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Teaching intonation in discourse using speech visualization technology

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Abstract

Intonation, long thought to be a key to effectiveness in spoken language, is more and more commonly addressed in English language teaching through the use of speech visualization technology. While the use of visualization technology is a crucial advance in the teaching of intonation, such teaching can be further enhanced by connecting technology to an understanding of how intonation functions in discourse. This study examines the intonation of four readers reading out-of-context sentences and then the same sentences as part of coherent discourse-level texts. Two discourse-level uses of intonation, the use of intonational paragraph markers (paratones) and the distribution of tonal patterns, are discussed and implications for teaching intonation are addressed.

Keywords: Discourse; Intonation; Pronunciation; CALL; Computer-aided instruction; Speech visualization; Paratone

1. Introduction

Intonation has long held a fascination for linguists and language teachers alike. The intricate modulations of the voice, with its ranges and movements of pitch, its

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subtle nuances of voice quality, and its expressiveness of staccato or lengthened syllables have often seemed to hold the key to language meaning. Early pedagogical materials based on Pike (1945) and O'Connor and Arnold (1973) for example, argued that a speaker's attitude was especially tied to intonation, and that skillful use of intonation was necessary to communicate effectively.

It is now commonly accepted that crucial elements of intonational meaning can only be understood with reference to connected discourse (e.g., Brazil, 1997; Brazil et al., 1980; Brown et al., 1980; Chun, 2002; Johns-Lewis, 1986; McLemore, 1991; Wennerstrom, 2001; Wichmann, 2000). Research on discourse intonation has led to the recognition that there are consistent, systematic differences between the way intonation functions in discourse and how it functions in isolated phrases and sentences. This means that there is also a growing recognition that traditional sentence-level approaches may not be able to meet the needs of language teachers and learners, who need to develop awarenesses of explicit connections between intonational choices and the meanings communicated by those choices (Levis, 1999).

A promising way to address the teaching of intonation has been through the use of speech-visualizing technology. Indeed, the teaching of intonation has been greatly assisted by the widespread availability of computer technology to see as well as hear intonation. Programs such as *WASP* (Huckvale, 2003) and *PRAAT* (Boersma and Weenink, 2004) are freely downloadable, while other pedagogically oriented programs such as *VisiPitch* (Kay Elemetrics Corporation, 2004) and *SpeechViewer* (IBM, 2004) are commercially available. Unfortunately, the use of computer technology has furthered the dominance of sentence-level practice rather than promoting the use of discourse intonation.

Using Brazil's (1997) model of intonation in discourse, this paper argues for the greater use of computers in the pedagogical treatment of discourse-level intonational phenomena. We present an initial set of data designed to show two ways in which a discourse context affects intonational choices: The use of extra high pitch at topic junctures to signal intonational paragraphs, and patterns of unit-final movement, or the rising, falling or level pitch choices that relate the individual utterance to the discourse context. Four readers read lists of sentences and the same sentences forming a coherent text. We isolated and measured these two intonational choices using speech visualization technology in order to show how discourse-level intonation patterns can be compromised by the use of sentence-level texts. Our results show that a sentence level context interferes with patterns of discourse-level intonation structure and illustrate the importance of combining speech visualization technology with a discourse-level pedagogical treatment in order to most effectively use computers in the teaching of intonation.

2. Literature review

2.1. Development of speech visualization technology in language learning

The application of speech visualization technology to language learning environments dates from the 1960s when pitch analyzers were used for teaching the deaf and

then for work in second language learning of intonation (Abberton and Fourcin, 1975; Leon and Martin, 1972; Vardanian, 1964). The advantages of allowing the learner to concentrate exclusively on the prosodic aspects of an utterance were quickly recognized:

> It is extremely difficult to penetrate this system [of intonation] unless one has an excellent "ear" and good linguistic training. The visual presentation of intonation has permitted us to transpose a specific auditory gesture common to a closed linguistic community into a visual gesture capable of being decoded by a universal semiotic community (Leon and Martin, 1972, p. 143).

In the 1980s, instrumental analysis was coupled with models of intonation to address the need for a framework within which to interpret spectrographic displays. Based on the intonational model developed by t'Hart and Collier (1975), Kees de Bot and his associates (de Bot, 1980, 1983; de Bot and Mailfert, 1982; Weltens and de Bot, 1984) identified a set of "perceptually relevant" elements of pitch change for Dutch and English: The direction of pitch change, range of change, speed of change and place of change. These categories were investigated in experimental studies that tested the perception and production of second language intonation for Dutch and French learners of English. The results suggested that instructional programs benefit from the inclusion of speech visualization technology. Learners who received audio–visual feedback demonstrated improved perception and production of intonation patterns in the L2 and an increased sensitivity to pitch movement. The technology also fostered the use of positive learning behaviors by encouraging learners to repeat target sentences more often and to self-correct.

By the late 1980s and early 1990s, the validity of the technology had been established and a range of software and hardware systems were becoming available for more widespread use (Anderson-Hsieh, 1996; Spaai and Hermes, 1993.) A number of articles and papers disseminated the information to the field of second language teaching and focused on how these techniques could be applied to particular populations in ESL such as international teaching assistants (Anderson-Hsieh, 1989, 1992; Molholt, 1988).

2.2. An unchanging research design

While the technology used to extract pitch melody continued to develop during the latter half of the twentieth century, the research design of intonation studies remained largely unchanged. The intonation system was perceived primarily as a series of pitch contrasts determined by the grammatical form of the utterance (such as declarative versus interrogative, and wh-questions versus yes–no questions). Typically, participants imitated short utterances produced by native speakers (or in some cases, synthesized speech) and attempted to match the original pitch contour. Sentences were chosen based on contrasting grammatical patterns. Vardanian (1964) for example, tested six sentences comprising rising and falling question intonation, list intonation, and declarative (falling) sentence-level intonation patterns. Twenty

years later, Weltens and de Bot (1984) followed much the same procedures, asking participants to imitate a list of sentences also comprised of short declarative and interrogative sentences.

