

THE DEVELOPMENT OF A SIMPLE ONLINE STRESS-TIME TRAINING SOFTWARE

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Abstract

Students of English have difficulties in comprehending utterances spoken at natural speed, not merely because of grammatical/lexical complexities - which make their own significant demands on mental processing - but on account of problems with phonology. Depending on level, there are a range of receptive problems with individual phonemes, intonation or word/sentence stress, and these can affect the successful delivery of meaning. In spite of this, phonology continues to be neglected by teachers, and, unsurprisingly, most CALL applications, especially the 'home-made' variety, focus on text rather than audio. I argue that assisting students with phonological problems (using a skill-based theory) can reduce the cognitive load required for decoding meaning from grammar/lexis. English is a so-called stress-timed language (Abercrombie 1967), and thus differs from syllable-timed French, Japanese, etc. Most English teachers model sentences with an accompanying clap of the hand to emphasize (perhaps exaggerate) the natural rhythm. To assist in raising awareness of stress timing, I made a simple training software (specifically for recognition, not production) using Hot Potatoes plus audio files. I explain briefly how to set up the hard/software necessary for (re)creating it, and attempt to assess its impact on students' listening skills.

Note: accompanying audio files/exercises can be found at:

<http://www.teu.ac.jp/media/~campbell/confs/PacCall2004/index.htm>

1 Context: The Shifting Fortunes of Phonology

Since the rise and fall of the audiolingual method, phonology has often been seen as an object of neglect for teachers of English. Whereas during the 1950s and 60s the phonological system was championed alongside grammar as constituting the very "organization of language and by implication the units of production and comprehension" (Richards & Rodgers, 2001), after the rise of communicative language learning in the 70s, phonological drilling more or less vanished from the classroom together with structural drills. Moreover, accuracy in pronunciation had importance only inasmuch as it interfered with successful communication, and consequently found itself swept under the pedagogical carpet. Since that time, and as mainstream language teaching has become methodologically more eclectic, features of English phonology have resumed their place both in textbooks and the classroom, and today are considered a normal and integral topic for most lessons, whether as a stage in their own right or as ad hoc to lexical or grammatical practice.

Indeed qualified teachers of English today need to understand its phonological system and then know how to teach it. Features of stress, intonation, connected speech and individual sounds are all intimately related, yet they are often taught separately in the belief or hope that the student will work out in due course how to integrate them for him/herself. Certainly this is how they are usually treated in course-books. Thus we find that in one lesson, students are asked to repeat after the teacher and if possible ape a certain aspect of pronunciation (e.g. minimal pairs), and in another, they are requested to chart patterns in intonation in a particular utterance, or to draw large or small lozenges representing the strong and weak forms they hear.

2 Methodological Issues in Phonology

Focus on explicit phonological knowledge ('the rules') as a discrete topic is considered legitimate if it is assumed to have a positive transference within speaking and listening skills. In other words, if the student understands the phonological features of ten particular model sentences, then this can help him/her towards producing or comprehending a similar eleventh sentence through extrapolation. This is to take the view a) that knowledge of phonology can be gained through practice (i.e., a skills-based theory of learning), and b) that such knowledge, once gained, will automatically transfer itself successfully to new examples for both reception and production, and perhaps also c) that these skills, once developed, will run automatically and last indefinitely. It may also assume that all students are capable of developing this skill, and that all parts of phonology are equally teachable and learnable. Predicating teaching practice on such assumptions is understandable but highly suspect.

First of all it is well documented (Swan & Smith, 2001) that a learner's L1 influences the ease or difficulty with which different aspects of English phonology can be recognized or produced. This is not merely a question of individual sounds (the fact that the Japanese phonetic alphabet transcribes "hard" and "heard" in the same way, for example), but also, as we shall see, each language has its own sense of rhythm, lying somewhere between stress-timing and syllable-timing, broadly speaking, where the length of an utterance depends on the number of stressed-syllables or the total number of syllables, respectively. Yet, since the pronunciation of a language is a system of highly interconnected variables, it is not the case that students whose L1 is considered to be stress-timed, such as Arabic, for example, will produce a natural English rhythm more readily than a syllable-timed French speaker. Equally skill in one area of phonology does not imply skill in other areas. Just because a student is good at sound discrimination does not mean that she will be good at production of sentence stress.

