PHONETICS AND PHONOLOGY

An Extended Syllabus Prepared for the New Liberal Arts

by

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Swarthmore College
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OF THE
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Phonetics and Phonology
Linguistics 45 - Swarthmore College

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October, 1990

Our phonetics and phonology course divides the semester equally between the study of the isolated sound segments that occur in natural language (phonetics) and the study of groups of sounds and their interactions when used in natural language (phonology). We do not concern ourselves with sounds that are produced by anything other than a human, although interesting lab assignments could easily involve a comparison of human sounds with a specific type of nonhuman sound. And, among human sounds, we look only at those that are involved in speech production, although, again, lab assignments might well involve a comparison of oral human sounds that are not part of speech production (groans, hiccoughs, etc.) to speech sounds.

Our goals are to describe the speech sounds that occur in the languages of the world, to see the patterns they fall into, to see how they change in varying contexts, to discover the rules that effect these changes, and to discover the principles that govern these rules.

We begin with phonetics because the information and concepts developed in this section are the foundation for the study of phonology in the following section. Within phonetics we start with articulatory phonetics, the study of the physiology of the vocal tract in the production of specific sounds. We then move on to acoustic phonetics, the study of the physical properties of sound and instrumental measurement of those properties.

There are several reasons why one would want to do both articulatory and acoustic phonetics. Articulatory phonetics is immediately accessible to the students. They have teeth, tongues, lips, noses. They can put their hands on their throats and feel the vibrations of their vocal cords. They can feel the air inhaled and exhaled. All of these things mean that from the very first lesson in articulatory phonetics, the students can contribute to class discussions with accurate observations. They can be actively involved from day one. This kind of participation and rapid comprehension enhances a student's confidence, thus encouraging the student to go on with the study of language sounds and making the classroom a more likely place for true discoveries. And, certainly, this kind of participation makes the classroom a more exciting experience for everyone. Also, when the student examines sounds from other languages that do not exist in their native language, they can be taught to

produce them with articulatory descriptions of the sounds. This would be impossible with acoustic descriptions; a student told to create a soundwave with a specific form, a certain fundamental frequency, and a fixed intensity will look at you as though you are crazy. But a student told to make a voiced, bilabial implosive will think for a moment and then produce the desired sound. With a background in articulatory phonetics, a student can approach phonology and mentally hear the sounds that are being discussed in whatever article they are reading. This perception helps them to recognize regularities in the sound patterns so that the discussion of phonological theory makes sense to them in a more concrete way. Certainly no student of linguistics can go very far in studying any aspect of language for which an understanding of speech sounds is required (including phonology, morphology, sociolinguistics, historical and comparative linguistics, and others) without a thorough knowledge of articulatory phonetics.

But there are serious advantages in studying acoustic phonetics, as well, not just for the future acoustician, but for the introductory student of linguistics. For one, by looking at the acoustic features of sounds, we can often explain why one sound is confused for another. Second, certain sounds are difficult to describe in articulatory terms (particularly the nontense vowels), but are easily distinguished by their acoustic features. Third, if we want permanent data to study on speech sounds, we typically get recordings, not photographs or x-rays of the vocal tract. So we need to be able to analyze these recorded data -- and acoustic phonetics is our tool in these instances. Fourth, once we get into the study of phonology, we find that sound segments vary according to context. Acoustic analysis can show us exactly which features of a given sound are affected by a given context in which ways, often showing us effects that might have been difficult to detect and describe if we limited ourselves to articulatory analysis only. Fifth, debates often arise in the classroom as to what exactly we have heard. For example, in the word kitten, some people may claim they hear a vowel in the second syllable, rather than a syllabic nasal. Even in the face of phonological evidence to the contrary (such as the fact that the [t] here does not become a flap, which it would have done had it been followed by a vowel; compare to kitty), students may persist in saying there is a vowel here. With acoustic analysis, we can give those students instrumental evidence of a visual nature to convince them. This evidence satisfies in ways that phonological evidence never can, since the phonological evidence depends on the students believing that our theory of phonology is correct. Anyone who has used a phonetics lab as a teaching tool could add to this list most probably, but the above reasons are representative of the types of advantages a study of acoustic phonetics gives to the undergraduate. While many undergraduate programs do not have a phonetics laboratory, we have found that the addition of a lab has given us the above advantages plus pulled together researchers on sound from all

over our campus (particularly from our Engineering Department, but also from Music and from Modern Languages and Literatures). The financial investment can be relatively small given the curricular and research advantages.

After we finish acoustic phonetics, we move on to phonology. We have tried a variety of approaches here, as the syllabi for individual courses below show. Our best success at this point is with initiating a discussion of generative linear phonology and, once the students have a reasonable facility with it, introducing its shortcomings and going on to geometric phonology. We rarely touch on metrical phonology in this course beyond a brief discussion of stress patterns.

While our course varies considerably each time we offer it (and so far each time the course has been offered, we've had a different instructor), there are certain things that remain constant. One is that the students have frequent problem sets, usually on a weekly basis. During the section on acoustics, they have periodic lab assignments. We vary as to whether we give a final exam, a term project, both, or neither (the decision is left to the instructor).

The following gives an outline of the four major sections of the course: articulatory phonetics, acoustic phonetics, linear phonology, and geometric phonology. These are generic listings in that no given course may actually cover all this material in exactly the order it is presented here. Yet most courses will present this material at some point during the semester. Syllabi of actual courses we have offered are included at the end.