During this time, however, researchers in discourse-based phonology and psycholinguistics were exploring the role of prosodics in discourse. Experimental studies showed that pitch and pause structure were significant in the production and processing of both local (utterance-level) and global (discourse-level) information structure (Grosz and Sidner, 1986). Chun (1988) expanded discussion of the functions of intonation and investigated its systematic use in indexing sociolinguistic information and controlling interactive structure. Models of discourse intonation in English (Brazil, 1997; Gussenhoven, 1983; Pierrehumbert and Hirschberg, 1990) proposed that isolated contours or tones form part of a larger organizational structure through which they acquired their full significance. Johns-Lewis (1986, p. xxiii), saw a key role for the use of instrumentation in the investigation of discourse-level patterns and using pitch visualizers to match theoretical categories to the phonetic realizations of intonation contours. This was recently reiterated by Chun (1998, p. 65), who called for an integration of "two areas of linguistics that have often been placed on opposite ends of the continuum in terms of the scope of their respective domains: acoustic phonetic analyses [and] discourse-level linguistic analyses".

2.3. Speech visualization technology and discourse intonation

Chun (1998) proposes four areas in which pitch visualization technology can be integrated into intonation teaching: (1) providing learners with visual feedback; (2) providing learners with "authentic and extensive speech"; (3) using computers to record and analyze interactions between speakers; and (4) using computers to monitor student progress (p. 66). The challenge of matching advice and action is reflected in Chun's text, where apart from one constructed dialogue containing short, declarative sentences, there are no discourse-level examples. The need for authentic examples, Chun argues, can be met by teachers taking examples of natural data from corpora (e.g. the *Corpus of Spoken English*) which can then be "pitch tracked and presented to learners" (Chun, 1998, p. 73).

The assumption underlying this strategy is that practice with computer models of individual, short utterances will enable the teacher to understand and distinguish pitch patterns in connected speech and recognize significant elements of discourse-level intonation. However, published work addressing prosodic transcription of the Corpus of Spoken English (Knowles et al., 1996, see particularly, pp. 104–105) demonstrates that the description of prosodic patterns beyond the sentence-level is not a simple matter. In fact, a teacher or researcher who takes on the challenge of conducting an instrumental analysis of discourse-level intonation structure will find that sentence-based models of pitch melody are woefully inadequate. They are incomplete in terms of describing the processes that can occur across sentence boundaries and create a deceptively simplistic picture of the reality of pitch movement in natural speech.

3. Two features of discourse-level intonation

3.1. Intonational paragraphs

Intonational paragraphs, or paratones, involve the use of a high pitch onset and a low pitch close with a gradual decline in pitch peaks from the first to the final tone unit within a speech paragraph (Brown et al., 1980; Tench, 1996; Wichmann, 2000.) Fig. 1 shows the F0 (fundamental frequency) reading of a paratone initial high pitch on the prominent syllable 'SEcond' from the female speaker's text B reading (Appendix B).

Fig. 2 shows the F0 reading of the entire second paratone from text B read by the same speaker. The actual pitch values (in Hz) are given below and show a gradual decrease in the height of the pitch peaks throughout the paratone. The first prominence in the unit, 'SEcond', exhibits the highest pitch peak of 315 Hz. As the paratone progresses, the peak values decline in height until the stable 256 Hz reached on the prominent syllables 'LOWer' and 'howEVer':

Now our SEcond (315) major competitor is Zecron. They ENtered (290) the market at the same time as us. They have a LOWer (256) market share than us and their products are sold at slightly higher prices. HowEVer (256), their annual return shows greater profitability.

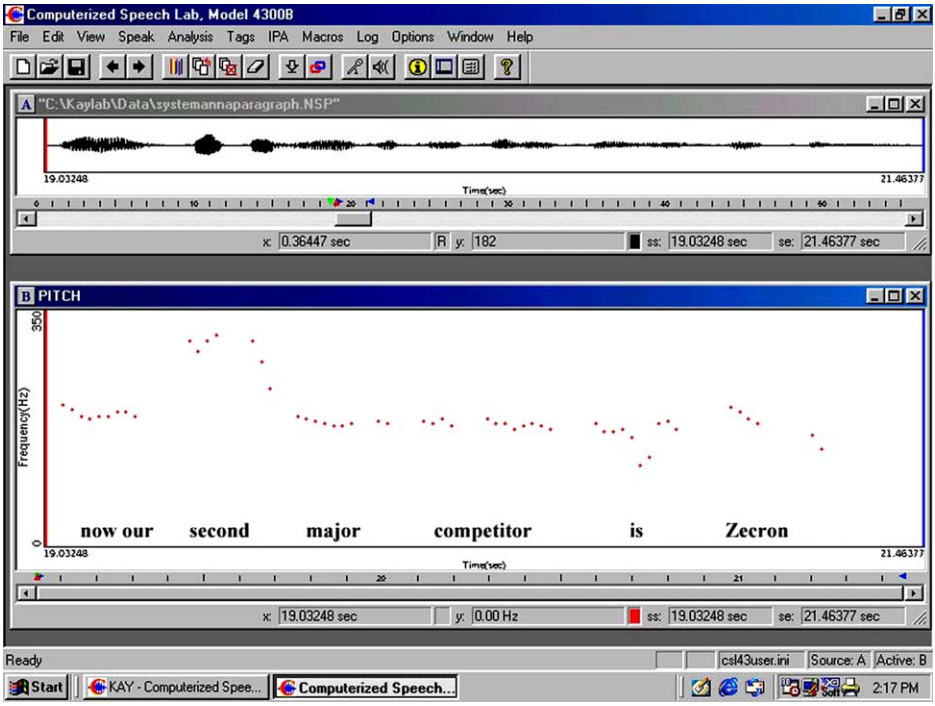

Fig. 1. F0 reading of a paratone initial high pitch from text B.