As for the theory of learning phonology, what alternative is there to practice? Ellis (2003) contrasts skill-based theory (where knowledge originates as an explicit form and is automatized over time through practice) with a theory of implicit learning (where learning takes place unawares, in the process of communication, for example). Where does phonological knowledge fit into this equation? Could it be that phonological proficiency comes bundled in with combinations of structure and vocabulary, learned implicitly and stored as chunks? In other words, can phonology simply ride on the back of other linguistic knowledge that has been internalized? The problem is that once those chunks need to be restructured, what explicit knowledge of pronunciation can the student refer to? Furthermore the processing required for unpacking the chunks and rebuilding structures may not leave much available for phonological accuracy. In any case it is difficult to imagine how we might pinpoint the methodology responsible for giving rise to each aspect of phonology that a student displays, especially since most lessons contain a mixture of explicit instruction and

free, communicative practice in which new language and skills may be developed without reference to explicit knowledge. Whichever theory of learning is involved, explicit knowledge can help a student to learn language, whether through exercise or exposure, or, in other words, whether it is used as a starting point for skills development, or whether it helps the student to notice form during unfocused tasks (Ellis, 2003).

Nevertheless, as with grammar and lexical knowledge, the teachability and learnability of each phonological item are crucial. Indeed Dalton and Seidlhofer (1994) argue that “more than any other aspect of a foreign language” pronunciation is influenced by affective factors such as motivation. They caution that “especially in pronunciation, there can never be a one-to-one relationship between what is taught and what is learnt”. Features of attitudinal intonation, since they can depend so much on individual personality and the discourse in which they lie, are more difficult to teach than, say, differences between voiced and unvoiced consonants. There seems to be consensus that attitudinal intonation be left outside the classroom in the hope that students will acquire it implicitly when talking with native speakers. The paradox is that such features which are of immense communicative importance are abandoned by the teacher who spends class time on items of less importance.

Since natural English rhythm appears to have a noticeable regularity (indeed, according to Woods 1979, quoted in Richards(1985), English stressed syllables occur on average every 0.6 seconds!) learning sentence stress can easily be turned into fun. Limericks are a well-known example. It can also be linked with music very easily, where the stressed syllables fall on the main beats of the bar. Carol Graham’s (1980) *Jazz Chants for Children* are a well-known example, but there are versions available for adults, too (e.g. Koike, 2004). One common notion used to market such materials is that by focusing on the regularity of the beat (enhanced by a pop music background), and repeating phrases like a mantra, students can learn natural rhythm, plus acquire chunks of language at the same time. However, children are renowned for learning such chunks quickly, but then forgetting them equally quickly. It remains unclear how rhythm practice can help adults to acquire structure and vocabulary (apart from appealing to a sense of enjoyment) and whether this is transferred into long term memory. I am not aware of any research done on this theory of language learning.

3 The Transformation of Audio

In view of the renewed importance given to phonology in classroom practice, textbooks and various publications, one might expect the CALL community to have already developed considerable expertise in this area. After all, just as with grammar and lexis, the computer seems to provide a medium very suitable for such instruction. Knowledge of rules can be strengthened through quizzes and accompanying feedback.

Furthermore CALL is by no means limited to text. Indeed there are various multi-media ways of helping students to notice features of native speaker speech, to distinguish what is salient and even to reproduce it. Audio, in fact, has never been so popular, so widespread and so easy to use. The rise of the i-Pod has been nothing less than meteoric during the last three years, and with it the shift away from the mere digital audio file towards the compressed mp3 which can be stored, edited and played almost anywhere, with the obvious exception of older CD players. Only ten years ago it was somewhat unusual to have monitor speakers on one’s desk. Since then, they have become a standard feature of desk-top packages, as have headphone sockets on notebooks. Headphones themselves have been made to adapt to the computer user

– today they usually come with a volume wheel and a microphone, and increasingly connect via USB.

As for software, the latest free Windows Media Player (v10), to cite one example, enables the user to store all audio files in a “library” as mp3s or wma files, or ‘sync’ them with an i-Pod, mobile phone or similar portable device, and even play them back at slower or faster speeds. Peer-to-peer networks plus online CD stores where you can purchase tracks from 99 cents, have given birth to a huge array of support software (e.g. the dozens available at AudioToolsDirect.com) where you can change file formats, select the file size (i.e. quality), splice or merge clips, automatically trim silent bits from the start or end, add effects and so on. For a hefty price, the full facilities of a professional recording studio are now available for installation into your notebook computer (e.g. Cubase SX), although most teachers would be best to hone their skills with simple freeware such as ‘Audacity’ and the Windows Sound Recorder (see below).