I. Articulatory Phonetics

We begin with the consonants of English, discussing:

vocal organs
places of articulation
manners of articulation
distinctive features

and comparing them to close consonants in other languages. Then we go to English vowels, discussing

front, back, central
height
tenseness
lip rounding
distinctive features

and comparing them to vowels in other languages, particularly with respect to the matches between frontness and rounding, etc. We do transcription exercises for English. At this point we are

ready to begin serious investigation of other languages. We discuss more fully

glottals
laryngeals
pharyngeals
implosive, explosive

TAPES:

We work with five tape recordings. One is that of Daniel Jones demonstrating his cardinal vowels (see his book An Outline of English Phonetics, London: Heffer, 1957). This tape reinforces the concept of "vowel space", since it indicates the extremes of frontness, backness, height, and lowness for vowels. In addition, it exemplifies markedness in language universals with the feature [round]. The primary cardinal vowels (the unmarked set) feature unrounded front and low vowels and rounded back non-low vowels. While there are languages that have vowels similar to the primary cardinal vowels and no vowels similar to the secondary cardinal vowels (e.g. English), there are no languages with secondary cardinal vowels and no primary ones (in terms of rounding). Furthermore, this tape is of historical value and the students enjoy hearing it, particularly since we use the Ladefoged book in our course and this book refers to Jones' vowel system. I do not know how one goes about getting a copy of this tape today.

The second is the series of three tapes with accompanying manual by the same name:

Catford, John C. 1979 "General Phonetics Practices"

Ian Catford is Professor Emeritus of Linguistics at the Univ. of Michigan in Ann Arbor, Mi., and writing to him directly is the only way I know of to obtain the manual and tapes, for which he holds the copyright. The tapes are brief (less than twenty minutes a side, 5 sides) and extremely skillful in getting the student to make exotic consonants and vowels correctly. We often use this tape series right in the classroom during class time.

The third is a series of thirty-three tapes that accompany the manual:

Smalley, William A. Manual of Articulatory Phonetics

The tapes are available by writing to:

Sound Recording Service
977 Creekdale Rd.
Clarkston, GA 30021
tel. (404) 294-0405.

The manual is presently out of print (as of fall, 1990), but it is scheduled to be reprinted by University Press. The tapes are useless without the manual. However, with the manual, they are the best source we know of for training the vocal tract to produce sounds and for training the ear to recognize sounds. The manual contains multiple transciption exercises, as well. Smalley's tapes are much too long and difficult to cover fully in an introductory course, and we do not even try to squeeze them into our approximately 3 to 4 weeks on articulatory phonetics. Instead, we select certain materials to cover and we spread those materials out over the entire semester. That means that students will still have assignments in the Smalley tapes even when we have moved on to the study of phonology. We find this manual and tapes to be an invaluable teaching aid.

We recommend skipping the simpler early lessons (1-5, 7, 9), discussing all these issues in class, and then going directly to the first review lesson (after lesson 9). At that point you can backtrack if you find the students need extra work on any area. The one exception is the material on pitch (lessons 6 & 8), which should be done with care.

All of lessons 10 through 33 are valuable, but many of them get too advanced toward the end of each lesson to be anything but frustrating in an elementary course. Doing the initial exercises of each lesson is, however, useful.

The fourth is a set of tapes that go along with a manual called "The Principles of the International Phonetic Association". These tapes exemplify various speech sounds by offering passages of texts read by native speakers of the language or dialect in question.

The fifth is not tapes per se. We have software for the MacIIx which is called "Sounds of the World's Languages". A number of less common speech sounds are examined (such as Polish consonant clusters and !Xoo clicks), where the program gives transcriptions of the sounds and recordings that allow the student to hear the sounds in context repeatedly, as well as compare the sounds with others in the language. The program also provides information on linguistic affiliation for many of the languages included. This software can be purchased from the Phonetics Lab at UCLA.

READINGS:

All the readings in Smalley are valuable. We also use:

Ladefoged, Peter 1982 A Course in Phonetics (second edition), Harcourt Brace Jovanovich, Publishers, New York.

We cover the first seven chapters in three weeks. A good book to use for reference, but which we have not had outstanding success with as a classroom text, is:

Brosnahan, L. F. and Bertil Malmberg 1970 Introduction to Phonetics, W. Heffer & Sons Ltd, Cambridge.

II. Acoustic Phonetics

In this section we give more elaborate explanation than in the other sections because while all people who teach undergraduate courses in phonetics and phonology will be familiar with articulatory phonetics, linear phonology, and geometric phonology, not all of them will necessarily be familiar with acoustic phonetics.

We study primarily the three areas of (1) pitch, (2) loudness, and (3) quality.

The pitch of a sound depends on the rate of vibration of the vocal cords. Higher frequency of vibration leads to higher pitch. Each opening and closing of the vocal cords results in a peak of air pressure in the sound wave, so by measuring the rate of occurrence of the peaks in the waveform, we can estimate the pitch of a given sound. The peaks in the waveform indicate complete cycles of variations in air pressure for that sound. We call the number of cycles occurring in a second the frequency of that sound. The unit of frequency measurement is the Hertz (Hz) (where a sound that has 100 cycles in a second would be said to have the frequency of 100 Hz). As a sound goes up in frequency, it goes up in pitch.

We can study the pitch of a sound by looking at its waveform in the lab. Both our MacSpeechLab and our Zenith programs (which came from the University of Massachusetts at Amherst's phonetics lab) will print waveforms for speech that is prerecorded and for speech that we feed into a microphone right there in the lab. But counting the number of peaks in a second of speech (or in .1 seconds and then multiplying by 10) is a time consuming way to study pitch. Furthermore, it is graphically less than immediate for the student. Instead, we use pitch tracking (which is on MacSpeechLab and for which a Swarthmore engineering student, Aaron Smith, wrote us a program for the Zenith that uses Microsoft Windows), whereby the frequency of sounds is automatically recorded and marked on the screen in a matrix whose vertical axis is the number of Hz and whose horizontal axis is time. The result is an intonation contour for the utterance being analyzed. Voiced sounds (those that cause the vocal cords to vibrate) have regular waveforms that give rise to a precise sensation of pitch. If a voiced sound is articulated in a continuous fashion (such as [v], but not [g]), you can hum a tune with it. Voiceless sounds, on the other hand, have waveforms

that are caused by the airstream being interrupted as it passes through the narrow channels of the mouth or is forced over the irregular surfaces in the mouth. The waveforms that result are very rapid (so of high frequency). The contrast is remarkable: for voiced sounds a male voice may produce frequencies of between 80 to 200 Hz; a female voice may go up to 400 Hz. But for both men and women voiceless sounds have frequencies typically above 2000 Hz. Pitch differences at this level are not distinguishable by the naked ear, so humming a voiceless continuous sound (such as [s]) results in no sensation of tune.