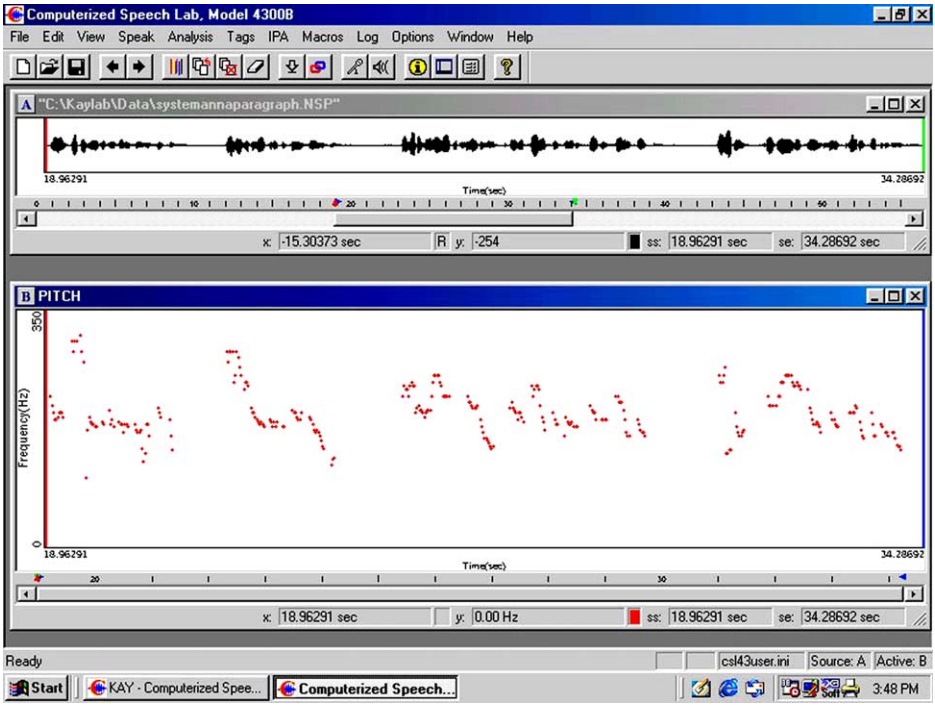

Fig. 2. F0 reading of the second paratone from text B.

Following *profitability* there is a pitch reset at the beginning of the next unit, *the LAST competitor* to 306 Hz, signaling the opening of a new paratone.

Intonational paragraphs, or high paratones, mark topic shifts, similar to the written use of indentation and paragraphing conventions. These topic shifts are not evident in isolated utterances but are only evident above the level of the tone unit or thought group. Speakers mark topic shifts with an extra high pitch reset. Following the high pitch are successively lower pitch peaks which are usually finally demarcated by a final low, falling pitch choice. In other words, paratones mark the beginning of spoken paragraphs. These spoken paragraphs may be coterminous with a paragraph in written discourse, as is evident in the texts used in this study, but are also evident in spoken texts which cannot easily be organized into traditional written paragraph forms. Paratones are used by speakers with all types of texts, those which are read as well as those which are spoken. They are produced and interpreted by speaker–hearers using the phonetic cues that appear at their boundaries.

3.2. Tonal composition

Tonal composition, or tone choice, refers to the choice of a sustained rising, falling or level pitch movement on the tonic, or nuclear syllable, of the tone unit. Tone

choice summarizes common ground between speakers. According to Brazil (1997), falling tones indicate a speaker's assumption that the content of the tone unit is a new assertion and unrecoverable from the prior context. Rising tones indicate that the speaker assumes that the matter is part of a shared knowledge base between speakers. This shared background may come from the immediate context or areas that are generally understood to be common ground between interactants. This explanation suggests that the reading of sentences is likely to evoke a higher percentage of falling tones, and that the use of connected discourse will allow readers to assume more common ground.

Brazil suggests that the tonal composition of an utterance or group of utterances can be pragamatically exploited by the speaker to create a *state of convergence*, i.e., moving toward informational or social confluence with a participant; or can be used to project minimal involvement with the hearer and indicate a temporary withdrawal from the context of the interaction. Specifically, a selection of a combination of largely falling and rising final tone choices is termed *direct discourse* and indicates a move toward convergence with the hearer. Alternatively, a combination of falling and level tones is termed *oblique discourse* and indicates an orientation by the speaker toward the language sample itself, i.e., it reports nothing more than "this (linguistic item) is what is written here" (Brazil, 1997, p. 135).

Figs. 3 and 4, and their accompanying sound files, illustrate the difference between oblique and direct discourse. Fig. 3, the oblique discourse, shows a combination of level and falling pitches. The sentence sounds relatively flat and unexpressive, as though the reader was simply running through the list of sentences (as indeed she was). Fig. 4, on the other hand, is an example of direct discourse, and the tone units are marked by rising and falling–rising pitch. In contrast to Fig. 3, the reading sounds animated, as though the sentence is meant for someone to listen to. Not all sentence pairs in the study were as different as these two, but overall, sentences in discourse appear to be much more direct than those which are simply sentences removed from a meaningful context.