As literacy with audio software has grown and spread, personally produced or selected audio has also taken off. Yahoo Messenger, for example, now allows you to attach audio ‘emoticons’, not just text. Hard drives have become enormous and more ubiquitous; there has never been so much space available for storing audio, whether on your digital camera, on your telephone, your home DVD player, your PDA or just your computer. Audio, even when compressed, still occupies much more space than text. Typically, a professional quality mp3 file of spoken voice of 1 minute duration will take up about 1500 KB (i.e. 1 second of speech requires 25 KB of space). By contrast a video file of 1 minute is about ten times the size, around 15,000 KB.

The launch in 2004 of Macromedia Flash Communication Server MX 1.5 (see references below to Macromedia and the demonstration at Jim Duber’s CALL website) is another step forward for audio (and video) applications. Students can upload their voice messages immediately to the server and download audio replies from classmates in a few seconds. The audio clips are stored on the server ready for the teacher or the students themselves to evaluate. Such technology is available – it is now waiting for someone to examine the full pedagogical possibilities. For pronunciation teaching, it seems clear that the teacher could model a sentence and then have the students practice it individually before getting them to submit a version online. This could then be saved for later listening, or played back in front of the class for review and comment. The source of the audio clip could be kept anonymous, and thus (unless they have an instantly recognizable voice) shy or low level students could be spared the potential embarrassment of being singled out in front of their classmates. Indeed they may feel it is preferable to being asked, as it were, ‘live’, by the teacher.

4 CALL’s Neglect of Both Audio Technology and Phonology

The world of digital audio, then, is vast and expanding rapidly. Yet, even a casual glance at books, periodicals, conference proceedings from the last few years reveals that the CALL community has ignored both audio as well as applications for phonological training. Phonology hardly merits a mention in widely read CALL primers (e.g. Levy 1997, Chapelle 2001, Beatty 2003) nor in the grand online Survey of Unanswered Questions in CALL web site. In the global questionnaire carried out by and cited in Levy (1997 p236) pronunciation software is not even mentioned in the list of possible CALL software categories, although to be fair, this took place in 1991, 6 years before publication of the book, and at a time when

audio technology was still something for ‘techies’, not teachers. Beatty’s survey (2003) cites that of 145 CALL-related articles reviewed, only one had anything to do with phonology. Kluge’s (2002) review of 9 year’s of CALL conferences in Japan shows no phonologically-oriented development whatsoever. A similar picture can be found with a flick through copies of ReCall and other CALL journals. One might have expected to find somewhere in our midst a practical attempt at computer-mediated phonology training, or, if not, perhaps a theoretical account of why such an endeavor is impossible. What the reasons are for this neglect is unclear. As we have seen, it is no longer enough to say that audio production should be left to the BBCs of this world. The fact is that for relatively little money, and with very little knowledge, it is possible to produce audio in very little time. Indeed CALL practitioners should aim to be able to put audio online as easily as text.

Perhaps the same will be said of video in the next few years. In my view, though, the technical demands and price of video remain out of reach for most teachers for the time being. Even so, one advantage of audio is that it provides comparative anonymity for the teacher – after all, it is not everyone who wants his image to be accessible to all students on a campus, although few would object to their voice being so. Of course shy teachers could compromise and disguise themselves behind an avatar or semi-animated Flash character if they wanted to, but again this may be a daunting technical task for many in the profession at the moment.

For all this, the reason for neglect may be simply a matter of priority, just as it often is in the classroom: grammar and vocabulary come first, and in the remaining time, speaking and listening are practiced without much attention to phonological accuracy. This may be on the grounds that students have enough to worry about in terms of achieving accuracy in the language without adding to the load with phonology. Yet since so much CALL exists within a blended setting anyway, it is surely possible to provide help with phonology in software that students can access outside the lesson time. In other words, teachers do not need to take up classroom time with a topic they consider to be low priority. They can hand over such a task to CALL and let the students cover phonology in their own time. This would be especially useful for a teacher who is in charge of a class of mixed nationality students, all of whom have differing phonological needs.