Loudness generally is related to the size of the variations in air pressure that a sound produces, called the acoustic intensity. The intensity is proportional to the average amplitude of the variations in air pressure. It is measured in decibels (dB) relative to the amplitude of some other sounds. When one sound has an intensity 5 dB greater than another, it is twice as loud. A change in intensity of 1 dB is about the smallest volume change that the human ear can reliably notice. From the wave form one can see the intensity of a sound. In general, vowels have the greatest intensity (which contributes to the common perception that the vowels carry the beat of the syllable), nasals and laterals have slightly less intensity, various forms of /r/ have less, and the fricatives have still less. Voiceless sounds have minimal intensity. In order to study the intensity of voiceless sounds, it is useful to compare them without having your graphic representation include the intensity of the voiced sounds. One way to do this is to filter out the low frequency sounds (which voiced sounds are -- recall that voiceless sounds generally have frequencies over 2000 Hz) with a high-pass filter. The graphic representation, then, will not include all the voiced sounds, but the voiceless sounds will come through without reduction. By doing this the student can see that voiceless fricatives are of decidedly greater intensity than voicelss stops, for example. We have band-pass filters in our laboratory (on both our Mac and our Zenith) that block frequencies that are both lower than speech sounds (such as the 60 Hz hum of the electric lights) and higher than speech sounds. If we want to look only at high frequency speech sounds, we have a short-time energy calculator on the MacSpeechLab. Therefore we can represent both relative intensity of all sounds and relative intensity of high frequency sounds alone. Just as frequency (and, therefore, pitch) varies according to the speaker, intensity varies according to the speaker and according to stress patterns, where both word stress (lexical stress) and stress that is assigned relative to the position of a word in a sentence are relevant. Measurements of intensity, then, can help the student in understanding stress patterns.

In feeding information into the speech analysis system, our students are told to be wary of differences in the waveforms which follow because of variations in the rate of utterance. Typically utterances elongate toward the end. Thus if the

students are studying a list of words, they usually put each word in a fixed frame (the frame Ladefoged recommends is "Say _____ now"). Alternatively, if they read in a list of items, they add extra items at the end which will be thrown out.

The quality of sounds is what allows us to distinguish one sound from a different sound (as opposed to one token of a sound from a higher pitched or louder token of the same sound). When it comes to vowels, it is the overtones that allow us to distinguish between them. That is, each vowel sound contains a number of different pitches simultaneously. A vowel has its own characteristic auditory quality, which is the result of the specific variations in air pressure due to its vocal tract shape being superimposed on the fundamental frequency produced by the vocal cords. The pitch at which a given vowel is spoken (the fundamental frequency) can be changed at will without changing its quality (which is dependent upon the specific shape of the vocal tract in making that vowel sound). In order to perceive the overtones that give the vowel its quality a number of demonstrations can be done right in the classroom. For example, if the students whisper a series of vowels, the vocal cords will not be vibrating and ordinary pitch of the voice is absent. But the students will easily discern an overtone that distinguishes the vowels. Another experiment is to have the students say a series of vowels in a low creaky voice. A separate overtone will now be discernible. The overtones that characterize vowels are called the formants of the vowels. The two demonstrated by the classroom experiments described above are readily visible on a spectrogram. Other formants exist, but there are no simple ways of demonstrating their pitch in the classroom. One of these others also appears clearly in spectrograms.

Spectrograms are visual representations of the component frequencies of sounds (and both MacSpeechLab and our Zenith allow us to do spectrograms, where, once again, our student Aaron Smith wrote the program for spectrographic analysis on the Zenith). The relative intensity of each component frequency is shown by the darkness of the mark. For this reason, the formants of vowels show up as dark horizontal bars. We call the lowest formant on the spectrogram the first formant, the next one up the second formant, and so on. The student will easily discover that the first formant varies inversely with respect to vowel height and the second decreases as we go from front vowels to back vowels. The degree of lip rounding also affects the frequencies of the formants, with more rounded sounds causing the higher formants to decrease in frequency.

The acoustic structure of consonants is more complex than that of vowels. The spectrograms of all stop sounds are identical at the moment of closure, since these moments are silent. To compare the acoustics of varying stops, the student can pronounce each of them in a syllable, CV, with a fixed vowel. The acoustic structure of the stops, then, can be seen as the way

they affect the onset of the vowel sound. For example, the student can compare the effects of lip release and gradual opening of the oral cavity on [a] when [b] precedes it to the effects of tongue release and gradual opening of the oral cavity on [a] when [d] precedes it. The same experiment can be done for syllables with a fixed vowel of the form VC. One might then conclude that the acoustic structure of the stops is the way they affect the coda of a vowel sound. The actuality is probably a combination: stop sounds convey their quality by their effect on the adjacent vowel (whether the vowel precedes or follows).

Nasals have a formant structure similar to that of vowels, but their formants are slightly fainter (since the intensity of nasals is slightly lower than the intensity of vowels) and their frequencies depend on the characteristic resonances of the nasal cavities. Laterals again have their own formants, but even fainter. Fricatives do not have formants, but, instead, show random noise at high frequencies, similar to the marks that show up for aspiration.