4. Methodology

4.1. Participants and materials

To demonstrate how intonation functions differently in discourse and at the sentence-level, we recorded two sets of data by four native speakers of English. Two speakers (1 male, 1 female) read the narrative discourse-level text and isolated sentences shown in Appendix A, and two additional speakers (one male, one female) read the text and sentences shown in Appendix B, which comprise a formal presentation in a business context. To ensure the comparability of the sentences in the lists and the texts, half the isolated sentences were taken from the discourse-level texts, and half were used because they were similar to the discourse sentences in length, structure and register. In the sentence lists, all sentences were scrambled so that the readers would not be able to identify the sentences that belonged together.

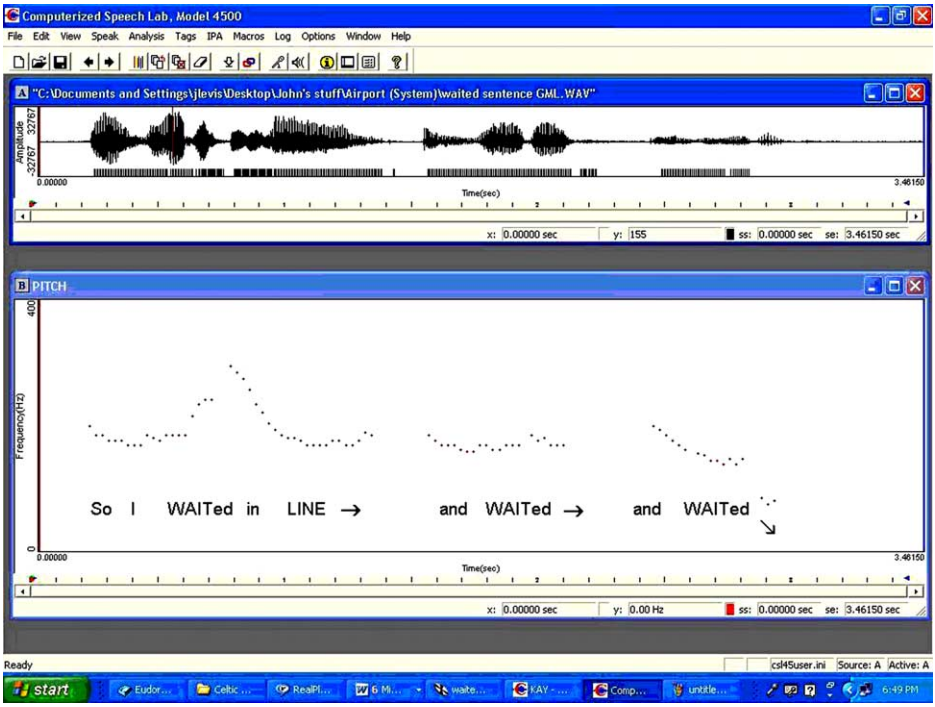

Fig. 3. Sentence reading of So I WAITed in LINE / and WAITed / and WAITed.

Our assumption was that readers would read each sentence as its own unit and would not be overly concerned with creating a context for individual sentences. This proved to be the case, although some readers afterwards commented that it seemed as if some of the sentences might have been related.

4.2. Procedures

Sentences were recorded first, followed by the related discourse-level text. The texts were divided into paragraphs. Partly, this was because the texts were logically divisible in this way, and partly, the paragraph boundaries were meant to make explicit how speakers use intonation differently in discourse, particularly in how they use extra-high pitch to mark topic junctures. Simply dividing the text into paragraphs meant that we did not need to do anything unusual to call attention to discourse structure, and that the readers would automatically use the speaking resources available to them to mark discourse structure. The recordings were made using a Kay Elemetrics *Computerized Speech Laboratory* (CSL) and analyzed for phrasing and intonation using the pitch extraction function of the CSL. Each sentence or text was analyzed for phrasing and F0. We then compared the sentence level readings and the discourse-level readings for both targeted intonational features: the

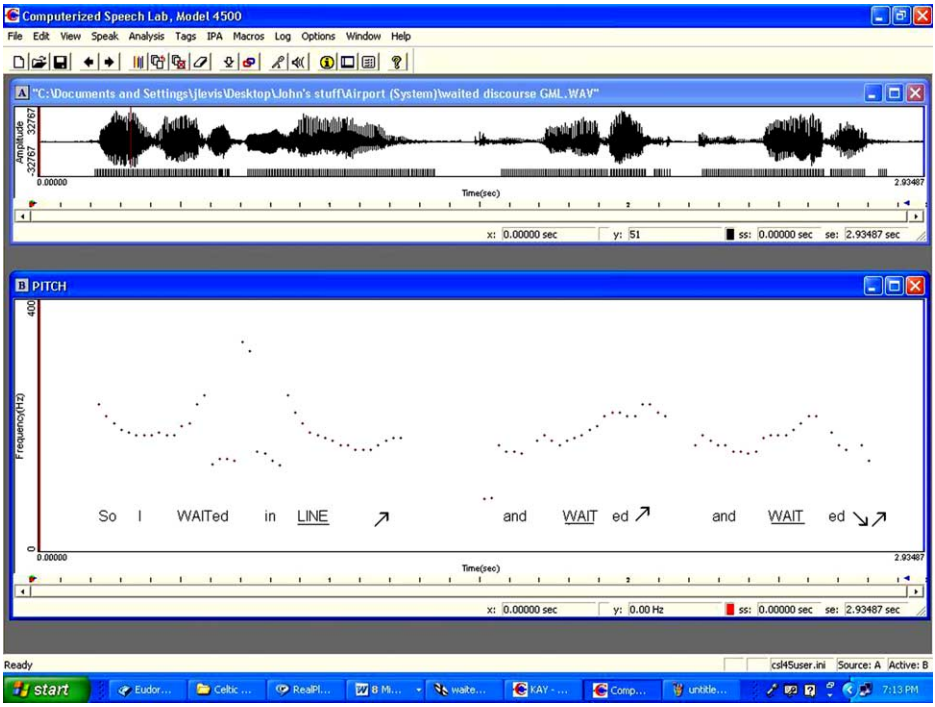

Fig. 4. Discourse reading of "So I WAITed in LINE / and WAITed / and WAITed.

pitch levels related to the use of intonational paragraphs and the ways the readers chose tones based on the reading task.