5 Example: Two Makers of Computer-Assisted Phonology Tasks

Two of the biggest online CALL players, GlobalEnglish and DynEd (see references) do provide some phonological training, however. GlobalEnglish allows students to practice pronunciation by recording their voice and comparing the result with the native speaker’s model, but this is done only for single words or the occasional phrase, and not sentences. Clearly, it would be difficult to practice sentence stress if you are having to read the sentence at the same time. The alternative is to memorize the words and then concentrate on getting the stress right, but this seems to be an unreliable method.

In GlobalEnglish, text sentences containing the target vocabulary are provided as examples and come complete with an optional audio clip. Yet nowhere is stress mentioned, and neither are any learning tasks included. Students can simply click it if they want to. It would be interesting to know how many choose to do this since it is merely the pedagogical equivalent of handing the student a dictionary! In any case, explicit knowledge about phonology is completely absent. DynEd has a separate phonological training program called “Clear Speech Works”. It provides scored exercises for distinguishing between minimal pairs, plus video clip

explanations of how to form individual sounds. Again, however, stress is left out of the picture.

Both GlobalEnglish and DynEd recruit speech recognition technology in the service of active pronunciation skills. Thus students can speak into a microphone and the computer program decides whether or not this is near enough to the native speaker's original clip for it to 'recognize' and therefore be 'correct'. Such technology remains no more than a gimmick, however, since (in an unofficial test at my university) English native speakers found that the program often failed to recognize their English. Effectively, this flawed use of an imperfect technology forces learners of English to feel insecure about their pronunciation even when it may be perfectly comprehensible to native speakers or students of other nationalities.

We have seen, then, that the CALL community as a whole has ignored both audio applications and the task of raising awareness of phonological knowledge, and in particular, sentence stress. Furthermore, the few programs available (in two high profile web-sites) have put the emphasis on learning phonology for production not recognition, and the technology associated with this is both frustrating to use and likely to prove harmful. If one compares the low-tech phonological instruction available in a popular course such as the best-selling Headway series (OUP), or in a dedicated textbook such as Hancock (2003), it is even easier to see how CALL has failed.

6 Focusing on Phonology in order to Improve the Listening Skill

To be fair, human teachers may not have done much better than CALL, and have tended to demand production as soon as possible. This is in spite of the fact that one of the few golden rules that exists in language teaching, and one that has reverberated throughout ELT pedagogy for decades, is that reception should precede production, on the grounds that it is unreasonable to expect students to produce something which they cannot actually hear. Yet, the students, themselves, are impatient to try new phonology out, and teachers like to be able to hear if their instruction is 'working'. In reality, it may be that half of the class cannot recognize what they are being asked to produce. Taking a short cut to accurate production of a target item remains, nonetheless, a popular classroom practice, even if dubious from a pedagogical point of view.

It seems to me that the value of focusing on phonology for reception, rather than production, has been ignored or underestimated. Raising awareness of phonology in order to help with decoding incoming messages, as opposed to improving speaking skills, is seldom mentioned. Successful listening, in L1 as in L2, depends upon determining meaning using both top-down and bottom-up processing, in other words from attention to both the message (knowledge of the world) and the medium (knowledge of language). Skehan (1998) points out that attention resources are limited for online processing of input and that bottlenecks can occur. In my view, students who are accustomed to English rhythm, who are aware of how connected speech works, and who understand how stress can provide clues for meaning, have more resources available for decoding from language and schemata than students who are still struggling to distinguish which words have been said, let alone what they mean. Students who are tuned into stress (subconsciously) realize that the stressed syllables "provide listeners with vital clues as to the salient points of the speaker's message" (Kelly, 2000). I decided therefore to attempt to help my own students to achieve 'coolness under fire' when confronted with

natural speed speech, by getting them used to English rhythm, and this in the belief it will have a positive psycholinguistic effect on the listening skill.

7 Focus on Sentence Stress

Awareness of sentence stress is of course closely related with other phonological features of English and they all need to be taught comprehensively, as part of a system. However, Dalton and Seidlhofer (1994) argue that “work on stress is the most convenient focal point for any course in pronunciation” on the grounds that it is of relatively high communicative importance (in comparison with individual sounds) and yet more teachable than attitudinal functions of intonation. Furthermore since the concept of stress takes in word stress on one side and prominence on the sentence side, this seemed to me the optimum place to start with training software. As Kelly (2000) points out, “Using language which is rhythmic and clearly patterned can... be very useful ... for making students aware of the importance of stress (and intonation) in English, and also for highlighting weak forms and other features of connected speech”.