Besides the ability to study the three areas of pitch, loudness, and quality, we have the ability to do speech synthesis (on the Delta System, available from Cornell University). Our spring, 1990, course (described below) used the speech synthesizer in some lab exercises. We also have a program for doing metrical analysis (on the Zenith). So far we have not used this program for classes, but we have a phonology seminar that will probably be offered in 1992-93 that will concentrate on metrical analysis and we plan to bring the class into the lab at that time. We have found that having the Microsoft C 5.1 compiler and the Window Software Development Kit is very useful in that we can make programs for speech analysis that suit our particular needs. For example, the original pitchtracking and spectrogram programs we had for the Zenith were quite difficult for our students to use. So Aaron Smith wrote programs that were easily accessible to them.

III. Linear Phonology

We give a straightforward picture of generative linear phonology, following pretty much the outline in:

> Kenstowicz, Michael and Charles Kisseberth 1979. Generative phonology, New York: Academic Press.

We do not always assign this book to the students in our courses, but when it is not assigned as a text, the book is still used by the professor as a resource. Once the students are familiar and comfortable with notation, we concentrate on the concepts, with a heavily problem-solving orientation. The problems in the book above are very useful for this purpose. Two other good sources of problems are:

Halle, Morris and George N. Clements 1983 Problem Book in Phonology, Cambridge, MA: MIT Press.

Cowan, William and Rakusan Jaromira 1985 Source Book for Linguistics. Philadelphia: John Benjamins.

IV. Geometric Phonology

We know of no good text for geometric phonology right now (fall, 1990), although one by John Goldsmith is slated to come out with Blackwell. In the meantime, we either introduce the theory on our own and then often go back to some of the problems we did in linear phonology and re-do them with a geometric framework, or we make a reading packet of articles for the students. A good list of readings in this area is given in the syllabus for the spring, 1988, course that we gave. We have found the readings by Clements to be the most readily accessible to our students.

Syllabi for specific courses:

(1) Note: In the spring of 1988 we gave our first course on phonetics and phonology, but we did not have a phonetics laboratory at that time. We have included the syllabus from that course so that you can see the change in the orientation of the course that the addition of the laboratory made. (The language lab referred to below is run by our Dept. of Modern Languages and Literatures, and is the place where the students go to listen to tapes from their various language courses. We housed the Smalley tapes in that laboratory, and still today we keep a copy of the tapes there so that students can listen either in the language lab or in the phonetics lab.)

There are four required texts for this course:

> Generative Phonology by Michael Kenstowicz and Charles Kisseberth (abbreviated as "K&K")
> Problem Book in Phonology by Morris Halle and Nick Clements (abbreviated as "H&C")
> Manual of Articulatory Phonetics by William Smalley (described in section I on articulatory phonetics above)
> Autosegmental Phonology by John Goldsmith, available through the Indiana University Linguistics Club.

There is also a handout of required readings with Catford's phonetics manual as part of the handout.

There are regular assignments in the language lab, where you will listen to cassettes that accompany the Smalley manual. Make sure you bring your manual with you when you go to the language lab to listen. And you may well want to bring a notebook so you can take notes if you like.

There are also regular exercizes in the language lab, both in class and outside of class.

Each week we have two class meetings. During the Tuesday meeting we will discuss the readings assigned for that class and we will listen to some phonetics tapes by Ian Catford and do some phonetics exercizes in the language lab. During the Thursday class we will do problems in phonology together and continue our general discussions of the readings.

Every Thursday you will be assigned some problems which are due the following Tuesday in class. Twice during the semester, however, you will be assigned problems on a Tuesday which are due the Thursday of the same week.

On Tuesday you will typically be assigned language lab work. On Thursday you will typically be assigned readings.

You are encouraged to talk with each other as you do the

problem sets. But each person must write up the problem sets individually.

You will have one grade each week (from your problem set) for a total of 12 grades. Those will make up the entire set of grades for the course. There are no papers and no exams (believe me, the problem sets will be enough work). All problem sets are required, and all will count toward your final grade. If you hand in a problem set late, it cannot get a grade -- it will receive a zero. So get them in on time. All problem sets must be handed in by the end of the semester or you will receive an incomplete for the course.

Schedule of readings, problems, and language lab work:

Jan. 19: for next class read K&K ch 1. Listen to Smalley 1,2,12
Jan. 21: for next class read K&K ch 2.
for next class do PROBLEMS IN H&C p. 37, 39, 41

Jan. 26: for next class listen to Smalley 3,9,28
Jan. 28: for next class read K&K ch 3.
for next class do PROBLEMS IN K&K p. 72-73 on Lamba & Polish

Feb. 2: for next class listen to Smalley 13,14,16
Feb. 4: for next class read K&K ch 7.
for next class do PROBLEMS in H&C p. 73, 77, 79

Feb. 9: for next class listen to Smalley 4,6,8
Feb. 11: for next class read Goldsmith.
for next class do PROBLEMS in H&C p. 45, 47

Feb. 16: for next class listen to Smalley 10, 32
Feb. 18: for next class read van der Hulst and Smith.
for next class do PROBLEMS in H&C p. 49, 51

Feb. 23: for next class listen to Smalley 5,7,15
Feb. 25: for next class read McCarthy
for next class do PROBLEMS in H&C p. 53, 59

March 1: for next class do PROBLEMS in H&C p. 87, 55
March 3: for next class read Garcia
for next class do intonation PROBLEMS in handout

Vacation week

March 15: for next class listen to Smalley 19,20,25
March 17: for next class read K&K ch 4
for next class do PROBLEMS in H&C p. 85, 95

March 22: for next class listen to Smalley 18,22,26
March 24: for next class read Archangeli & Steriade
for next class do PROBLEM in H&C p. 103, 97

April 5: for next class listen to Smalley 23,27,29
April 7: for next class read K&K ch 5
for next class do PROBLEM in K&K p. 175 on Hindi

April 12: for next class listen to Smalley 11,21,24
April 14: for next class read K&K ch 6
for next class do PROBLEM in H&C p. 121

April 19: for next class listen to Smalley 17,30,31
April 21: for next class read K&K ch 8 and Clements
for next class do PROBLEM in H&C p. 125