4.3. Data analysis

4.3.1. Intonational paragraphs

In both cases, the discourse text was divided into paragraphs (as shown in Appendix A and B.) The onset pitch of each paragraph was measured and compared to the onset pitch of the same sentences as they were read from the list. The results are shown in Table 1.

In all cases, the onset pitches used in the original text were the highest pitch choices made in each paragraph, creating gradually falling overall F0 contours similar to that shown in Fig. 2 above. Each paragraph closing pitch was followed by an extra-high pitch reset to mark the opening of the following paratone. Therefore, the paratone structure created by the reader as defined by pitch movement was, for these readings, consistently coterminous with the paragraph structure of the written text. The comparison further shows that the onset pitch of each paratone is significantly higher than the equivalent onset pitch from the list reading. The lack of a genuine discourse context in the list reading thus disrupts patterns of systematic pitch change

Table 1
Onset pitch of paragraph-initial units from Text A and Text B and lists of sentences

Text	Speaker	Pitch onset	Text	List of sentences
Text A	Female speaker	LAST time	363	320
		It was FUNny	276	205
		This went ON	250	195
	Male speaker	LAST time	235	186
		It was FUNny	258	235
		THIS went on	235	216
Text B	Female speaker	LET us look	282	245
		Our SEcond	315	245
		The LAST	306	212
		SO what	290	216
	Male speaker	LET us look	172	104
		Our SEcond	172	151
		The LAST	172	123
		So WHAT	175	139

that would normally be seen in discourse and contributes to a more compressed overall pitch range.

4.3.2. Tonal composition

Patterns of tone use are also influenced by the speaking task. Oral reading of any kind is dominated by falling tones. One way of understanding this is that speakers engaged in oral reading tend to orient strongly toward proclaiming or asserting the information they read (Brazil, 1997). The texts used in this study were also composed of declarative sentences, the kind most often associated with falling tones. There is, however, a difference in the text-based data and sentence-based data in the use of rising tones. This is shown in Table 2.

In all cases, there is a tendency toward an increased use of rising tones in the text-based data. Rising tones are typically thought to signal incompleteness and assumed to be more likely to occur in non-final position in utterances comprising multiple tone units. Falling tones signal completeness and thus are more likely in utterance final tone-units (Cruttenden, 1997). This explanation, however, cannot account for the differences in tone use in this study since identical sentences were used. Almost all tone-units at the end of grammatical sentences for both speakers finished in fall-

Table 2
Percentage of rising tone choices by each reader in texts and lists of sentences

Text type	Female readers % of rising tones	Male readers % of rising tones
Text A	28	16
List A	11	6
Text B	12	12
List B	8	4

ing tones, lending support to the completeness explanation, but rising tones were still used at a higher rate in the discourse-level texts, which indicates that rising tone use was sensitive to discourse context.

In Brazil's discourse intonation framework, rising tones project a context of information shared between speaker and hearer. There is clearly less context to share in a list of isolated sentences since each sentence does not make reference outside itself to other elements of the discourse. In contrast, in the text reading, the speaker may choose to refer to elements from the immediate context or elements the speaker will assume to be common ground. Hence, there is a greater use of rising tones in the text reading, where there is context built into the reading, a finding clearly consistent with other studies of rising tones (Hewings, 1990).

In addition to the type of reading (i.e., text versus isolated sentences), the speaker may choose different ways of reading aloud, or different degrees of engagement with the text and the listener. Brazil (1992) suggests a continuum of five degrees of engagement, each of which is characterized by a slightly different tonal composition. Speakers freely choose their level of engagement although this is likely to be affected by type of reading as well as additional contextual factors. Level 1 or "minimal engagement" describes a mechanical reading of the language sample with no consideration of meshing the utterance(s) with any larger understood context or common ground shared by the hearer. One might think, for example, of a small child reading aloud from the newspaper. Low levels of engagement constitute oblique readings and tonal composition comprises largely falling tones, or a combination of level and falling tones. At the furthest end of the continuum, level 5, reading aloud most closely resembles interaction, "speech in which participants pursue conversational purposes taking into account the entire complex network of shared assumptions" (p. 222). This constitutes a direct reading, and tonal composition comprises rising and falling tones with few level tones. The results of the tonal composition analysis are shown in Table 3. When the tonal composition for the texts is compared to the composition of the equivalent lists of sentences, the text-based readings encouraged the readers to create a higher level of engagement than in the sentence-based readings; that is, in all cases, there is a larger number of rising tones in the text-based readings, and in the case of the female readers, fewer level tones in the text-based readings compared

Table 3
Tonal composition of texts and lists of sentences

Text type	Speaker	% Falling tones	% Rising tones	% Level tones
Text A	Female	64	28	8
List A		58	11	31
Text A	Male	61	16	23
List A		71	6	23
Text B	Female	76	12	12
List B		67	8	25
Text B	Male	64	12	24
List B		84	4	12

to their equivalent sentence-based readings. Thus, the tonal composition of the discourse alters when the information is fragmented as opposed to when it is presented in its larger, authentic context.