One thing that needs to be stated at the outset is that the idea that English is a stress-timed language and that, say, Japanese, is syllable-timed, may give the mistaken impression that neither the total number of syllables in an English utterance, nor the number of stressed syllables in a Japanese utterance, have any bearing on the length. In fact, it is better to conceive of a continuum between stress-timing and syllable-timing, between a regular stress pattern and no stress pattern in other words, and allow for a degree of overlap, depending on the speed of speech, the context, the relationship between the speakers, and incidental factors in unplanned speech. It is true, however, that regular patterns of stress do not occur in French as they do in English, and that English does have a tendency, more than most languages, to reduce the length of a vowel in an unstressed syllable. Stress-timing may be apparent in an exaggerated way in English poetry (limericks being a popular example), but elsewhere in everyday speech, the regularity is generally less noticeable. Thus we need to find a balance between not infecting students with the notion that English conversation needs to be as catchy as the rhythm in “There was an old man from Brazil”, yet showing them that for so many commonly-used questions and responses (e.g. What did you do yesterday?) there is a discernible rhythm which native speakers of English do produce.

8 Development of Simple Online Stress-Time Training Software

My software, then, aims to raise awareness in recognizing stress-timing in everyday English. It is described above as “simple”, and this refers to the fact that it is made with Hot Potatoes with which many teachers are already familiar, and one which aims to raise awareness of it through recognition. All of my courses have an online (LAN) component in any case, plus all my students possess a notebook computer (most carry headphones, too.) They can either access the audio files on campus or via VPN (virtual personal network), or save them to hard disk and take them home for later use.

For future listening skill courses, I am planning to add new parts which focus on aspects of connected speech (elision, assimilation and so on), and I will obviously look to see what can be done using more complex software such as Authorware and Flash. Because of the problems found with speech recognition technology mentioned above, I do not anticipate

moving into software for production for the time being unless I can work something out using the Macromedia Flash Com server 1.5 mentioned above.

9 Task Types

First I made a number of simple audio files as demonstrations of stress timing. Some of these I recorded 'live' in class on MD, then edited, trimmed and uploaded. Some of these feature myself providing a model sentence, others show the students copying these. Students can thus get an aural record of (some of) their class at the very least. This is of course usually backed up with text where the stresses are marked. This led to one Hot Potatoes quiz in which I gave the students 5 sentences with stress marked in a text. Some of these were completely right, some completely wrong, and some only partially correct. They had to listen carefully and determine which, correcting where errors appeared.

I was careful to provide some clips with audible clicks (as a hint) and others without, and sometimes restored a click for the answer. I attempted to give a variety of task types. (Please see the accompanying web-site, quoted above, to view these files.) I tried to surprise students by including some sentences in which all syllables are stressed ("Large cars waste gas"). I also tried to surprise them by including sentences which contain similar elements, but with differing total syllables yet which have the same number of stressed syllables (e.g. here, quoted in Kelly (2000), "They live in a nice old house" and "They've been living in a delightful old cottage".) Some questions were designed simply to ask how many syllables were stressed (e.g. 3 in the question: "Could you let me know if you can come to the meeting?"). Others were matching exercises, where sentences with the same stress pattern were grouped together (e.g. "What did you do yesterday?" with "Traveled to London with Bill!" under the column "OooOooO" and so on). Other quizzes featured sentences with each syllable numbered, and the students had to write in those which received stress.

10 Equipment and Software Used

I am lucky to have rather a luxurious set of equipment for audio production, far more than I really need. I have therefore tried to suggest below simpler options for those interested in starting with audio.

Hardware used:

- Normal desktop computer with a dozen or so giga free space for data storage
- Good quality sound card (e.g. Delta 66 from M-Audio)
- Good quality microphone (e.g. Shure PG48 is designed specifically for spoken voice recordings)
- Mini MD recorder (e.g. Sony et al) with an open microphone, plus blank MD cassette, for recording content in class. MD automatically assigns a new track number for each recording – very useful at editing stage!
- Optionally: an interface between computer and sound source such as M-Audio OMNI Studio (available in Japan), which enables you to use two microphones (if you have a kind colleague to help you record dialogues), and quickly alter monitor levels, plus add other sounds (e.g. from a MIDI keyboard) etc. At this stage a small mixing desk might even come in handy.

- Of course, students need some kind of headphones if they are using their notebook computer in a public place.