April 26: for next class listen to Smalley 33; read K&K ch 9
April 28: the end

List of reading in the course pack:

Catford, John C. 1979 General Phonetic Exercises
van der Hulst, Harry and NorvalSmith 1982 "The framework of nonlinear generative phonology". 3-55.
McCarthy, John 1981 "A prosodic theory of nonconcatenative morphology", Linguistic Inquiry 12. 373-418.
Garcia, Cheryl Ramsey 1986 "Sex and the question: terminal contours of responses by women and men". BLS 12. 124-134.
Archangeli, Diana 1985 "Yokuts harmony: evidence for coplanar representation in nonlinear phonology", Linguistic Inquiry 16. 335-372.
Steriade, Donca 1986 "Yokuts and the vowel plane" Linguistic Inquiry 17. 129-146.
Clements, George N. 1985 "The geometry of phonological features", Phonology Yearbook. 225-252.

(2) In spring, 1990, we gave our first phonetics and phonology course that made use of our brand new phonetics laboratory. The following materials are from that course.

Texts:

Ladefoged, Peter. 1982. A course in phonetics, New York: Harcourt Brace Jovanovich (abbreviated as "L")
Kenstowicz, Michael and Charles Kisseberth. 1979. Generative phonology: description and theory, New York: Academic Press (abbreviated as "K&K")

Requirements:

In class midterm and final exam. Homework problems. Short phonetics project to be presented in class with handout.

Homework Problems:

These can be time consuming, so set time aside for them. You may work together on them and may even combine efforts on writing them up. They will be graded on clarity of exposition and argumentation. A simple listing of rules will not suffice. Problems must be handed in by the beginning of the next class. Late problems will receive a 0. You will be allowed to rewrite problems once and the final grade for the problem will be the average of your original grade and the rewrite. No rewrites will be accepted after May 1. You may elect not to hand in one homework problem or to drop the lowest problem grade from your record.

[NOTE: The discussion of rewriting homework problems may surprise people from other colleges. At Swarthmore we have a set of courses that are called Primary Distribution Courses. These courses have specific goals, one of which is to teach the students to write better. Our phonetics and phonology course was approved as a PDC in spring, 1990. For that reason, the students were encouraged to rewrite their problem sets after discussing them thoroughly with the professor.]

Grading:

transcription quiz	5%
midterm	15%
final	15%
Homeworks	40%
phonetics project	15%
class participation	10%

The course met twice a week with the reading assignments below.

Week 1		
Tuesday 1/23	Articulatory phonetics	L1
Thursday 1/25	Phonology and phonetic transcription	L2
Week 2		
Tuesday 1/30	No class. Smalley exercises.	
Thursday 2/1	Transcription exam: The Consonants of English	L3
Week 3		
Tuesday 2/6	English vowels and phonological rules	L4
Thursday 2/8	English words and sentences	L5
Week 4		
Tuesday 2/13	Airstream mechanisms and	L6

	phonation types	
Thursday 2/15	Place and manner of articulation	L7
Week 5		
Tuesday 2/20	Acoustic phonetics	L8
Thursday 2/22	Acoustic phonetics	
Week 6		
Tuesday 2/27	Vowels and vowel-like articulations	L9
Thursday 3/1	Syllables and suprasegmental features	L10
Week 7		
Tuesday 3/6	Midterm in class	
Thursday 3/8	The representation of sounds	K&K 1,7

VACATION: spring break

Week 8		
Tuesday 3/20	Phonological rules Student presentations 1,2	K&K 2
Thursday 3/22	Notation Student presentations 3,4	K&K 9
Week 9		
Tuesday 3/27	Phonological problem solving, alternations Homework: p. 72 #3 Polish Student presentations 5,6	K&K 3
Thursday 3/29	Chamorro: vowel fronting and reduction; Tonkawa rule ordering Homework: p. 74 #6 Serbo-Croatian Student presentations 7,8	K&K 3
Week 10		
Tuesday 4/3	Phonological sketches Yawelmani Yokuts Homework: p. 72 #1 Lamba Student presentations 9,10	K&K 4
Thursday 4/5	Slovak vowel lengthening and diphthongization Homework: p. 72 #2 Tagalog Student presentations 11,12	K&K 4
Week 11		
Tuesday 4/10	Lardil and Lardil Damin (cluster simplification, deletion, language games) Homework: p. 73 #4 Karok Student presentations 13,14	K&K 4
Thursday 4/12	Makua tones	K&K 4

	Homework: p. 73 #5 Yagua Student presentation 15
Week 12	
Tuesday 4/17	Theories of Phonology excerpt from The sound pattern of English by Morris Halle and Noam Chomsky
Thursday 4/19	Autosegmental phonology excerpt from Autosegmental Phonology by John Goldsmith Homework: pitch tracking problem
Week 13	
Tuesday 4/24	Extensions of non-linear phonology, Greek prosody, Icelandic aspiration excerpts from Donca Steriade
Thursday 4/26	Geometry of features excerpts from George N. Clements
Week 14	
Tuesday 5/1	Complex segments excerpt from Sagey

Note: We do not have a list of the articles by Steriade, Clements, and Sagey that were used in this course, nor do we know exactly what excerpts were used from the Chomsky and Halle book and the Goldsmith book. The professor who taught the course in spring 1990 has since left the college and did not leave behind this information.

