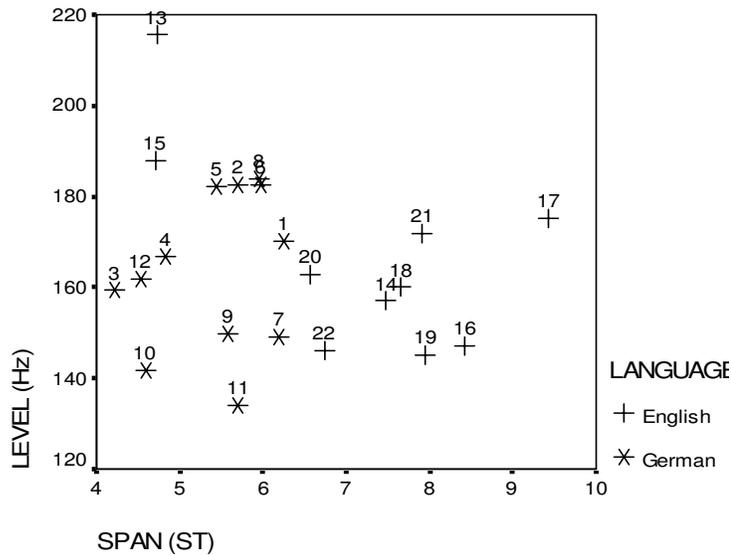


Figure 5. Level (Hz) and span measures (ST) for twelve monolingual German females and twelve monolingual English females. Stars represent the measures for the native German females, plus signs represent the native English females. The numbers represent the different speakers.

Table 2 shows the averaged pitch range results for each of the non-native speakers in each of their two languages. Results for the non-native speakers showed that neither span nor level differed across the two languages of the non-native speakers (for span ST  $F < 1$ , n.s.; for span Hz  $F < 1$ , n.s.; for level Hz  $F < 4$ , n.s.), although there was a tendency for a higher level in their English which failed to reach significance due to a lack of statistical power ( $p=0.059$ ).

Table 2. The means of span and level measurements for each of the non-native speakers. On the left are the means for their German, on the right are means for their English.

SPEAKERS	GERMAN			ENGLISH		
	SPAN (ST)	SPAN (Hz)	LEVEL (Hz)	SPAN (ST)	SPAN (Hz)	LEVEL (Hz)
1	4.36	53.2	157.8	5.93	69.6	168.0
2	5.52	70.6	148.0	8.82	110.3	148.0
3	9.12	103.3	131.2	9.02	108.6	154.0
5	7.03	74.8	128.7	6.02	67.0	146.3
6	4.19	53.7	184.0	4.09	51.0	187.0
7	6.41	67.0	133.5	5.33	58.1	141.7
8	5.84	68.3	150.7	5.74	69.8	155.0
9	5.01	56.6	148.0	5.08	57.8	149.6
10	8.20	97.4	137.0	6.39	75.7	148.3
11	8.82	113.1	135.0	4.88	59.6	163.6
Total	6.45	75.8	145.4	6.13	77.4	158.3

Figure 6 illustrates span and level measurements in the English and German spoken by eleven non-native speakers (due to some problems with transfer of the data, data for one of the speakers had to be excluded). When inspecting this scattergraph, it becomes clear that although more than half of the speakers have a higher level in their English than in their German, only two speakers have a wider span in their English. It thus appears that the majority of the non-native speakers are adjusting only one of the dimensions of pitch range, the one which is possibly the less common dimension of pitch range in native English – something that has never to our knowledge been suggested before.

Figure 6 also illustrates that speakers do not all follow the same strategy in their different languages. For example, speaker 1 has a wider span and a higher level in her English, whereas speaker 3 has a higher level in her English, but her span is similar across the two languages. Speaker 11, has a higher level but a considerably narrower span in her English, just as speaker 10 and 7. Speaker 2 on the other hand has a wider span in her English than German, but has a similar level in both languages. Audio examples are provided for the bilingual speaker 1 in English (EB1) and German (GB1), and speaker 8 in English (EB8) and German (GB8).

It is important to pay attention to such socio-phonetic differences in the use of pitch range between languages, particularly since it influences the way we perceive one another. Given that wider pitch ranges are generally perceived more positively, speakers of languages with a habitually narrower pitch range may be perceived as more negative by speakers of languages with a wider pitch range, and vice versa. It is likely that the negative perceptions towards German speakers described in section 1 could be partly due to such differences in pitch range. In order to avoid such misperceptions and misplaced stereotypes, it is important to address these differences in language pedagogy.

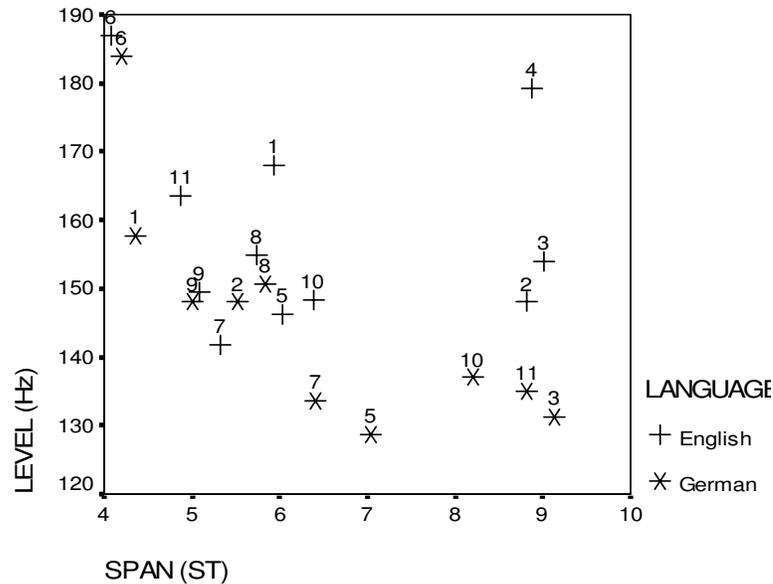


Figure 6. Level and span measures (in semitones) for eleven female German non-native speakers of English. Stars represent the measures for their German data and plus signs represent their English measures. The numbers represent the different speakers.

#### 4. Summary and future directions

The aim of this paper was to provide a summary of some of the most commonly occurring problems in non-native intonation, to reanalyse some past and current research findings in terms of a framework of intonational analysis that separates phonological representation from phonetic implementation, and to demonstrate the usefulness of such a distinction in L2 prosody teaching. It was suggested that L2 learners may go through different stages in the learning process and may first acquire phonological patterns of L2 intonation before they acquire the correct phonetic implementation of these patterns. This assumption was based on studies by Mennen (1999, 2004) which showed that native Dutch speakers who speak Greek near-natively were perfectly able to produce the correct phonological tonal elements but implemented these structures by using L1 phonetic regularities. This finding confirmed observations reported in a small-scale study by Ueyama (1997). Further research is necessary to verify this hypothesis quantitatively for different phonological and phonetic aspects of L2 intonation.

Examples were given throughout the paper to illustrate that intonational errors observed in L2 speech may not be what they seem and that a perceptually similar error may in fact have different underlying causes, which can be either difficulties with the phonological structure of the L2 or with its phonetic realisation. It was emphasised that it is important for teaching purposes to distinguish between phonological and phonetic errors, so that the source of the problem can be addressed in teaching. Only by careful comparisons of the language pairs using a commonly agreed framework of intonational analysis will it be possible to establish where the errors originate from.

Further analyses of different language pairs are necessary if we want to incorporate this in pronunciation pedagogy in foreign language teaching.

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