Software used:

- Windows XP
- Windows Media Player (versions 9 and 10 have speed functions enabling students to slow down the recordings of your speech)
- Some audio recording and editing software. I use Cubase VSX (which is very pricey but can do everything that a pro recording studio can), but you can equally use freeware such as Audacity and the Windows Sound Recorder
- A handy FTP or SCP program (e.g. Cute FTP, WinSCP) for rapid drag-and-drop uploading onto your LAN
- Hot Potatoes v6 (for quizzes and exercises)

11 How useful is this software? How effective is it?

This simple software aims to raise awareness of and improve recognition of sentence stress in English. Although it does not explicitly show how weak forms are produced, it is obviously hoped that, through repeated exposure, students will take notice of this as well.

My ultimate aim is to help students improve their listening skills by removing the mystery of English rhythm and increasing their confidence with natural speed speech. Unfortunately it may not be possible to measure my success or failure in this simply because I normally supervise one group of students for only 19.5 hours per semester. It would be worth waiting until I have added further phonological elements to my software before I can consider giving it a proper beta test.

As for Chapelle's (2001) six criteria for evaluating CALL tasks ("language learning potential, learner fit, meaning focus, authenticity, impact and practicality"), it is difficult to see how they all apply to what I have made. My software aims to raise awareness of one feature of phonology, not supply target forms for acquisition. I am confident that the level is suitable for my students, however, and that they have a positive experience with the tasks set. However I am unsure of the extent of how their awareness can have an impact on their listening skill in any given situation. As for reliability, my main pedagogical anxiety is that students can get enough correct answers by guessing, or by seeing patterns in the text supplied rather than through the audio clue. For all this it is some satisfaction to be moving into an area that CALL has all but neglected.

12 Conclusion

In this paper, I set out to describe the creation of an online tool that aims to raise awareness of the rhythm of spoken English. The software may at first sight seem rather underwhelming, but I deliberately set out to provide a prototype that other teachers could easily replicate and build on, using examples from their own classes and tailored to their students' needs.

What I hope that this paper has, in the process, highlighted is that phonology has to date been ignored by the CALL community, probably even outstripping the neglect from the language teaching profession generally. In view of the natural affinity between phonology teaching and multi-media, and the central role that the mp3 file, in particular, plays in many of our students' lives, this is a situation that CALL developers and practitioners need to put right as soon as possible. Excellent materials already exist in print and on cassette. Software developers could do worse than familiarize themselves with these – in fact, I believe the pedagogical risks taken by those peddling (way too early!) voice-recognition technology show that some have already done worse!

It does look perfectly possible to develop online phonology-training materials that music-loving adults - not just children - might enjoy using, and that could help with easing the burden of decoding meaning. As I hope to have shown, the very rhythm of English provides potential lessons in sentence stress and elements of connected speech. Beyond this, it might even go as far as offering a way of helping students acquire structure 'by stealth' as some books (Koike, 2004) already claim to do. This is not to hint at a return to audio-lingualism, but rather to point out that since phonology is perennially popular with students, and since it is regarded as a less threatening topic than grammar, it could offer a good opportunity to provide 'catchy' examples that students might otherwise find tough to remember or even understand.

Clearly, there is plenty in this field to keep the researcher busy. How can computer technology be optimized for teaching phonology? To what extent can this aid the listening skill or the speaking skill? How can we measure its success? How can rhythm and music be used in language education to greatest effect? In this connection, I am reminded of a classmate at high school who had a terrible stammer and could barely communicate, but was able to sing fluidly and without hesitation. I confess I do not know why. But could there be somewhere a case for teaching our students to sing, rather than speak?

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- <http://audacity.sourceforge.net/> Audacity freeware tool for recording and editing audio files
- <http://www.audiotoolsdirect.com/index.shtml> for full range of audio shareware, freeware, various tools
- <http://www.dyned.com> online tutorial program using Speech Recognition technology
- <http://www.globalenglish.com> online tutorial program using Automatic Speech Recognition (ASR) technology Macromedia, Inc Flash Communication Server MX 1.5
- <http://www.macromedia.com/software/flashcom/>
- <http://www.stanford.edu/~efs/callsurvey/index.html> for a "survey of unanswered questions in CALL".
- http://messenger.yahoo.com/feat_voice.php;_ylt=AlqCOXQmcxPAuQi7WTauKFVnMMIF for Yahoo Messenger Voice Chat