Lab Exercises for Phonetics and Phonology:

1. Familiarization with MacInTalk IPA (font for phonetic transcription)
2. Numerous exercises from the first 3 chapters of Smalley and from selected additional chapters as relevant to particular students
3. Ladefoged Movies (These are available by writing to the Phonetics Laboratory at UCLA.)
    - lip height
    - frontness
    - tongue root
    - a byte movie
    - height
    - lip and jaw
    - r color
    - vocal cords
4. Intonation lab: Replicate the intonation examples in Ladefoged Ch. 5 and make f0 plots of your speech.
5. Use MacSpeechLab to answer question D, p. 112 of Ladefoged.
6. Familiarize yourself with MacSpeechLab by making, editing, and

labeling spectrograms of your speech.
7. Speculate on the content of the unlabeled spectrograms in Ladefoged pp. 190-191 and test your hypotheses by making spectrograms of your guesses.
8. View Ladefoged's "Acoustics tutorial" on the MacPlus (air pressure, sine waves, etc.).
9. VOT exercise. Edit your speech to turn a [t] into a [d] on MacSpeechLab.
10. Simulate a voiceless aspirated consonant by artificial means solely from the juxtaposition of a click, aspriation, and voicing.
11. Make a spectrogram, wave form, and f0 plot of a sentence and label it in detail.
12. View the Hyperstack Languages of the World series on !Xoo clicks.
13. Review the Languages of the World stacks on complex segments, affricates, etc.
14. View Jones' phones: A hyperstack of Daniel Jones' cardinal vowels illustrated by digitized eamples from an actual tape by Daniel Jones.
15. Plot a formant chart for the spectrograms on p. 177 of Ladefoged. Optionally use the Excel to get the exact values of your own version.
16. Listen to tapes of Lardil Damin and attempt to identify the marked phonemes.

Lab Research Projects and Presentations:

Each student was required to research and present with spectrographic evidence a report on a specific project in acoustic phonetics. Topics presented in spring, 1990 included:

clicks in Amharic
lateral Lisp
rounded vs. unrounded vowels
vowel r combinations in New York
merry, Mary, marry, Murray vowel distinctions
gender differences in frequency range
vowel nazalization vs. vowel raising
voice onset time
bilabials
the acoustics of musical speech (chanting, singing, etc.)
affricates in Cherokee
the Scottish dialect
complex segments
tone in Cantonese
lateral consonants

The final exam for this course appears in Appendix A.

(3) The materials in this section are from our phonetics and phonology course in fall, 1990, which is presently in progress. For that reason, the materials are incomplete.

Meeting times:

Tuesday/Thursday 11:20 - 12:35

Required texts:

Ladefoged, Peter. 1982. A course in phonetics, New York: Harcourt Brace Jovanovich (abbreviated as "L")
Problem Book in Phonology by Morris Halle and Nick Clements (abbreviated as "H&C")

Course Objectives:

The course is designed as an introduction to phonetics and phonology, related subdisciplines of linguistics. Over the semester through readings, lab work, problem sets, and class discussion, the student will acquire an understanding of the fundamentals of articulatory phonetics, acoustic phonetics, and phonology.

Requirements:

Along with regular readings and expected participation in class discussion, there will be twelve homework assignments involving phonetic transcription, lab work, or phonology problem solving. These assignments must be handed in on the due date in order for you to receive credit for the assignment. Furthermore, all assignments must be turned in before the end of the semester or an incomplete will be given in the course.

You are encouraged to talk with each other about your homework assignments and problem solving, but you are responsible for writing up your own homework individually. Homework assignments dealing with phonology problem solving must include a statement of the problem and your proposal for solving it. In other words, a list is not sufficient.

Schedule of work:

PHONETICS

Weeks 1-4: Articulatory phonetics and phonetic transcription

Sept 4-13

Reading: L, chapters 1, 2, 9 (pp. 197-205)

Exercises: L pp. 17-19 A-D (due 9/11)
L pp. 31-32 #1-39, and pp. 43-44 A-D (due 9/18)

Performance exercises: L pp. 45-46 A-C

Sept 18-28

Reading: L, chapters 3, 4 (to p. 82)

Exercises: L pp. 63-67 A,B,D (due 9/25)
L pp. 89-92 A,B,C,D,E,I (due 10/2)

Performance exercises: L pp. 67-68 A-F and pp. 95-96 A,C

Weeks 5-7: Acoustic phonetics

October 2-18

Reading: L, chapters 6,8

Exercises: L pp. 136-137 C-E (due 10/9)

Lab exercise: Recreate Ladefoged's figure 8.6 (p. 177) with your own voice and plot the results on figure 8.8 (p. 181). Note any differences you find. (due 10/16)

(other exercises to be announced)

October 22-26: Vacation: fall break

PHONOLOGY

Week 8: Phonemes and allophones

October 30- November 1

Reading: H&C chapter 1, pp. 1-3

Exercises: H&C p. 69 (due 11/1)
H&C pp. 39, 45, 47, 49 (11/6)

Weeks 9-11: Phonological rules and rule writing

November 6-20

Reading: H&C pp. 93 and 101.

Exercises: H&C pp. 51, 53, 55 (due 11/13)
H&C pp. 97, 103 (due 11/20)

November 22: no class for Thanksgiving recess

Weeks 12-13: Distinctive features

November 27-December 6

Reading: H&C pp. 3-9
L pp. 241-254

Exercises: H&C pp. 95, 99 (#1-6 only -- due 12/4)
H&C pp. 71, 73, 77, 79 (due 12/6)

December 11: semester wrap-up

Phonetics and Phonology: Final Exam **Name:** _____

1. Serbo-Croatian

(a) The following was given as a rule of vowel epenthesis for the Serbo-Croatian problem (K&K, p. 74) . It applies in the derivation of the form [múkao] from /mukl/. It has a typo. What is it?

Incorrect formulation of Vowel Epenthesis:

$$\varnothing \rightarrow a \; / \_\_ \begin{bmatrix} C \\ \alpha obst \end{bmatrix} \begin{bmatrix} C \\ -\alpha obst \end{bmatrix} \#$$

List one ungrammatical surface form that the above rule would generate:

[_____]

(b) Write the correct form of this rule.

Correct Formulation:

(c) List four other surface forms that involve the application of the correct form of this rule.

[_____] [_____]

[_____] [_____]

(d) Why is the additional alpha portion of the rule necessary? List the form that necessitates this particular complication of the Vowel Epenthesis rule.