On an individual basis, there were differences between speakers in their level of engagement as demonstrated by tone choice. The attention that speakers brought to the task may account for this difference. In both cases, the male readers read both individual sentences and the full text quickly, without a lot of extra attention. The female readers were more attentive and careful in their reading of the text. In the case of text A particularly, the female reader used a much more expressive manner, as though actually telling a story. The male reader, on the other hand, was intent on completing the task. In the absence of specific instructions to be expressive, he was not. As regards text B, although the male reader chose a fairly low level of engagement for the text-based reading as reflected in the number of level tone choices; he chose an even lower level of engagement, what Brazil terms a ''minimal'' level 1 engagement for the list of sentences reflected in the almost complete absence of rising tones (Brazil, 1992, p. 214).

One implication of the differences in tonal composition is that sentence reading, the traditional methodology for intonation practice, encourages minimal engagement in meaningful use of the language. Although we know that speakers and hearers do not communicate in isolated sentences, that they communicate in context, and that

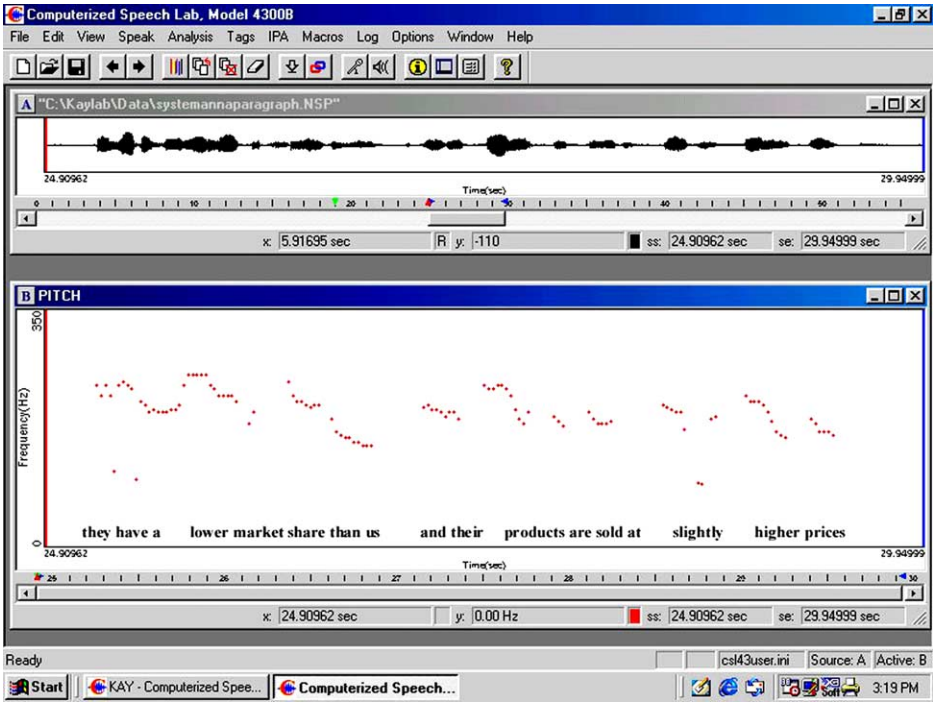

Fig. 5. F0 reading of pitch choices from a discourse reading.

the intonational choices they use contribute meaning to the interaction, the use of sentence reading obscures this meaning because it is evident only in a larger context.

5. Discussion

The widespread availability of computers has forever changed the teaching of intonation. Effective intonation practice without computers is ultimately restricted to teachers and students with good micro-listening skills. The use of visualization technology has made intonation practice reliably available to even those without the ability to confidently identify pitch changes. This removes one of the most important obstacles to the teaching of intonation. However, there is another obstacle, perhaps more important, which remains. Without an explicit understanding of the functions of intonational choices, students are in danger of practicing the forms without learning their meanings or uses and without perceiving the real shape of pitch patterns in discourse. Currently, providing visual feedback encourages sentence level practice and a focus on grammatical form. However, sentence-level practice, while valuable in its own place, is insufficient to teach how intonation is used in connected speech. Furthermore, it may promote the use of the kinds of intonational features that can negatively affect the prosodic composition of nonnative speech such as a predominance of falling or co-occurring falling and level tones and a significantly reduced pitch range (Mennen, 1998; Pickering, 2001; Pirt, 1990).

A reduction in pitch range connected to the marking of new or contrastive information was demonstrated in our data. An explicit example of an internal contrast was found in Text B, where 'lower' and 'higher' were made prominent: *They have a LOwer market share than us and their PROducts are sold at slightly HIGHer prices*. In the text reading, the internal contrast between *lower* and *higher* is emphasized with high pitch choices as shown in Fig. 5.

They have a LOwer (256) market share than us and their PROducts (234) are sold at slightly HIGher (230) prices.

In contrast, in the equivalent reading from the list of sentences by the female reader, shown in Fig. 6, the contrast is less marked and the pitch peaks follows the declination pattern expected for isolated sentences, ending in a low pitch termination.

They have a LOwer (234) market share than us and their PROducts (200) are sold at slightly HIGher (183) prices.

Although this kind of explicit contrast appears to be amenable to sentence-level pedagogical treatment, in fact, the reduced context alters the pitch pattern. This may also apply to implicit contrasts, i.e., those that occur with comparative terms such as *However, their annual return shows GREAter profitability* (implying less for another competitor) which rely on a discourse context to be understood.