[_____]

(e) List the underlying forms for the following six Serbo-Croation words:

[skúbao] /_____/ [kralá] /_____/

[dóbar] /_____/ [véo] /_____/

[béo] /_____/ [pleló] /_____/

The following palatalization rule also has an error. It is supposed to correctly handle the consonant alternations in the words for *bake* and *burn* below.

pečém	pékao	peklá	pekló	'bake'
žežém	žégao	žeglá	žegló	'burn'

Incorrectly formulated rule:

Velar Palatalization:

$$\begin{bmatrix} C \\ +back \\ \alpha voice \end{bmatrix} \rightarrow \begin{bmatrix} +continuant \\ -\alpha delayed\ release \end{bmatrix} / \_\_\_ \begin{bmatrix} V \\ -back \end{bmatrix}$$

(f) What are the underlying forms of:

[pečém] /_____+_____/

[žežém] /_____+_____/ or possibly /_____+_____/

(g) Explain why there are 2 possible underlying forms for [žežém].

(h) How do the sounds [č] and [ž] differ?

Can this difference be characterized by a single feature? a. yes b. no

What feature(s) characterize(s) this difference? List them:

(i) What is the problem with the rule of Velar Palatalization as it is stated above?

(j) The misformulated rule of Velar Palatalization will be unable to generate any surface form for 'bake' 1st sg. pres. because of a conflict between two feature values. Why?

(k) What feature is causing the problem? Circle one below.

a. +continuant b. αvoice c. C d. +back e. -back

(l) How could we change it to resolve the conflict? Choose one solution below:

a. delete it altogether
b. change its value to α
c. change its value to -α
d. change its value to +
e. change its value to -

(m) The misformulation of the Velar Palatalization rule will generate *[žeɣém] as one possible surface form of 'burn' 1st sg. pres. Given the alternative underlying form one could postulate what other ungrammatical surface form might be generated by this rule.

a. *[žeɣgém] b. *[žezém] c. *[žegʲém] d. *[ɣeɣém]
e. *[žegém] f. *[žečém] g. *[žexkém] h. *[čečém]

(n) What feature must be added to the change part of the rule to keep from changing /g/ to /ɣ/ rather than /ž/?

a. -continuant b. αplace c. +anterior d. -back e. -αvibrant

(o) What are the 2 central features involved in the process of palatalization?

(p) Write the correct formulation of the Velar Palatalization rule below:

(q) Write out in your own words what the Velar Palatalization rule does.

(r) Is it ordered with respect to any other rules in Serbo-Croation that we have discussed?

a. yes b. no

(s) The following rules were proposed for Serbo-Croation Write them below in the order that they must apply indicating by drawing line between them those orderings for which there is evidence in the data: l vocalization (/l/ → [o]); velar palatalization; d deletion; a epenthesis; stress rule

_____

_____

_____

_____

_____

Format for sample derivations:

/underlying form/ → intermediate form → ... → [surface form]
Rule X **Rule Y** **Rule Z**

(t) Derive [múkao] indicating which rules have applied.

(u) Derive [véo] indicating which rules have applied.

(v) Derive [pečém] indicating which rules have applied.

(w) Derive [mlád] indicating which rules have applied.

(x) Derive [kralá] indicating which rules have applied.

(y) Derive [skúbao] indicating which rules have applied.

(z) Derive [púst] indicating which rules have applied.

2. Karok (pg. 73, K&K) has 3 alternations: [s] ~ [š]; [ʔ] ~ Ø ; and V ~ Ø.

(a) List all the underlying forms for all the Karok words in our corpus:

Imperative	1 sg.	3 sg.	Gloss
[pasip] /	/ [nipasip] /	/ [ʔupasip] /	/ 'shoot'
[si:tva] /	/ [nišiːtva] /	/ [ʔusiːtva] /	/ 'steal'
[kifnuk] /	/ [nikifnuk] /	/ [ʔukifnuk] /	/ 'stoop'
[suprih] /	/ [nišuprih] /	/ [ʔusuprih] /	/ 'measure'
[ʔifik] /	/ [niʔifik] /	/ [ʔuʔifik] /	/ 'pick up'
[ʔaktuv] /	/ [niʔaktuv] /	/ [ʔuʔaktuv] /	/ 'pluck at'
[ʔaxyar] /	/ [nixyar] /	/ [ʔuxyar] /	/ 'fill'
[ʔiškak] /	/ [niškak] /	/ [ʔuskak] /	/ 'jump'
[ʔikšah] /	/ [nikšah] /	/ [ʔuksah] /	/ 'laugh'
[ʔišriv] /	/ [nišriv] /	/ [ʔusriv] /	/ 'shoot at a target'
[ʔuksup] /	/ [nikšup] /	/ [ʔuksup] /	/ 'point'

(b) State the three rules that account for the three alternations observed above and indicate their ordering with respect to one another.

(c) Derive the imperative 1st sg. forms of 'pluck at' ([ni?aktuv]) and 'fill' ([nixyar]). What do forms like this reveal about the phonemic status of the glottal stop (/ʔ/)?

Derivation of [ni?aktuv]:

Derivation of [nixyar]:

What is the phonemic status of the glottal stop?

3. In Georgian (pg. 42, K&K) a clear lateral [l] alternates with a dark lateral [ɬ].

(a) Which lateral is underlying? a. [l] b. [ɬ]

(b) Write the underlying forms for all the examples in the corpus:

[ɬamazad]	/	/	'prettily'
[leɬo]	/	/	'goal'
[saxɬšˇi]	/	/	'at home'
[ɬxena]	/	/	'joy'
[kbiɬs]	/	/	'tooth'
[zarali]	/	/	'loss'
[kaɬa]	/	/	'tin'
[pepeɬa]	/	/	'butterfly'
[kleba]	/	/	'reduce'
[ertʰxeɬ]	/	/	'once'
[xeli]	/	/	'hand'
[xoɬo]	/	/	'however'
[cʰecʰxli]	/	/	'fire'
[vxlečʰ]	/	/	'I split'
[cʰoli]	/	/	'wife'

(c) Write the rule for deriving the surface laterals from the underlying laterals in Georgian.

4. The following data are from Sierra Miwok (pg. 43, K&K). The position of stress is indicated and each word is annotated below with labels indicating the pattern of consonants and vowels. C indicates a consonant or glide. V indicates a vowel. Notice that the stress is not consistently on the same syllable in every word.

[há:na?]	[čá:mayi?]	[yá:ya:li?]	[hánna?]	[wíttapt?]	[húššše:pi?]
CVVCVC	CVVCVCVC	CVVCVVCVC	CVCCVC	CVCCVCVC	CVCCVVCVC
[kawá:či]	[wataksa?]	[kalaŋpa:]	[palátta?]	[čímteyya?]	[pátkayt?]
CVCVVCV	CVCVCCVC	CVCVCCVV	CVCVCCVCVC	CVCVCVCCVC	CVCCVCVC

(a) Choose the best formulation of the stress rule from those given below. Be careful some of the formulations are wrong and others are just more complicated but still correct.

a. $V \rightarrow$ [+stress] / (CV)___

b. $V \rightarrow$ [+stress]/ $\#(CV)_0$___

c. $V \rightarrow$ [+stress]/ $\#C\left(\begin{bmatrix} V \\ -lg \end{bmatrix} C\right)_0$___

d. $V \rightarrow$ [+stress]/ $\#C\left(\begin{bmatrix} V \\ -lg \end{bmatrix} C\right)$ ___

e. $V \rightarrow$ [+stress]/ $\#C\left(\begin{bmatrix} V \\ -lg \end{bmatrix} C_0\right)$___

f. $V \rightarrow$ [+stress]/ ___$(C_0V)_0(?)\#$

(b) Justify the rule you chose in (a) above.

(c) Assuming the following two forms were added to this corpus of Sierra Miwok, which stress rule given above in (a) would then be best?

[nikanúhzakeh]	[wahoyó?dʌ?]
CVCVCVCCVCVC	CVCVCVCCVC

Circle one:

a. b. c. d. e. f.

(d) Again, justify your choice of a rule from (a) above as it would apply to the corpus plus the two new forms given above in (c).

5. On the top of the next page are the data from the pop quiz on Angas Sonorants:

(a) Pick the BEST statement of the rule that handles the voicing alternations in Angas from those given below:

a. [-syllabic] → [-voice] / ___#

b. $\begin{bmatrix} \text{-syllabic} \\ \text{+sonorant} \end{bmatrix}$ → [-voice]/ ___#

c. [-voice] → [+voice] / ____ $\begin{matrix} C \\ \text{+voice} \end{matrix}$

d. $\begin{bmatrix} \text{-syllabic} \\ \text{+sonorant} \end{bmatrix}$ → [-voice] / ___ [+voice]

e. [+sonorant] → [-voice] / ___#

(b) Defend your choice.

Angas Sonorants

Voicing is predictable in Angas sonorants. State the rule.

1.	mut	'to die'	13.	fʷaŋ	'to rain'
2.	nuŋ	'to ripen'	14.	taṃ	'bench'
3.	ntaŋzuṃ	'wasp'	15.	ŋgak	'snake'
4.	mbaŋga	'drum'	16.	ndarṃ	'bark'
5.	nemʸcị	[name of village]	17.	pampaṃ	'bread'
6.	siṛ	'to forgive'	18.	lɐp	'to send'
7.	li:li:	'slowly'	19.	dondoṇ	'yesterday'
8.	?ara	'road?'	20.	?aṛ	'road'
9.	kʷaị	'joint'	21.	tarwep	'harvest season'
10.	kʷɔnsaṛ	'finger'	22.	deŋ	'to drag'
11.	mɓɛlṃ	'to lick'	23.	potiŋ	'sky'
12.	nfʷarṃ	'head cold'	24.	zigɔị	'Satan'

6. In Ganda, [r] and [l] are in complementary distribution. The rule accounting for their distribution is roughly stated as follows:

$$[l] \rightarrow [r] \; / \begin{bmatrix} V \\ -bk \end{bmatrix} \_\_\_\_$$

(a) Assuming the above rule to be correct write the underlying forms for the following surface forms:

[kola]	/	/	[wulira]	/	/
[lwana]	/	/	[beera]	/	/
[buulira]	/	/	[jjukira]	/	/
[lya]	/	/	[eryato]	/	/
[omuliro]	/	/	[lagira]	/	/
[ebendera]	/	/	[luula]	/	/
[leerwe]	/	/	[ssaffaali]	/	/

(b) What is the surface form of the following underlying forms in Ganda?

/eladdu/	[	]	/olulimi/	[	]
/emmeeli/	[	]	/laldil/	[	]
/lumbel/	[	]	/leveleli/	[	]

7. The following data are from Taiwanese secret language as reported in (Li, 1985). They involve distortion of words on syllable based principles. Speaking in terms of onsets and rhymes of a syllable and paying attention to simple morphology such as suffixes and prefixes, you should be able to state the rule for deriving the secret language forms from their Taiwanese counterparts. All morphological affixes are in italics.

Taiwanese Forms		Secret Language Forms	Gloss
tsiao-*a* bird-suffix	→	liao tsi *a*	'bird'
ho *e* bo ai lai good nom. not want come suffix	→	lo hi *e* lo bi lai i lai gi	'The good ones don't want to come'
ho bo good Q (question particle)	→	lo hi lo bi	'Alright?'
a- pa prefix father dimin.	→	*la i* la pi	'Daddy'
e hiao can know	→	le i liao hi	'know how'

Formulate the rule(s) for deriving Taiwanese secret language forms below. Explain your answer.