5.1. Pedagogical applications

Expanding the context of the pedagogical material and computer-based practice that are provided to students is more likely to result in pitch patterns that mirror

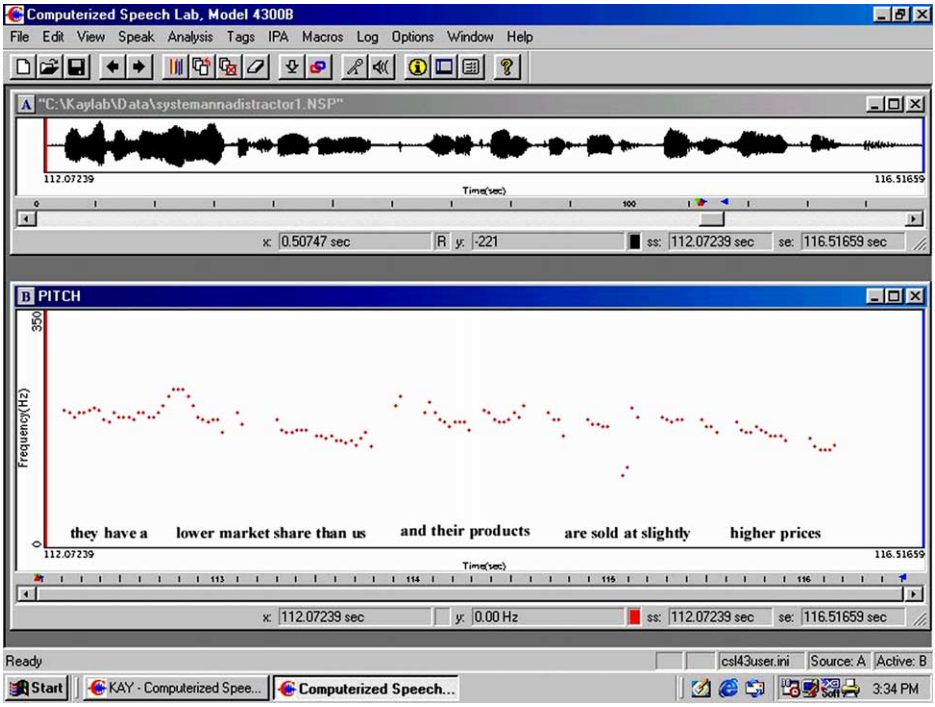

Fig. 6. F0 reading of pitch choices from a sentence reading.

Exercise: Predicting Prominences

Using (■), predict where you think the speaker is likely to choose to mark prominent syllables

We use the pH meter/ to measure the acidity or alkalinity of compounds/ If the pH value is lower than seven/ then it's an acid/ If the value is larger than seven/ then it's a base/ If the value is exactly seven/ then we call this a neutral compound/ For example/ water is a neutral compound/

(Adapted from Hahn and Dickerson, 1999, p. 62)

Fig. 7. Pedagogical exercise to practice predicting pitch patterns (Adapted from Hahn and Dickerson, 1999).

authentic patterns in speech. The following sample activity, shown in Fig. 7, embeds contrastive patterns similar to those we discussed in the previous section (for example, *acidity* versus *alkalinity* and *values lower than seven* versus *values larger than seven*.) Students predict the prominence patterns that the speaker is likely to choose

We use the pH meter/ to MEAsure the aCIdity/ or ALkalinity of COMpounds/ If the pH value is LOwer than SEven then it's an ACid/ If the value is LARger than SEven/ then it's a BASE/ If the value is exACtly seven/ we CALL this a NEUtral COMpound/ For exAMple/ WAter is a NEUtral compound/

Fig. 8. Answers to exercise shown in caps.

based on their understanding of how pitch movement will reflect the new and contrastive information structure of the text.

The answers to the exercise and accompanying sound file are given in Fig. 8 and demonstrate the speaker's choice to reinforce contrastive information structure with his choice of prominence patterns, e.g., *if the pH value is LOWer than SEven* , ... *if the value is LARger than SEven*, ... *if the value is exACtly seven*.

This kind of discourse-based exercise is additionally effective because English language learner speech tends to exhibit excessive multiple prominences which can obscure information structure (Pickering, 2001). Emphasizing the production of stressed syllables outside of a meaningful discourse context may exacerbate this problem, encouraging a lack of consideration of the semantic value of a choice of prominence.

An exercise like that shown in Fig. 7 can be easily expanded to incorporate discussion of pitch height as a phonetic boundary marker to indicate intonational paragraphs or paratones. This can be done by asking learners to explain the topic more fully, as is common in microteaching exercises used in courses for international

↑ **O**k. We use the pH meter/ to measure the acIDity/ or alkaLINity of COMpounds/ The ph scale runs from ZEro to fourTEEN,/ but the NEUTral level /is not at either END of the scale, /but rather in the MIDdle,/ that IS, /SEVen. / WATer, /especially PURified water, / is aROUND this neutral level./

↑ **LOW**er ph levels / are found in aCIDic solutions. / The LOWer the NUMber, / the more aCIDic the soLUtion. / This means that a VEry acidic solution / may have a ph value of TWO, / ONE, / or even ZEro. / aCIDic solutions / have a relatively LARGE concenTRAtion /of HYDrogen ions. /

↑ **HIGH**er ph levels / are found in BASic, / or ALkaline solutions. / The HIGHer the ph is aBOVE SEVen, / the more ALkaline the solution. / Thus solutions with ph levels at TWELVE, / THIRrteen, / or even FOURteen / are STRONGly basic. / BASic solutions / have a relatively large concenTRAtion /of hyDROXyl ions. /

Fig. 9. Expansion of Fig. 7 exercise to practice paratone usage.

teaching assistants. In the possible expansion in Fig. 9, the initial bolded words are likely to be marked with paratones, which can be practiced with pitch visualizing software (Other syllables that may be prominent are marked with CAPITAL letters, and possible phrasing is marked with /.).

Of course, preconstructed texts, such as that shown in Appendix B, can also be used for this kind of pedagogical practice. What is important for teachers to realize is that pitch visualizing software can be used for longer texts, as long as target features (such as paratones) are limited and easy to identify on the screen.

6. Conclusion

Increasingly, as a profession, we are being offered newer and better opportunities to incorporate computer-based instruction into our classes. This is particularly true in the use of speech visualization technology, which has only fairly recently become widely available. The current tendency is to fit this technology into traditional, sentence-level pronunciation pedagogy, yet because of the coinciding development of a more sophisticated understanding of how pitch functions systematically in discourse, we have the opportunity to encourage contextualized, discourse-level practice with intonation. This use of computer-based instruction may finally fulfill the decades-long hope of using intonation to effectively communicate meaning.

Providing practice with discourse-level intonation features is clearly the next step in using technology for the teaching of intonation. It is not enough to talk about or explain discourse meanings with sentence level practice. This assumes that learners can fill in the blanks with native speaker intuitions, an ability that we cannot and should not assume (Levis, 1999). Software is now capable of presenting longer stretches of speech, and systematic meanings of discourse pitch movement have been described in ways that are more transparent for the learner. The availability of commercially available discourse oriented intonation materials (e.g., Cauldwell, 2001) also means that teachers are not limited to sentence-level practice. Most importantly, our increased understanding of the form and function of intonation in discourse gives teachers the knowledge they need to help their students use intonation for real communication, making it increasingly possible that learners will understand and learn to use intonation for their real communicative needs.

Appendix A. Text A (adapted from James et al. (1980))

Last time I was at an airport, I was between planes and I had to make an important phone call. I looked around and all the phones were busy so I waited in line and waited and waited. And finally, I began to listen to the conversation of the guy who was talking on the phone I was waiting to use.

It was funny because he was an old man and he was talking to his wife and he was talking about his trip. And he said that he was having a good time and he talked about the weather and he asked about the weather back there. And all the time he was talking to his wife he was eating a sandwich and drinking coffee.

This went on and on and on, and I really was getting impatient because the phone call I had to make was important. I maybe waited there 10, 15, 20 minutes. Finally the guy hung up the phone and he turned around because he had seen me standing there. And he said, ''Well, I am sorry I took so long on the phone, but I was having dinner with my wife''.

Sentences

1. The guy hung up the phone and he turned around because he had seen me standing there.
2. The other day, I saw an expensive vase being sold for a cheap price in a thrift shop downtown.
3. I maybe waited there 10, 15, 20 minutes.
4. Once or twice a month, I like to go to the airport to watch jets as they take off and land.
5. All the time he was talking to his wife he was eating a sandwich and drinking coffee.
6. Most people who like to play sports that involve teamwork also enjoy working in groups on projects.
7. I began to listen to the conversation of the guy who was talking on the phone I was waiting to use.
8. It was obvious that the students were looking for attention and were acting wild so they would be noticed.
9. They thought that there would not be any trouble and the hike would be easy and it would not rain.
10. This went on and on and on, and I really was getting impatient because the phone call I had to make was important.
11. She said, ''Actually, I really hate to leave so early, but I have to get up for my trip in the morning''.
12. At no time did she ever stop trying, but she kept writing letters until it was too late.
13. He said that he was having a good time and he talked about the weather and he asked about the weather back there.
14. I looked and looked and looked, but the money was well hidden because I never was able to find it.
15. It was funny because he was an old man and he was talking to his wife and he was talking about his trip.
16. They could have been there for two, three or even four days.
17. I looked around and all the phones were busy so I waited in line and waited and waited.
18. The kids put away their clothes and cleaned up their rooms since they wanted to watch TV.

19. He said, "Well, I am sorry I took so long on the phone, but I was having dinner with my wife".
20. Last time I was at an airport, I was between planes and I had to make an important phone call.

Appendix B. Text B (adapted from Donna (2000))

Let us look at the competition. Our main competitor – Benton – entered the market 10 years later than us. But since then they have grown more rapidly and are noe the biggest in terms of market share. Why? Their products are better, sold at lower prices and presented more attractively.

Now, our second major competitor is Zecron. They entered the market at the same time as us. They have a lower market share than us and their products are sold at slightly higher prices. However, their annual return shows greater profitability.

The last competitor is Mansell. They have a much smaller market share but their products are sold at the top end of the market at much higher prices. As a result, they achieve the best profitability of the four companies with a much lower turnover.

So, what can we say about our own position?

Sentences (additional sentences adapted from Cummings (1992))

1. Nationally, they were known for poor quality and late delivery of merchandise.
2. The final issue is reputation.
3. They have a much smaller market share but their products are sold at the top end of the market.
4. They entered the market at the same time as us.
5. Let us look at the competition.
6. So, how can you triple your money in two weeks?
7. You can avoid impulse buying but this would not ensure that you will realize financial gain.
8. Our main competitor, Benton, entered the market ten years later than us.
9. These are opportunities for huge gains or total losses.
10. For this reason, a low price does not mean a safe buy.
11. First, the company tried to compete in the national market.
12. Let us consider how to assess a stock's potential for growth.
13. Since then, they have grown more rapidly and are now the biggest in terms of market share.
14. Their products are better, sold at lower prices, and presented more attractively.
15. The last competitor is Mansell.
16. So, What can we say about our own position?
17. You must carefully analyze the company's reputation, product and financial base.
18. However, their annual return shows greater profitability.
19. Consequently, while the stock sold briskly in the local market, the company took a loss.

20. They have a lower market share than us and their products are sold at slightly higher prices.
21. When you examined their reputation, you found that their local reputation was acceptable.
22. The secret is knowing which stocks to buy and which stocks to avoid.
23. Now, our second major competitor is Zecron.
24. As a result, they achieve the best profitability of the four companies with a much lower turnover.

Appendix C. Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.system.2004.09.009.

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